Appendix A:

Digest of biodiversity changes and threatening processes across each rangeland bioregion.

Bioregions are as defined by Thackway and Cresswell (1995). This summary builds on reviews of the conservation status of all bioregions in Queensland (Sattler and Williams 1999), the Northern Territory (Connors *et al.* 1996), New South Wales (Benson 1999), Western Australia (Hopkins *et al.* 1996) and northern Australia (Allen *et al.* 1999); and on a review of the refugia and extent of endemism in each of the arid and semi-arid rangeland bioregions (Morton *et al.* 1995).

Bioregions which have a relatively small proportion of their area in the rangelands are indicated with brackets around the heading name in the section which follows. Bioregions with <10% of their area in the rangelands are omitted.

BROKEN HILL COMPLEX

Major land uses.
Pastoralism (extensive grazing mostly by sheep) is the dominant land use. Mining is a major industry, with more acute localised impacts.

Conservation areas.
Conservation reserves comprise 2.2% of the New South Wales portion of the bioregion (*ca* two-thirds of its national extent) and 0.1% of the South Australian portion (*ca.* one third) (Thackway and Cresswell 1995; Benson 1999).

Condition and threats.
High population densities of rabbits and (locally) feral goats and pigs have contributed to major vegetation changes, including lack of recruitment and hence regional declines of many plant species, such as purple-wood wattle *Acacia carnei* (Auld 1993). In some areas, this has been exacerbated by increases in the abundance of large macropods, due to increased water availability. These effects have compounded those due to pastoralism, through grazing by sheep and exclusion of fire (Lunney 1994*b*; Noble 1997). The most notable vegetation changes are landscape-wide changes in vegetation structure, with increases in some woody shrub and tree species, and concomitant declines in some perennial grasses and lack of regeneration of palatable species (Denny 1992; Benson 1999). Over-grazing (by livestock and feral animals) has also caused substantial areas of soil loss and other degradation (Benson 1991; Pickard 1991; Morgan and Terry 1992; Lunney 1994*b*; Pickard and Norris 1994), with sheet soil erosion widespread (Benson 1999). Little or none of the semi-arid vegetation of this bioregion has been cleared, but all has been subjected to stock grazing and wood cutting for over 100 years (Benson 1999).

Feral cats and foxes are widespread and abundant in this bioregion (Wilson *et al.* 1992).

There are at least localised weed problems, including African boxthorn *Lycium ferocissimum* and mesquite *Prosopis* spp.

Changes in biodiversity.
This bioregion has suffered extensive changes in biodiversity in the period since European settlement. This is most evident in the regional extinction of about 27 mammal species (mostly bandicoots, larger dasyurids, smaller macropods and larger rodents) (Southgate 1990; Dickman and Read 1992; Dickman 1993, 1994; Dickman *et al.* 1993; Denny 1994). There has also been substantial change in the bird fauna, with probable regional extinction for two species (night parrot *Pezoporus occidentalis* and thick-billed grasswren *Amytornis textilis*), declines for around 60-100 other bird taxa and increases for 50-80 taxa (McAllan 1987; Smith and Smith 1994).

One native plant (*Acanthocladum* dockeri) is known to have disappeared from this bioregion (Briggs and Leigh 1996).

BURT PLAIN

There has been no comprehensive overview of threats or trends in status of biodiversity in this bioregion, although existing information is summarised in Connors *et al.* (1996).

Major land uses.
This bioregion is predominantly (84%) pastoral leasehold, used for extensive cattle production. Smaller areas (15%) of Aboriginal freehold comprise most of the rest of this bioregion.

Conservation areas.
Conservation reserves comprise only 0.25% of this bioregion.

Condition and threats.
This bioregion is principally mulga woodlands and spinifex (hummock grass) grasslands. the proportion of weeds to native flora is amongst the highest recorded for Northern Territory bioregions (Connors *et al.* 1996) and include buffel grass *Cenchrus ciliaris* and couch grass *Cynodon dactylon*.

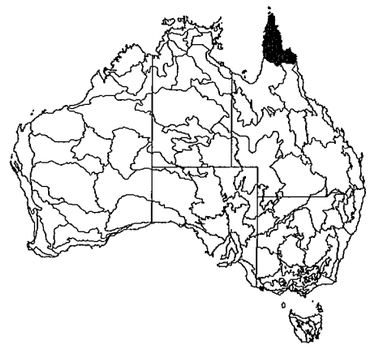
Morton *et al.* (1995) list "feral horses, patchy but intense rabbit infestations, land degradation due to over-grazing by cattle" as major threats to the biodiversity of this area. Bastin *et al.* (1993) also noted substantial areas of degradation due to pastoralism. Changes in fire regimes may also have contributed to biodiversity changes (Burbidge *et al.* 1988; Latz 1995). Feral predators (foxes, cats) may have contributed to decline in mammal species (Burbidge *et al.* 1988).

In the spatially dominant mulga woodlands, pastoralism has led to some change in floristics, increases in extent of bare ground, and changes in the abundance of some reptile species (Schlesinger 1999).

Changes in biodiversity.
Mammals which have become regionally extinct or declined in this bioregion over the last 100 years include the western quoll *Dasyurus geoffroii*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, pig-footed bandicoot *Chaeropus ecaudatus* , brushtail possum *Trichosurus vulpecula*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur*, mala *Lagorchestes hirsutus*, and crescent nailtail wallaby *Onychogalea lunata*, which all probably became extinct in this bioregion sometime between the 1940s and 1960s (Burbidge *et al.* 1988).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

CAPE YORK PENINSULA



Abrahams *et al.* (1995) provides a summary of biodiversity information for most of this bioregion.

Major land uses.
The main land uses and industries include bauxite and silica sand mining, broadacre pastoralism, tourism and fishing (Sattler and Williams 1999). Most land is pastoral leasehold, Aboriginal land (Deed of Grant in Trust) or conservation reserve.

Conservation areas.
Conservation reserves comprise 13.8% of the bioregion (Sattler and Williams 1999).

Condition and threats.
Of 211 regional ecosystems defined for this bioregion, 6 are considered endangered and 8 are classified as of concern (Sattler and Williams 1999). The main threats to these are clearing, changed fire regimes and weed invasion (Neldner *et al.* 1997; Sattler and Williams 1999). Sattler and Williams (1999) also noted the potential for increased development for cropping and improved pastures. Weeds posing the most current and potential problems include sicklepod *Senna obtusifolia* (which is displacing large areas of native *Imperata cylindrica* grasslands), grader grass *Themeda quadrivalvis*, rubber vine *Cryptostegia grandiflora* and deep water exotic grasses introduced for ponded pasture.

Changes in biodiversity.
Over the last century, there have been major changes in the composition and extent of grasslands in this bioregion (principally involving expansion of *Melaleuca* onto grasslands), due mainly to the inter-related impact of changed fire regimes and pastoralism (Stanton 1992, 1995; Crowley 1995; Crowley and Garnett 1998). These environmental changes have contributed to ongoing declines in, at least, Black Treecreeper *Climacteris picumnus melanota*, Star Finch *Neochmia ruficauda,* and

Golden-shouldered Parrot *Psephotus chrysopterygius* (Garnett and Bredl 1985; Garnett and Crowley 1995a, 1995b, 1995c, 1997).

Young (1991) considered that the Palm Cockatoo *Probosciger aterrimus* had declined in this bioregion because an increased incidence of hot (late dry season) fires had decreased the number of hollow-bearing trees.

In contrast to most other rangeland areas, there has been comparatively little change in the mammal fauna of this bioregion (Winter and Allison 1980), although declines for some larger rodent and dasyurid species, possums, bandicoots and small macropods may now be evident (J. Winter *pers. comm.*) The northern hopping-mouse *Notomys aquilo* is known from Cape York Peninsula only from the original collection in around 1870, but anecdotal reports suggest that it may still be present (Woinarski *et al.* 1999*d*).

Ten native plant species are known to have disappeared from this bioregion (Briggs and Leigh 1996).

CARNARVON

The biodiversity of this bioregion is the subject of a current NHT-supported project undertaken by the Department of Conservation and Land Management.

Major land uses.
Pastoralism is the predominant land use of this bioregion, and principally involves extensive sheep production on long-term leasehold lands (Burbidge *et al.* in press). Other industries present include salt mining, fishing and tourism.

Conservation areas.
Conservation reserves comprise <10% of the bioregion (Thackway and Cresswell 1995). 52 (49%) of the bioregion's 112 recognised vegetation types are unreserved, with a further 44 types (39%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Over-grazing has led to extensive land degradation in this bioregion (Payne *et al.* 1987; Wilcox and Cunningham 1994). Feral herbivores (notably rabbits) have contributed to such damage. Most of the riparian vegetation in this bioregion is rated as in "poor" condition, due to very heavy grazing pressure (Water and Rivers Commission 1997). Payne *et al.* (1987) provided a detailed assessment of land condition across almost all of this bioregion (with generally similar findings reported for the northern margin by Payne *et al.* 1988). They classified 0.9% of the area as being in "extreme landscape deterioration, with degraded pastures and moderate or severe erosion", and 23% of their sampled sites were in "poor" land condition, with degradation most evident in currant bush (*Scaevola spinescens*) shrublands, bluebush (mostly *Maireana* spp.) shrublands, saltbush (*Atriplex* spp.) shrublands, stony chenopod shrublands (dominated variably by *Acacia, Maireana, Enchylaena, Rhagodia* and *Cassia* spp.) and *Acacia* mixed shrublands

Feral cats and foxes are widespread in the bioregion, including on several islands (Burbidge 1989); feral goats are widespread, feral rabbits are common especially in coastal areas, feral donkeys are patchily common and there is a small population of feral camels (Payne *et al.* 1987).

Many species of weeds (notably buffel grass *Cenchrus ciliaris*, but also Victorian tea-tree *Leptospermum laevigatum*) are increasing at the expense of native plants (Keighery and Gibson 1993; Department of Conservation and Land Management, WA. 1999).

Changes in biodiversity.
There has been a major change in the mammal fauna of this bioregion over the last 100 years. The most comprehensive evidence of this change is for the Cape Range Peninsula (in the north-west of this bioregion), where Baynes and Jones (1993) reported that at least half of the mammal fauna (of 49 species) has become extinct since European settlement. The species lost include mulgara *Dasycercus cristicauda*, western quoll *Dasyurus geoffroii*, northern quoll *D. hallucatus*, red-tailed phascogale *Phascogale calura*, golden bandicoot *Isoodon auratus*, western barred bandicoot *Perameles bougainville*, bilby *Macrotis lagotis*, burrowing bettong *Bettongia lesueur*, common brushtail possum *Trichosurus vulpecula*, lesser stick-nest rat *Leporillus apicalis*, golden-backed tree-rat *Mesembriomys macrurus*, short-tailed hopping-mouse *Notomys amplus*, long-tailed hopping-mouse *N. longicaudatus*, Alice Springs mouse *Pseudomys fieldi*, western chestnut mouse *Pseudomys nanus* and pale field-rat *Rattus tunneyi*.

Many mammal species recorded in the early years of settlement have disappeared from the continental portion of the bioregion, but have retained populations now of national conservation significance on the islands of Shark Bay.

Kendrick (1993) notes the presence of exotic mammal species on the Cape Range Peninsula, most notably with feral populations of goats (locally common), house mice, rabbits and foxes (common).

Based on comparison of current records with those from 1899-1902, Kendrick (1993) considered that at least nine land and freshwater bird species had declined or become regionally extinct in at least the Cape Range Peninsula - Exmouth Gulf area. These included plumed whistling-duck *Dendrocygna eytoni*, chestnut teal *Anas castanea*, freckled duck *Strictonetta naevosa*, musk duck *Biziura lobata*, white-fronted chat *Epthianura albifrons*, elegant parrot *Neophema elegans*, collared kingfisher *Todirhamphus chloris*, mangrove golden whistler *Pachycephala melanura* and mangrove robin *Eopsaltria pulverulenta*. The local losses of the last three species have been ascribed to "natural" changes in the structure and species composition of mangrove communities (Johnstone 1990; Kendrick 1993). Against these losses, at least white-breasted wood-swallow *Artamus leucorhynchus*, bar-shouldered dove *Geopelia humeralis* and white-breasted whistler *Pachycephala lanioides* have colonised the current mangrove communities (Johnstone 1990; Kendrick 1993). More widely across the bioregion, there has been range expansion and/or population increases for at least the

galah *Cacatua roseicapilla* and emu *Dromaius novaehollandiae*, due to changes associated with pastoralism.

In the southern part of the bioregion (but including also information from the Geraldton Sandplains bioregion, and small adjacent parts of the Murchison and Gascoyne bioregions), Johnstone *et al.* (in press) considered that no bird species had become extinct (with the possible exception of the pheasant coucal *Centropus phasianus*), but 10-15% had decreased in abundance (including mallee-fowl *Leipoa ocellata*, Australian bustard *Ardeotis australis*, pallid cuckoo *Cuculus pallidus*, blue-winged kookaburra *Dacelo leachii*, southern emu-wren *Stipiturus malachurus*, hooded robin *Melanodryas cucullata* and rufous songlark *Cinclorhamphus mathewsi*) since European settlement and about the same proportion had increased (including emu *Dromaius novaehollandiae*, nankeen kestrel *Falco cenchroides*, banded lapwing *Vanellus tricolor*, crested pigeon *Ocyphaps lophotes*, galah *Cacatua roseicapilla*, budgerigar *Melopsittacus undulatus*, rufous whistler *Pachycephala rufiventris*, welcome swallow *Hirundo neoxena*, yellow white-eye *Zosterops lutea* and richard's pipit *Anthus novaeseelandiae*).

One native plant species is known to have disappeared from this bioregion (Briggs and Leigh 1996).

CENTRAL ARNHEM

Major land uses.
This is one of the most sparsely populated bioregions in Australia, with a total population of fewer than 2000 people. This bioregion is almost entirely (99%) Aboriginal freehold land, vested in the Arnhem Land Aboriginal Land Trust. A small part of one pastoral leasehold (Mainoru) extends across the south-western border, and cattle grazing occurs in some parts of the Aboriginal freehold land (Connors *et al.* 1996).

Conservation areas.
There are no formal conservation reserves or indigenous protected areas in the bioregion.

Condition and threats.
The major threatening processes in the bioregion are weeds (notably *Mimosa pigra*), feral animals (notably pigs and water buffalo) and changed fire regimes (from localised frequent cool burns to more extensive and hotter late dry season fires: Russell-Smith *et al.* 1997, 1998). These are degrading a high proportion of monsoon rainforest patches in this bioregion (Russell-Smith and Bowman 1992), and are probably also affecting the condition of wetlands and, less intensively, all other vegetation types in the bioregion.

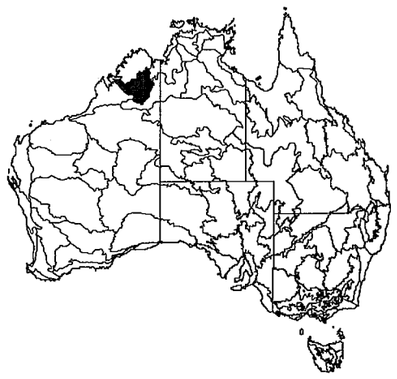
The most significant wetland in the bioregion, the Arafura Swamp, is threatened by saline intrusion. Cane Toads have colonised this bioregion over the last two years. Feral cats are present at low numbers, but there are no foxes.

Changes in biodiversity.
There is little baseline information published for this bioregion, which renders extremely difficult any assessment of biodiversity change. At least several larger rodents and small to medium sized dasyurids have declined over the last century (Woinarski *in press*), but the timing and extent of this decline is difficult to define.

The Northern Cypress-Pine *Callitris intratropica*, a subdominant tree widespread across much of this bioregion, has suffered (and is continuing to suffer) catastrophic population crashes in the many areas where traditional Aboriginal fire regimes have been changed recently (Bowman and Panton 1993; Price and Bowman 1994). This change is unusually obvious for this species (because dead trees remain evident), but comparable changes may have occurred for many less conspicuous plant species.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

CENTRAL KIMBERLEY



Major land uses.
The bioregion is predominantly pastoral leasehold for extensive cattle production, with smaller areas of Aboriginal lands.

Conservation areas.
Thackway and Cresswell (1995) reported that <5% of the bioregion was in conservation reserves, with the "only significant reserve in the n-w extremity of the district". Burbidge *et al.* (1991) noted that "There are no reserves representing ecosystems of the driest southern interior of the Kimberley Basin". 49 (74%) of the bioregion's 66 recognised vegetation types are unreserved, with a further 13 types (20%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
The small patches of monsoon rainforest in this bioregion are being degraded by a combination of changed fire regimes, feral animals and livestock, and weeds (McKenzie and Belbin 1991), although notably relatively few patches were included in that study.

Wilcox and Cunningham (1994) reported land degradation due to over-grazing. "The riverside vegetation of the lower Fitzroy (River system) has suffered extreme degradation. The tall "cane-grass" ... has almost all been grazed to the ground" (Rowley 1993). The condition of the frontage areas of the Fitzroy River has improved following significant fencing off from cattle production. However, Noogoora Burr continues to invade the Fitzroy and its tributaries.

Other localised weed and exotic plant problems exist, including spread of buffel grass *Cenchrus ciliaris* (Department of Conservation and Land Management, WA. 1999).

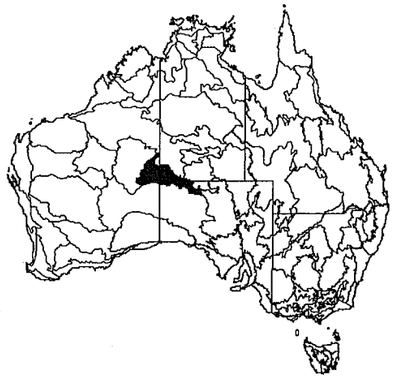
Changes in biodiversity.
This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996). However, the Northern Cypress-Pine *Callitris intratropica*, a subdominant tree widespread across parts of this bioregion, has suffered (and is continuing to suffer) catastrophic population crashes in the many areas where traditional Aboriginal fire regimes have been changed recently (Bowman and Panton 1993; Price and Bowman 1994). This change is unusually obvious for this species (because dead trees remain evident), but comparable changes may have occurred for many less conspicuous plant species.

Resulting from the degradation of riparian vegetation because of livestock and feral stock, the purple-crowned fairy-wren *Malurus coronatus* has suffered at east local extinction (Smith and Johnstone 1977; Rowley 1993). However, sighting of this species have increased in the last 6 to 7 years.

Local and regional extinctions of mammal species have been reported by McKenzie (1981), although the extent of the decline for this bioregion is difficult to evaluate, as there was very limited historical collection. Presumed losses (or declines) include golden bandicoot *Isoodon auratus*, golden-backed tree-rat *Mesembriomys macrurus*, pale field-rat *Rattus tunneyi*, common brushtail possum *Trichosurus vulpecula* and northern quoll *Dasyurus hallucatus*. In contrast to this assessment of substantial loss, the State of the Environment Reference Group (1998) reported only 0-1 regional extinctions for marsupials and rodents.

Increases in the abundance of common macropods (especially agile wallaby *Macropus agilis*) have been reported (Rowley 1993; McKenzie 1981*a*).

CENTRAL RANGES



Major land uses.
This sparsely populated bioregion mostly comprises Aboriginal lands, with small areas of pastoral leasehold.

Conservation areas.
In 1995, there were no formal conservation reserves (Thackway and Cresswell 1995), but Indigenous Protected Areas are being established (Noble and Ward 1999). In the Western Australian portion of the bioregion, 9 (47%) of the bioregion's 19 recognised vegetation types are unreserved, with a further 9 types (47%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Feral herbivores (principally camels and, until recently, rabbits) are at high densities in parts of this bioregion, with impacts affecting a range of vegetation types (Connors *et al.* 1996; Noble and Ward 1999). Feral cats and foxes have contributed to the decline of native mammals in the bioregion, and are generally uncontrolled (Copley *et al.* 1989; Pearson 1992; Pearson and the Nagaanyatjarra Council 1997; Pearson and Kinnear 1997; Noble and Ward 1999).

Fire regimes have also changed, and the new regime is contributing to ongoing vegetation change (Noble and Ward 1999).

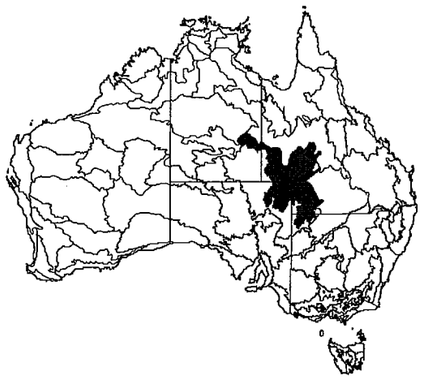
Changes in biodiversity.
This bioregion has lost many mammal species (State of the Environment Reference Group 1998), including western quoll *Dasyurus geoffroii*, red-tailed phascogale *Phascogale calura*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles*

eremiana, lesser bilby *Macrotis leucura*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur*, mala *Lagorchestes hirsutus*, central hare-wallaby *L. asomatus*, crescent nailtail wallaby *Onychogalea lunata* and lesser stick-nest rat *Leporillus apicalis* (Lindner 1966; Burbidge *et al.* 1988; Copley *et al.* 1989; Copley 1999). Other mammals (e.g. brush-tailed possum *Trichosurus vulpecula*) are now restricted to rocky refuges, and apparently still declining (Pearson 1992; Kerle *et al.* 1992; Pearson and the Nagaanyatjarra Council 1997; Pearson and Kinnear 1997).

Comparison of recent bird records with those reported between 1873 and 1945 suggest that Australian bustard *Ardeotis australis*, bush stone-curlew *Burhinus grallarius* and spinifex pigeon *Geophaps plumifera* have declined; and chestnut quail-thrush *Cinclosoma castanotus*, night parrot *Pezoporus occidentalis*, grey currawong *Strepera versicolor*, malleefowl *Leipoa ocellata*, scarlet-chested parrot *Neophema splendida*, princess parrot *Polytelis alexandrae* and redthroat *Pyrrholaemus brunneus* have probably declined (Storr 1977; Close and Jaensch 1984; Reid and Fleming 1992). In contrast, there have been increases for at least black kite *Milvus migrans*, crested pigeon *Ocyphaps lophotes*, galah *Cacatua roseicapilla*, magpie-lark *Grallina cyanoleuca*, magpie *Gymnorhina tibicen*, common bronzewing *Phaps chalcoptera* and grey butcherbird *Cracticus torquatus* (Close and Jaensch 1984; Reid and Fleming 1992). These changes were attributed to "*grazing by sheep and cattle, the spread of modern (as distinct from aboriginal) settlements, hunting with firearms, and the trapping of parrots*" (Close and Jaensch 1984).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

CHANNEL COUNTRY



The Channel Country bioregion and the adjacent Simpson-Strzelecki Dunefields bioregion are the only bioregions to cross four jurisdictions. This disrespect for State borders complicates any attempt at a succinct overview. The most comprehensive coverage of biodiversity and land use in any part of this bioregion is provided by McFarland (1992) and Sattler and Williams (1999) for the Queensland portion, and Tyler *et al.* (1990) and Reid and Gillen (1988) for the South Australian portion.

Major land uses.
This bioregion is sparsely populated. The dominant industry in this bioregion is cattle grazing, with smaller areas used for mining and tourism (Sattler and Williams 1999). At least in the Queensland and Northern Territory portions, land tenure is almost entirely pastoral leasehold, with most leases being very extensive (>4,000 km^2) and run by large pastoral companies.

Conservation areas.
Conservation reserves comprise 24% of the SA extent, 14% of the small NSW extent, and <1% of the Queensland extent of the bioregion (Thackway and Cresswell 1995; Benson 1999). In the 31,000 km^2 extent of this bioregion occurring in the NT, there are no conservation reserves (Connors *et al.* 1996).

Condition and threats.
Of 56 regional ecosystems defined for the Queensland sections of this and the adjacent Simpson-Strzelecki Dunefields bioregion, two were considered endangered and five "of concern" (Sattler and Williams 1999). Cattle grazing was given as a threatening factor for both endangered ecosystems, and grazing-related land degradation was regarded as frequent in dunefields, sand plains, riparian strips and mulga areas (Dawson and Turner 1982; Reid and Gillen 1988; Wilson and Purdie 1990). Mound springs were classified as endangered because of their small total extent, and threats from trampling and desiccation

caused by water extraction from the Great Artesian Basin. *Acacia peuce* woodlands were threatened by lack of regeneration, "possibly due to grazing pressure" (Sattler and Williams 1999). Notwithstanding the prevalence of grazing, Tothill and Gillies (1992) noted that most pasture resources in the bioregion were considered to be in reasonable condition.

Sattler and Williams (1999) also noted that grazing by feral animals, particularly rabbits but also camels, pigs and goats is widespread in the bioregion, with impact particularly on waterholes. They also noted other major threats to biodiversity were feral cats and foxes, changed fire regimes and mining (with localised impacts).

The small extent of this bioregion in New South Wales is extensively grazed; and the significant wetlands there are threatened by alterations to water flows due to irrigation developments in Queensland (Benson 1999).

In the Queensland portion of the bioregion, the most significant weed infestations involved *Acacia farnesiana*, parkinsonia *Parkinsonia aculeata*, bathurst burr *Xanthium spinosum*, noogoora burr *X. strumarium*, buffel grass *Cenchrus ciliaris* and feathertop rhodes grass *Chloris virgata* (Boyland 1984).

Changes in biodiversity.
A relatively high number of threatened plants and animals persist in this bioregion, albeit generally with declining range or abundance (Sattler and Williams 1999). At least seven mammal species, the desert rat-kangaroo *Caloprymnus campestris*, western quoll *Dasyurus geoffroii*, golden bandicoot *Isoodon auratus*, pig-footed bandicoot *Chaeropus ecaudatus*, lesser bilby *Macrotis leucura*, burrowing bettong *Bettongia lesueur*, and crescent nailtail wallaby *Onychogalea lunata* have become extinct from the bioregion (Kemper 1990; Carr and Robinson 1997), and at least four others (kowari *Dasyuroides byrnei*, mulgara *Dasycercus cristicauda*, bilby *Macrotis lagotis* and dusky hopping-mouse *Notomys fuscus*) have declined substantially (Archer 1984; McFarland 1992). Among birds, the night parrot *Pezoporus occidentalis* has also declined (McFarland 1992).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

(COBAR PENEPLAIN)

Major land uses.
Pastoralism (extensive grazing by sheep) is the dominant land use. Mining is also a major industry.

Conservation areas.
1.7% of the bioregion is represented in conservation reserves (Benson 1999). A conservation strategy for the bioregion has been developed recently (Creaser and Knight 1996).

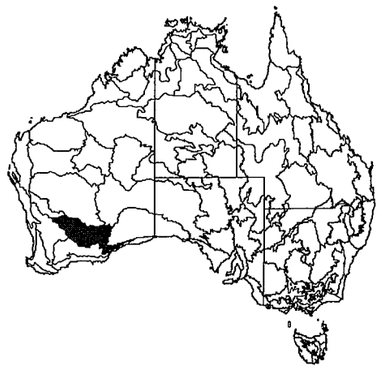
Condition and threats.
A high proportion of the eastern part of this bioregion (in the Central Division of NSW) has been cleared (Benson 1991, 1999; Dick 1992), with a total cleared area of 32.5% of the bioregion (Benson 1999). The whole region has a long history of heavy grazing, and parts are now affected by increased abundance of native woody unpalatable shrubs (Benson 1999) and/or other manifestations of degradation (Benson 1991; Pickard 1991; Pickard and Norris 1994).

Changes in biodiversity.
Reid (1999) identified 20 landbird species which had declined in the NSW sheep-wheat belt (which includes a large part of this bioregion). These were: emu, painted button-quail, brown treecreeper, speckled warbler, chestnut-rumped thornbill, southern whiteface, jacky winter, red-capped robin, hooded robin, eastern yellow robin, grey-crowned babbler, white-browed babbler, varied sittella, crested shrike-tit, crested bellbird, rufous whistler, restless flycatcher, white-browed wood-swallow, dusky wood-swallow and diamond firetail. He also noted 29 native, and 7 introduced, land birds which had increased in abundance or range in this area.

In common with other bioregions in western New South Wales, there has been substantial losses of larger rodents and dasyurids, bandicoots and smaller macropods (Southgate 1990; Dickman and Read 1992; Dickman 1993, 1994; Dickman *et al.* 1993; Denny 1994).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

COOLGARDIE



Major land uses.
Mining (principally for gold and nickel) is the most economically significant industry. There are some areas of pastoralism (principally extensive grazing by sheep), but most of the bioregion is vacant crown land (State of the Environment Reporting Unit 1997).

Conservation areas.
Conservation reserves comprise about 9% of the bioregion (State of the Environment Reporting Unit 1997). 33 (35%) of the bioregion's 93 recognised vegetation types are unreserved, with a further 48 types (52%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
In historic mining areas, much of the vegetation was affected by removal of timber and general vegetation clearance, with impacts still evident (Beard 1972; McKenzie and Hall 1992). Some highly restricted environments, such as outcrops of ultramaric rocks, supporting localised and endemic plant species have been (and continue to be) particularly favoured for mining activity, to the detriment of those species (Gibson and Lyons 1998*a,b*).

Other environmental impacts associated with mining include waste disposal and sulphur dioxide emissions (State of the Environment Reporting Unit 1997).

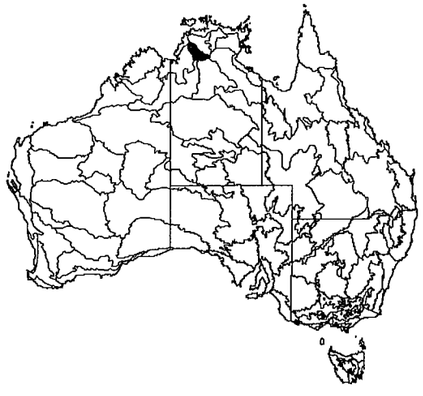
Overgrazing, by livestock, feral goats and rabbits, has had substantial impacts in some vegetation types (Morton *et al.* 1995).

Changes in biodiversity.

In common with other arid and semi-arid rangeland areas, there has been a marked loss of native mammals from this bioregion, including greater stick-nest rat *Leporillus conditor*, lesser stick-nest rat *L. apicalis*, short-tailed hopping mouse *Notomys amplus*, long-tailed hopping-mouse *N. longicaudatus*, desert mouse *Pseudomys desertor* and Alice Springs mouse *P. fieldii*, western chestnut mouse *P. nanus*, pale field-rat *Rattus tunneyi*, greater bilby *Macrotis lagotis*, numbat *Myrmecobius fasciatus* and western quoll *Dasyurus geoffroii* (Friend 1990; Southgate 1990; Morris 2000).

Two plant species are presumed to have become extinct in this bioregion (Briggs and Leigh 1996).

DALY BASIN



A comprehensive review of the conservation values and threatening processes of this bioregion has recently been completed (Price *et al.* in press).

Major land uses.
Most (61%) of this bioregion is pastoral leasehold. There are also substantial areas (12%) of Aboriginal freehold lands. This bioregion includes the city of Katherine, and extensive areas are devoted to horticultural production (principally grain sorghum, peanuts, melons, and mangoes). There are well-developed proposals for increasing the extent of large-scale intensive horticulture. Although occupying a relatively small total area, there are several large mines in the bioregion. Tourism is an important activity, focussed mostly on Litchfield NP, the Katherine area, and the Daly River (Connors *et al.* 1996).

Conservation areas.
Conservation reserves constitute 1.7% of the bioregion's area, with most of this in the extreme north (part of Litchfield NP).

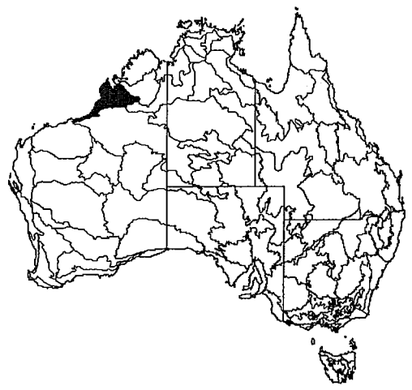
Condition and threats.
Price *et al.* (in press) noted that changed fire regimes (principally from frequent localised "cool" burns to more extensive late-dry season fires) were affecting several vegetation types in this bioregion, principally rainforests and sandstone environments. They also noted that 26 environmental weed species had been recorded for the bioregion, and that many of these were associated with pastoral improvements or infrastructure, but were now widely spread. Feral animals (principally pigs, cattle, and donkeys, but also black rat, house mouse, horse, and water buffalo) were widespread, and causing at least localised damage. Relative to other rangeland areas, a relatively high proportion (around

8%) of this bioregion has been cleared, and this extent is likely to increase substantially in the near future.

Changes in biodiversity.
There is little baseline information published for this bioregion, which renders extremely difficult any assessment of biodiversity change. At least several larger rodents and small to medium sized dasyurids (such as brush-tailed rabbit-rat *Conilurus penicillatus* and brush-tailed phascogale *Phascogale tapoatafa*) have declined over the last century (Woinarski *in press*), but the timing and extent of this decline is difficult to define. The current and projected levels of clearing suggest that there will be a change in the overall species composition of this bioregion, with reduced populations of woodland species and increased populations of grassland species.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996). However, the Northern Cypress-Pine *Callitris intratropica*, a subdominant tree widespread in this bioregion, has suffered (and is continuing to suffer) catastrophic population crashes in the many areas where traditional Aboriginal fire regimes have been changed recently (Bowman and Panton 1993; Price and Bowman 1994). This change is unusually obvious for this species (because dead trees remain evident), but comparable changes may have occurred for many less conspicuous plant species.

DAMPIERLAND



McKenzie (1983) provides a summary of biodiversity information for most of this bioregion, with information on the southern margin presented in McKenzie (1981*b*).

Major land uses.
Pastoralism (extensive grazing by cattle) is the dominant land use. Smaller parts of the bioregion are Aboriginal lands. Tourism is focused around the major town, Broome.

Conservation areas.
Conservation reserves comprise <5% of the bioregion (Thackway and Cresswell 1995), with no representation of the most productive environments (heavy alluvial soils, river frontages) (Burbidge *et al.* 1991). 57 (70%) of the bioregion's 81 recognised vegetation types are unreserved, with a further 21 types (26%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Along the valley of the Fitzroy River, there has been substantial vegetation change, associated with degradation due to pastoralism and feral stock (Speck *et al.* 1964; State of the Environment Reference Group 1998).

McKenzie (1983) noted "*there was hardly a hectare of the Dampier Peninsula which did not include at least one cattle pad ... trampling damage was especially apparent in the species rich communities along watercourses, in the ephemeral swamplands, and in the sub-coastal semi-deciduous vine forests: sites where cattle congregate.*"

McKenzie (1983) also noted that inappropriate fire regimes (apparently too frequent or too hot fires) were also degrading many environments: "*The widespread influence of fire*

on the Coulumb Point Nature Reserve had sharply reduced mature stands of the Acacia *dominated "pindan" vegetation for which the reserve was originally proclaimed.*"

Kenneally *et al.* (1996) considered that "*pervasive damage from cattle, feral donkeys, cats and inappropriate fire regimes are now apparent in many parts of the Kimberley, including the Dampier Peninsula*", and also noted some environmental impacts of tourism. McKenzie (1983) also noted that at least five species of exotic mammal are common in the bioregion (donkey, cat, cattle, black rat and house mouse).

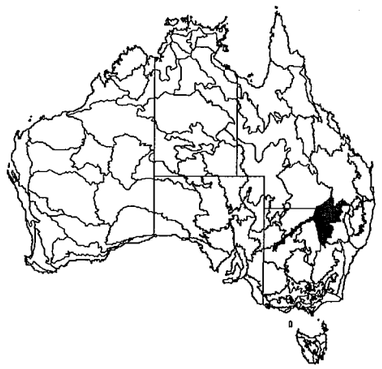
Localised weed problems exist, including spread of buffel grass *Cenchrus ciliaris*, prickly acacia and noogoora burr (Department of Conservation and Land Management, WA. 1999.

Changes in biodiversity.
This bioregion has lost a large component of its native terrestrial mammals. Five of the 28 non-bat mammal species present in 1895 are now regionally extinct, including the formerly very common burrowing bettong *Bettongia lesueur*, golden bandicoot *Isoodon auratus* (although there was an unconfirmed record of this species in 1971), golden-backed tree-rat *Mesembriomys macrurus*, brush-tailed phascogale *Phascogale tapoatafa* and pale field-rat *Rattus tunneyi* (McKenzie 1981*a*). Other mammal species, such as the bilby *Macrotis lagotis*, while still present appear to be declining (Kenneally *et al.* 1996). In contrast to this assessment of substantial loss, the State of the Environment Reference Group (1998) reported only 0-1 regional extinctions for marsupials and rodents.

Resulting from the degradation of riparian vegetation, the purple-crowned fairy-wren *Malurus coronatus* has suffered at least local extinction (Smith and Johnstone 1977; Rowley 1993), along parts of the Fitzroy River frontage.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996), however Kenneally *et al.* (1996) list the local disappearance of the tree orchid *Cymbidium canaliculatum*, apparently through illegal collecting.

(DARLING RIVERINE PLAINS)



Major land uses.
Pastoralism (extensive grazing by sheep and, less so, cattle) is the most extensive land use, with a history extending back to the 1840s (Galloway 1974*a*). There are also large areas devoted to the production of sorghum and other cereal, cotton and other crops, and smaller areas used for forestry (from plantation and native forest (Cocks 1974).

Conservation areas.
Only 0.9% of the NSW portion of the bioregion is represented in conservation reserves, and the reserves that do exist are small and isolated (Benson 1999).

Condition and threats.
This bioregion is one of the most extensively cleared (mostly for cropping and grazing) of all rangeland bioregions, with 36.3% of the NSW extent now cleared (Benson 1991, 1999; Dick 1992), with extensive clearing since about 1945 (Galloway 1974*a*). For example, Galloway (1974*b*) noted that "most belah *Casuarina cristata* forests have now been cleared by pulling followed by burning", with subsequent planting of exotic grasses or crops. Of 12 regional ecosystems defined for the small Queensland portion of this bioregion (termed the "Balonne-Culgoa Fan" province of Brigalow Belt), 8 were considered "of concern" and 2 were considered "endangered", largely because of clearing and high grazing pressure (Sattler and Williams 1999).

Fire regimes have now diverged substantially from those operating pre-European settlement. For the Queensland portion of the bioregion, Pedley (1974) noted that "much of the eastern part of the area was burnt in the 1930s to remove large quantities of dead prickly pear, a plant which had been a major pest".

Across the bioregion, over-grazing has caused substantial areas of degradation (Benson 1991; Pickard 1991; Pickard and Norris 1994).

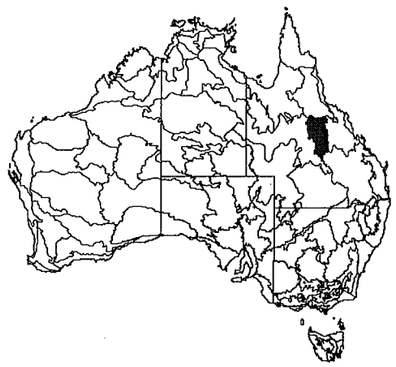
There are at least localised weed problems, including African boxthorn *Lycium ferocissimum*, and *Lippia* in forested wetlands (Benson 1999).

Changes in biodiversity.
Reid (1999) identified 20 landbird species which had declined in the NSW sheep-wheat belt (which includes all of this bioregion). These were: emu, painted button-quail, brown treecreeper, speckled warbler, chestnut-rumped thornbill, southern whiteface, jacky winter, red-capped robin, hooded robin, eastern yellow robin, grey-crowned babbler, white-browed babbler, varied sittella, crested shrike-tit, crested bellbird, rufous whistler, restless flycatcher, white-browed wood-swallow, dusky wood-swallow and diamond firetail. He also noted 29 native, and 7 introduced, land birds which had increased in abundance or range in this area.

As with other bioregions in the south-eastern rangelands, there has been major loss of native mammal species, including white-footed rabbit-rat *Conilurus albipes*, blue-grey mouse *Pseudomys glaucus*, pale field-rat *Rattus tunneyi*, bilby *Macrotis lagotis*, brush-tailed bettong *Bettongia penicillata*, eastern hare-wallaby *Lagorchestes leporides* and bridled nailtail wallaby *Onychogalea fraenata* (Southgate 1990; Dickman 1993; Dickman *et al.* 1993)

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

DESERT UPLANDS



Major land uses.
Pastoralism (extensive grazing by cattle) is the dominant land use.

Conservation areas.
Conservation reserves comprise 2.3% of the bioregion (Sattler and Williams 1999), with representation of only 43% of the regional ecosystems described for this bioregion.

Condition and threats.
This bioregion has probably the greatest current levels of vegetation clearance in the rangelands, with between 4 and 8% of the bioregion cleared between 1992 and 1995 (Rolfe *et al.* 1997). Especially spreading from cleared areas, the exotic buffel grass *Cenchrus ciliaris* is widespread, resulting in decline in native biodiversity (Fairfax and Fensham 2000). There are major weed problems in parts of the bioregion, most notably including rubber vine *Cryptostegia grandiflora* and parthenium *Parthenium hysterophorus* (Tothill and Gillies 1992).

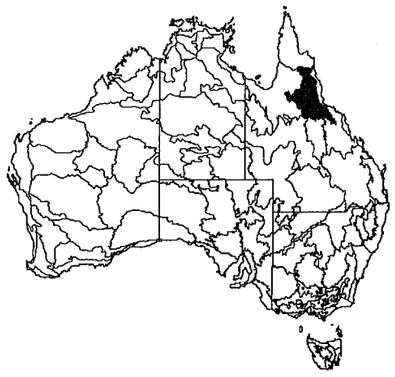
Of 58 regional ecosystems described for the Desert Uplands by Sattler and Williams (1999), 17 were considered endangered, and a further 20 "of concern". These threatened ecosystems are mainly in the relatively productive parts of the landscape, and in wetland/riparian areas, where they have been substantially affected by a history of high total grazing pressure.

Generally small property sizes and semi-arid climate has led to extensive pasture degradation across much of the bioregion, with this vegetation decline compounded by stock supplementation, reduced use of fire, and spread of exotic weeds and native "woody weeds" (Sattler and Williams 1999). Soil erosion is widespread.

Changes in biodiversity.
The western quoll *Dasyurus geoffroii* is presumed to be now extinct in this bioregion (Sattler and Williams 1999), and there has been substantial decline for at least gouldian finch *Erythrura gouldiae*, red goshawk *Erythrotriorchis radiatus*, star finch *Neochmia ruficauda* and plains wanderer *Pedionomus torquatus* (Franklin 1999; Sattler and Williams 1999). Twenty-one plant species are considered threatened in the region, with declines in abundance or range largely due to grazing and/or vegetation clearance (Sattler and Williams 1999).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

EINASLEIGH UPLANDS



Major land uses.
The major land use is pastoralism (extensive grazing by cattle), but mining and horticulture are locally significant (Sattler and Williams 1999). There are several major rural towns, the largest of which is Charters Towers.

Conservation areas.
Conservation reserves comprise about 1% of this bioregion (Thackway and Cresswell 1995; Sattler and Williams 1999).

Condition and threats.
Clearing has been widespread on the Atherton Tablelands on the eastern margin of this bioregion, and in scattered freehold land elsewhere in the bioregion. One of 46 defined regional ecosystems (Gidgee *Acacia cambagei* woodlands on heavy basalt-derived clays) is considered endangered, due to extensive clearing (Sattler and Williams 1999). Clearing for cropping and horticulture is continuing in the eastern part of the bioregion.

There are major weed problems in parts of the bioregion, most notably including rubber vine *Cryptostegia grandiflora*, parthenium *Parthenium hysterophorus*, chinee apple *Ziziphys mauritiana*, lantana *Lantana camara* (especially to dry rainforest thickets: Fensham *et al.* 1994; Fensham 1996), buffel grass *Cenchrus ciliaris*, and grader grass *Themeda quadrivalvis* (Tothill and Gillies 1992).

Mining activities (notably contaminated tailings dams and proliferation of access tracks) are affecting the conservation values of some areas (Sattler and Williams 1999).

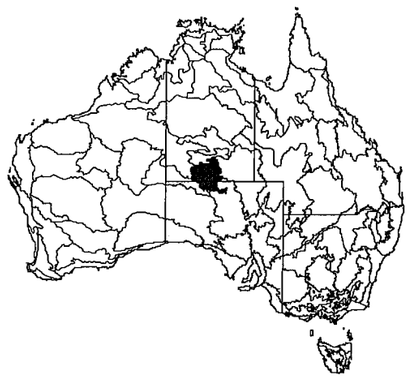
Rabbits and house mice occasionally reach high densities (Cummings *et al.* 1993). Other feral animals present include black rat, hare, cat, horse, pig, domestic pigeon *Columbia livia*, spice finch *Lonchura punctulata* and Indian myna *Acridotheres tristis* (Lavery and Johnson 1968).

Changes in biodiversity.
There has been no comprehensive review of changes in biodiversity in this bioregion. There have been losses or marked reductions for some bird species, particularly for the star finch *Neochmia ruficauda* (Holmes 1998) and gouldian finch *Erythrura gouldiae*, but also for spinifex pigeon *Geophaps plumifera* and pictorella mannikin *Heteromunia pectoralis* (Cummings *et al.* 1993). The koala *Phascolarctos cinereus* has probably declined in abundance and range (Lavery and Johnson 1968). Lavery (1968) considered that many birds (including brown quail *Coturnix ypsilophora*, peaceful dove *Geopelia striata*, pheasant coucal *Centropus phasianus*, singing bushlark *Mirafra javanica* and richard's pipit *Anthus novaeseelandiae*) "clearly have benefitted from man's activities" in this region.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996). However, inland rainforest patches (vine thickets) have generally been substantially reduced by clearing, and their condition adversely affected by weed invasion (Fensham 1996). Extensive pastoralism has led to some changes in floristics in the savanna woodlands, with fewer perennial forbs in grazed areas, and markedly reduced abundance of at least some native perennial grasses (e.g. *Capillipedium parviflorum* and *Sehima nervosa*) (Fensham and Skull 1999).

Studies comparing grazed areas and nearby ungrazed areas suggest that pastoralism may have had major impacts on the abundance and species composition of lizards and ants, and may have also produced substantial changes in abundance for some bird, mammal and spider species (Thurgate 1997; Woinarski and Ash *ms*, Woinarski *et al. ms*).

FINKE



There has been no comprehensive overview of the status of biodiversity in this bioregion, but an NHT-supported bioregional conservation planning project has just been commenced for the Northern Territory portion.

Major land uses.
Pastoralism (extensive cattle grazing) is the dominant land use, comprising 98% of the Northern Territory portion of the bioregion (Connors *et al.* 1996).

Conservation areas.
Only 0.02% of the bioregion is included within conservation reserves (Thackway and Cresswell 1995; Connors *et al.* 1996).

Condition and threats.
Large areas have been degraded by over-grazing (Bastin *et al.* 1993). Although this has affected most vegetation types present, chenopod shrublands have probably been most disturbed (Perry 1960). Feral animals (principally rabbits, camels and horses) have contributed substantially to this damage (Morton *et al.* 1995).

There are major weed infestations, notably of athel pine *Tamarix aphylla* in riparian areas (Griffin *et al.* 1989), and buffel grass *Cenchrus ciliaris* and couch grass *Cynodon dactylon* more extensively.

Foxes and feral cats are widespread (Strong and Low 1983).

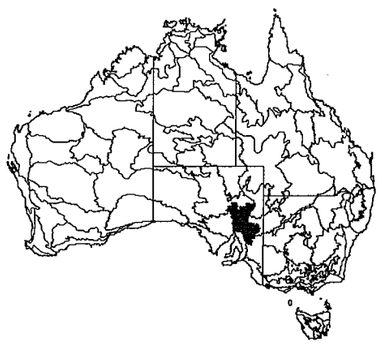
Fire regimes have changed appreciably since European settlement, and the current regime (principally of attempted exclusion with occasional extensive hot fires) is reducing environmental patchiness and the relative extent of mulga woodlands (Latz 1995).

Changes in biodiversity.
A very high proportion of the native mammal assemblage has been lost from this bioregion, including western quoll *Dasyurus geoffroii*, red-tailed phascogale *Phascogale calura*, numbat *Myrmecobius fasciatus*, brush-tailed possum *Trichosurus vulpecula*, golden bandicoot *Isoodon auratus*, pig-footed bandicoot *Chaeropus ecaudatus*, lesser bilby *Macrotis leucera*, bilby *Macrotis lagotis*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur*, crescent nailtail wallaby *Onychogalea lunata*, ghost bat *Macroderma gigas* and lesser stick-nest rat *Leporillus apicalis*) (Burbidge *et al.* 1988; Friend 1990; Baynes and Johnson 1996). The most precise dating for these losses is for brush-tailed possum, which became uncommon in the 1920s and persisted up to the late 1940s (Kerle *et al.* 1992), and bilby, which was lost from the region between 1936 and 1970 (Southgate 1990).

Birds which have declined from this bioregion include Australian bustard *Ardeotis australis*, bush stone-curlew *Burhinus grallarius*, spinifex pigeon *Geophaps plumifera*, chestnut quail-thrush *Cinclosoma castanotus*, night parrot *Pezoporus occidentalis*, grey currawong *Strepera versicolor* and slender-billed thornbill *Acanthiza iredalei* (Storr 1977; Close and Jaensch 1984; Reid and Fleming 1992), with this decline reaching regional extinction for grey currawong, bush stone-curlew and slender-billed thornbill. In contrast, there have been increases for at least crested pigeon *Ocyphaps lophotes*, galah *Cacatua roseicapilla*, magpie-lark *Grallina cyanoleuca* and pied butcherbird *Cracticus nigrogularis* (Close and Jaensch 1984; Reid and Fleming 1992).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

FLINDERS AND OLARY RANGES



Biodiversity information on this bioregion is summarised in Davies *et al.* (1996).

Major land uses.
Pastoralism (extensive grazing by sheep) is the dominant land use, with a history extending back to the 1840s (Mincham 1996). There has also been a long, if turbulent, history of agriculture (principally for wheat) and mining (principally for coal and copper) (Mincham 1996). Tourism is now also a major industry.

Conservation areas.
Conservation reserves comprise 10% of the bioregion, however these include only 14 of the 49 recognised environmental provinces (Thackway and Cresswell 1995).

Condition and threats.
Overgrazing (by sheep, rabbits and goats) has led to degradation, including lack of recruitment for a range of woody plant species (Lange and Purdie 1976; Crisp 1978; Lange and Graham 1983; Woodell 1990). The environmental changes due to this over-grazing may have reduced habitat suitability for the yellow-footed rock-wallaby *Petrogale xanthopus*, which is also jeopardised by feral predators (notably fox) (Lim *et al.* 1987).

Eight exotic animal species (rabbit, fox, cat, goat, black rat, house mouse, donkey and brown hare) are established in the bioregion (Smith 1996). Rabbits colonised the bioregion around 1860, and foxes around 1900 (Mincham 1996): until very recently, both were extremely common. Feral goats are locally common.

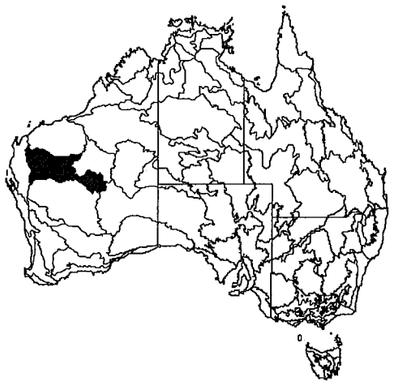
Gell and Bickford (1996) provide a review of the vegetation types recorded for the bioregion, with notes on condition. They noted for many vegetation types (e.g. white

cypress pine *Callitris glaucophylla* woodland and tussock grasslands), that the understorey now comprises mostly exotic species, particularly salvation jane *Echium plantigineum*, and especially so in areas where stock have grazed heavily. Greenwood *et al.* (1989) recorded 123 exotic plants in the greater Flinders Ranges area, most notably including rosy dock *Rumex vesicarius*, salvation jane, red brome *Bromus rubens*, ward's weed *Carrichtera annua*, *Centaurea melitensis*, common storksbill *Erodium cicutarium*, spiked malvastrum *Malvastrum americanum*, *Schismus barbatus*, smooth mustard *Sisymbrium erysimoides*, common sow thistle *Sonchus oleraceus*, onion weed *Asphodelus fistulosus*, horehound *Marrubium vulgare* and woolly burr-medic *Medicago minima*.

Changes in biodiversity.
The mammal fauna has suffered major losses, most notably in the regional extinction of 24 of 50 mammal species (or 23 of 40 species if bats are excluded) present at the time of European settlement (Southgate 1990; Tunbridge 1991; Smith 1996), including many species of small macropods, bandicoots, dasyurids and rodents. Until recent control of rabbits, foxes and goats, the yellow-footed rock-wallaby *Petrogale xanthopus* was continuing to decline (Lim *et al.* 1987).

Three plant species are believed to have become extinct in the Flinders Ranges: reed bent-grass *Deyeuxia quadriseta*, blunt pondweed *Poptogeton ochreatus*, and *Pilularia novae-hollandiae* (Department of Environment and Natural Resources 1995).

GASCOYNE



Major land uses.
Pastoralism is the predominant land use of this bioregion, and principally involves extensive sheep production on long-term leasehold lands. Harvesting of kangaroos is a minor industry (Williams 1978).

Conservation areas.
Conservation reserves comprise 2% of the bioregion (Thackway and Cresswell 1995). 36 (54%) of the bioregion's 67 recognised vegetation types are unreserved, with a further 23 types (34%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Pastoralism commenced in the 1880s and very high stocking rates on natural water sources were maintained for many decades, leading to severe local erosion and extensive degradation, particularly during periods of drought (Wilcox and Cunningham 1994). Most of the riparian vegetation in this bioregion is now rated as in "poor" condition, due to very heavy grazing pressure (Water and Rivers Commission 1997). Feral rabbits, goats and donkeys have contributed to total grazing pressure and degradation (State of the Environment Reporting Unit 1997*b*).

For the Gascoyne Basin (generally coincident with the Gascoyne bioregion), Williams (1978) estimated that 15% was "badly eroded, where irreversible degradation would follow continued grazing", 52% was "degraded and with some erosion", and the remaining 33% was mostly hilly or stony rangeland of limited suitability for grazing. For the far east of this bioregion, Beard (1974) reported that change in fire regime and grazing has led to some change in understorey and decline in mulga, but that "there are no apparent signs of deterioration".

Vegetation changes due to overgrazing have included change from long-lived perennial plant species to annual grasses and herbs and to inedible perennial species; and senescence and lack of recruitment for many perennial plants (Wilcox and McKinnon 1972; Williams 1978).

Payne *et al.* (1988) provided a detailed assessment of land condition in the north of this bioregion: they noted that vegetation types of low pastoral value (e.g. hard spinifex (*Triodia wiseana* and/or *T. lanigera*) grasslands on rugged and stony areas; mulga open woodlands/tall shrublands with short grass-forb understorey; stony short grass-forb vegetation) were generally in good or fair condition; mulga creekline vegetation was intensively grazed and in generally fair (but with some poor) condition, with sheet and gutter erosion in degraded areas; stony chenopod vegetation had moderate pastoral value and condition varying from good to very poor, "with almost complete loss of desirable shrubs in the latter case"; saltbush (principally *Atriplex bunburyana*) vegetation was intensively grazed and typically in poor to extremely degraded condition (with almost complete loss of shrubs and severe deflation and scalding of the soil surface); *Cassia* - short grass vegetation was of moderate pastoral value and generally in good condition, except for localised overgrazed areas which have suffered considerable loss of desirable shrubs; and bluebush (*Maireana, Chenopodium* and *Rhagodia* spp.) shrublands were of high pastoral value and generally in fair condition (although with localised areas of quite severe erosion). Loss of palatable native pasture species has encouraged the planting and widespread expansion of the exotic buffel grass *Cenchrus ciliaris* (Williams 1978; Department of Conservation and Land Management, WA. 1999).

Changes in biodiversity.
Many native mammal species have been lost from this bioregion since European settlement, including western quoll *Dasyurus geoffroii*, numbat *Myrmecobius fasciatus*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur* and lesser stick-nest rat *Leporillus apicalis* (Burbidge *et al.* 1988; Burbidge and McKenzie 1989; Friend 1990; Morris 2000)

Among birds, at least the bush stone-curlew *Burhinus grallarius* is declining in this bioregion (Reid and Fleming 1992).

One native plant species is presumed extinct from this bioregion (Briggs and Leigh 1996).

GAWLER

Robinson *et al.* (1988) reviewed biodiversity information for a large part of this bioregion.

Major land uses.
Pastoralism (extensive grazing by sheep) is the dominant land use.

Conservation areas.
Conservation reserves comprise 9.7% of the bioregion, and include representation of 20 of its 41 recognised environmental associations (Thackway and Cresswell 1995)..

Condition and threats.
Grazing (by sheep and rabbits) has led to substantial degradation, notably including prevention of regeneration (and hence decline) in at least some long-lived plants, such as western myall *Acacia sowdenii* (Lange and Purdie 1976; Lange and Willcocks 1980; Woodell 1990).

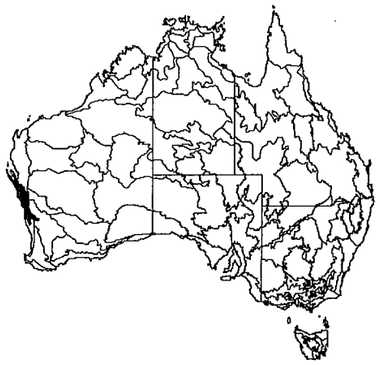
Foxes and feral cats, and herbivores (rabbits, goat and house mouse) are widespread (Robinson *et al.* 1988), and have had major impacts on the biota.

Changes in biodiversity.
In common with other arid and semi-arid rangeland regions, there has been substantial loss of the original mammal fauna, including bilby *Macrotis lagotis*, greater stick-nest rat *Leporillus conditor*, lesser stick-nest rat *L. apicalis*, short-tailed hopping mouse *Notomys amplus*, long-tailed hopping mouse *N. longicaudatus*, alice springs mouse *Pseudomys fieldi*, western quoll *Dasyurus geoffroii*, red-tailed phascogale *Phascogale calura*, numbat *Myrmecobius fasciatus*, western barred bandicoot *Perameles bougainville*, pig-

footed bandicoot *Chaeropus ecaudatus*, crescent nailtail wallaby *Onychogaela lunata*, brush-tailed bettong *Bettongia penicillata* and burrowing bettong *Bettongia lesueuri* (Robinson *et al.* 1988, 2000; Southgate 1990; Kemper 1990; Friend 1990).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

GERALDTON SANDPLAINS



Note that this bioregion is labelled as **Mid-west Coastal Plain** in State of the Environment Reporting Unit (1997).

Major land uses.
Pastoralism occupies nearly all of the region (Burbidge *et al.* in press; Johnstone *et al.* in press). Parts of the region have been intensively farmed for over a century. The mineral-rich sands of the Eneabba Plains are mined and the south of the region supports a bee-keeping industry (State of the Environment Reporting Unit 1997).

Conservation areas.
Conservation reserves comprise 9.5% of the bioregion's area (State of the Environment Reporting Unit 1997). 19 (22%) of the bioregion's 85 recognised vegetation types are unreserved, with a further 36 types (42%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
There is now a high sediment load in rivers in this bioregion (State of the Environment Reference Group 1998) and extensive salinisation, due to impacts of grazing across the catchments. The State of the Environment Reporting Unit (1997) noted that "the majority of the region has been cleared".

Localised weed problems exist, including spread of buffel grass *Cenchrus ciliaris*. Feral goats and rabbits occur in parts of the bioregion. Johnstone *et al.* (in press) noted that "the vegetation has been slightly to severely degraded by the grazing of sheep, goats and cattle, and in the far south rabbits".

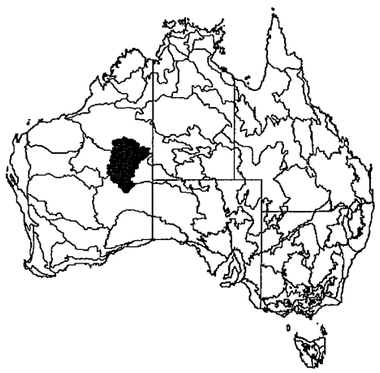
Weeds present in the bioregion include buffel grass *Cenchrus ciliaris*, bridal creeper *Asparagus asparagoides* and Victorian tea-tree *Leptospermum laevigatum* (Department of Conservation and Land Management, WA. 1999)

Changes in biodiversity.
The State of the Environment Reporting Unit (1997) noted "while the region once supported a rich fauna, this has declined following widespread clearing and other environmental disturbance, such as the drainage of wetlands, and the introduction of domestic and feral animals.

No bird species have become extinct in the bioregion, but 10-15% have decreased in abundance (including mallee-fowl *Leipoa ocellata*, Australian bustard *Ardeotis australis*, pallid cuckoo *Cuculus pallidus*, blue-winged kookaburra *Dacelo leachii*, southern emu-wren *Stipiturus malachurus*, hooded robin *Melanodryas cucullata* and rufous songlark *Cinclorhamphus mathewsi*) since European settlement and about the same proportion have increased (including emu *Dromaius novaehollandiae*, nankeen kestrel *Falco cenchroides*, banded lapwing *Vanellus tricolor*, crested pigeon *Ocyphaps lophotes*, galah *Cacatua roseicapilla*, budgerigar *Melopsittacus undulatus*, rufous whistler *Pachycephala rufiventris*, welcome swallow *Hirundo neoxena*, yellow white-eye *Zosterops lutea* and richard's pipit *Anthus novaeseelandiae*) (Johnstone *et al.* in press – based on comments for this bioregion, most of the Carnarvon bioregion and small parts of the Murchison and Gascoyne bioregions).

The relatively high total of nine plant species are presumed extinct from this bioregion (Briggs and Leigh 1996).

GIBSON DESERT



Major land uses.
Most of this sparsely populated bioregion is devoted to Aboriginal use. There is some mining activity and exploration.

Conservation areas.
Conservation reserves comprise >10% of the bioregion (Thackway and Cresswell 1995), principally comprising the Gibson Desert Nature Reserve (1.89 million ha) (Christensen and Burrows 1994). Five (24%) of the bioregion's 21 recognised vegetation types are unreserved, with a further 13 types (62%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Cats, rabbit, house mice, fox and camel occur widely across the bioregion (Burbidge *et al.* 1976; Noble and Ward 1999). Christensen and Burrows (1994) noted that high densities of feral cats foiled reintroduction attempts for burrowing bettongs *Bettongia lesueur*.

Feral herbivores (principally camels and, until recently, rabbits) are at high densities in parts of this bioregion, with impacts affecting a range of vegetation types (Noble and Ward 1999).

Fire regimes have also changed, and the new regime is contributing to ongoing vegetation change (Noble and Ward 1999).

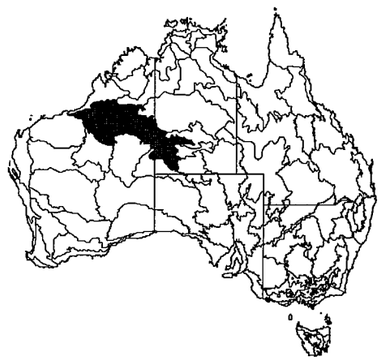
Changes in biodiversity.
This bioregion has lost many mammal species (State of the Environment Reference Group 1998), including western quoll *Dasyurus geoffroii*, numbat *Myrmecobius*

fasciatus; red-tailed phascogale *Phascogale calura*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, lesser bilby *Macrotis leucura*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur*, mala *Lagorchestes hirsutus*, spectacled hare-wallaby *L. conspicillatus*, central hare-wallaby *L. asomatus*, crescent nailtail wallaby *Onychogalea lunata* and lesser stick-nest rat *Leporillus apicalis* (Burbidge *et al.* 1976, 1988; Friend 1990a; Christensen and Burrows 1994).

There is little information on changes in biota other than for mammals, but the night parrot *Pezoporus occidentalis* has probably become regionally extinct (Higgins 1999), and the bush stone-curlew is declining in this bioregion (Reid and Fleming 1992).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

GREAT SANDY DESERT



There have been no comprehensive reviews of the biodiversity of this bioregion, but available information for the Northern Territory portion is summarised in Connors *et al.* (1996), a detailed survey was completed for the Western Australian section generally by Burbidge and McKenzie (1983), for part of the northern margin in Western Australia (McKenzie 1981b), and a substantial report completed for the Uluṟu area in the southeast of the bioregion (Reid *et al.* 1993).

Major land uses.
This bioregion is very sparsely populated. In the Northern Territory portion, 84% of the land is Aboriginal freehold and 14% pastoral leasehold. Mining is a less extensive land use. Tourism is concentrated around Uluṟu NP.

Conservation areas.
In the Northern Territory portion, conservation reserves comprise 1.6% of the extent. In the Western Australian portion, <5% is reserved. In both cases, the significant reserves are at the edges of the bioregion. In the Western Australian portion, 26 (57%) of the bioregion's 46 recognised vegetation types are unreserved, with a further 17 types (37%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
The main management problems for biodiversity across this bioregion are feral herbivores (principally rabbits (especially in the southeast of the bioregion) and camels), feral predators (cats, foxes), and altered fire regimes (Perry 1960; Bolton and Latz 1978; Saxon 1984; Burbidge and Pearson 1989; Pearson 1991; Reid *et al.* 1993; Masters 1993, 1996; Latz 1995; Short *et al.* 1998). Chenopod shrublands in particular have been affected by grazing.

Localised weed problems exist, including spread of buffel grass *Cenchrus ciliaris* and couch grass *Cynodon dactylon* (Department of Conservation and Land Management, WA. 1999).

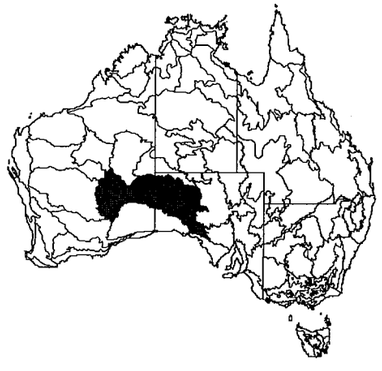
Changes in biodiversity.
There has been a major loss of mammals from this bioregion (McKenzie 1981*b*; Burbidge and McKenzie 1983; Burbidge *et al.* 1988; Churchill and Helman 1990; Reid *et al.* 1993; Pearson and Kinnear 1997; State of the Environment Reference Group 1998), with extinctions peaking around 40-50 years ago (including western quoll *Dasyurus geoffroii*, red-tailed phascogale *Phascogale calura*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, pig-footed bandicoot *Chaeropus ecaudatus*, lesser bilby *Macrotis leucera*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur*, central hare-wallaby *Lagorchestes asomatus*, crescent nailtail wallaby *Onychogalea lunata*, ghost bat *Macroderma gigas* and lesser stick-nest rat *Leporillus apicalis*), but some now extinct species persisting a little later (mala *Lagorchestes hirsutus*), and declines continuing for some still extant species (mulgara *Dasycercus cristicauda*, marsupial mole *Notoryctes typhlops*, bilby *Macrotis lagotis*, brushtailed possum *Trichosurus vulpecula*, spectacled hare-wallaby *Lagorchestes conspicillatus* and black-footed rock-wallaby *Petrogale lateralis*).

Patterns in the decline of the bird fauna are less clearcut, partly because of a very patchy historical record and "noisy" population fluctuations and range shifts by some species in response to rainfall conditions. Nonetheless, declines are evident for night parrot *Pezoporus occidentalis* and princess parrot *Polytelis alexandrae* (Reid and Fleming 1992).

The Great Desert Skink *Egernia kintorei* has declined across much of this bioregion (Cogger *et al.* 1993).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

GREAT VICTORIA DESERT



Information on the biodiversity of this bioregion is most comprehensively documented in Greenslade *et al.* (1986), although this report considers only the South Australian half of the bioregion. Burbidge *et al.* (1976) and the State of the Environment Reporting Unit (1997) provide some information from the Western Australian section.

Major land uses.
This bioregion is extremely sparsely inhabited. Most of the area is Aboriginal lands, in some cases also tenured as conservation reserve. During the late 1960s and early 1970s, a network of seismic shot lines was surveyed and bulldozed across large areas, and mineral exploration continues. Parts of the bioregion were used as restricted area for the Woomera Rocket Range, for nuclear testing and as storage for spent atomic fuels. Pastoral leases exist in the less arid margins of the WA portion of the bioregion.

Conservation areas.
The "Unnamed Conservation Park" in the South Australian portion of the bioregion is one of Australia's largest conservation reserves (with an area of 21,327 km^2). Thackway and Cresswell (1995) reported that >10% of the SA extent and 5-10% of the WA extent of the bioregion was in conservation reserves. In the Western Australian portion of the bioregion, nine (32%) of the 28 recognised vegetation types are unreserved, with a further 15 types (54%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Land condition was assessed in the far west of the bioregion by Pringle *et al.* (1994), who reported that 0.5% of the area was "severely degraded and eroded" (with this percentage increasing to 28% for some land systems); and that 28% of sites sampled had perennial vegetation in "poor or very poor condition", with the most frequently observed impacts of pastoralism being loss of perennial species richness and plant density, with decrease in cover also pronounced for the most susceptible vegetation type, chenopod shrublands.

Greenslade *et al.* (1986) noted that

> "*the introduction of several exotic mammals, most notably the rabbit, has undoubtedly been responsible for the decline in some mammals but for reptiles the full impact is possibly yet to come. Rabbits are present throughout much of the eastern Great Victoria Desert and continue to severely modify the environment. By eating all young seedlings, rabbits have for the past 100 years effectively prevented regeneration of many of the palatable, slow-growing, perennial tree and shrub species over much of the area. As this process continues, the whole character of the eastern Great Victoria Desert is likely to change dramatically as species like mulga die out over large areas. With them will go the characteristic assemblages of species they support ... Fires which have killed most mature mulgas over large areas of far eastern sections of the Great Victoria Desert are hastening this process.*"

They noted that rabbits were reported to have proliferated in the region as early as 1901, when exploration parties noted that in some places "the grass, lower branches and bark of bushes had been completely removed by these animals". Burbidge *et al.* (1976) noted presence of house mice, fox and camel widely across sites that they surveyed. At least in the far west of the bioregion, feral goats and feral cats are common and widespread, and weeds include the saffron thistle *Carthamus lanatus* (Pringle *et al.* 1994).

Aboriginal people largely moved from their traditional life style and hunting areas to settlements from the 1920s, leading to extensive changes in fire regimes (Greenslade *et al.* 1986).

Changes in biodiversity.

The richness of the reptile fauna is a feature of this bioregion (e.g. Pianka 1969). Greenslade *et al.* (1986) noted that this fauna appeared to be relatively intact, although two reptile species (the snakes *Acanthophis pyrrhus* and *Neelaps bimaculatus*) had not been collected in the South Australian portion of the bioregion for about 60 years, a possible decline which may be of concern.

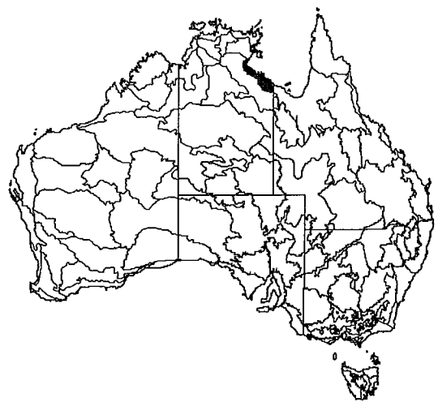
More drastically, a high proportion of the bioregion's mammal fauna (including the numbat *Myrmecobius fasciatus*, bilby *Macrotis lagotis*, burrowing bettong *Bettongia lesueur* and stick-nest rats *Leporillus* spp.) has become extinct, with the State of the Environment Reporting Unit (1997) estimating that "one-third of mammal species in the Great Victoria Desert have become extinct during the last 40 years" (cf. 2-3 species reported as regionally extinct in the State of the Environment Reference Group (1998)).

Five species of exotic mammal (camel *Camelus dromedarius*, house mouse *Mus musculus*, cat *Felis catus*, fox *Vulpes vulpes* and rabbit *Oryctolagus cuniculus*) have invaded.

Robinson *et al.* (1990) noted ongoing declines in some bird species in this bioregion, most notably for malleefowl *Leipoa ocellata* and scarlet-chested parrot *Neophema splendida*. Comparison of recent bird records with those reported between 1873 and 1945 suggest that Australian bustard *Ardeotis australis*, bush stone-curlew *Burhinus grallarius* and spinifex pigeon *Geophaps plumifera* have definitely declined; and chestnut quail-thrush *Cinclosoma castanotus*, grey currawong *Strepera versicolor*, malleefowl *Leipoa ocellata*, scarlet-chested parrot *Neophema splendida*, princess parrot *Polytelis alexandrae* and redthroat *Pyrrholaemus brunneus* have probably declined (Storr 1977; Close and Jaensch 1984; Reid and Fleming 1992). In contrast, there have been increases for at least black kite *Milvus migrans*, crested pigeon *Ocyphaps lophotes*, galah *Cacatua roseicapilla*, magpie-lark *Grallina cyanoleuca*, magpie *Gymnorhina tibicen*, common bronzewing *Phaps chalcoptera* and grey butcherbird *Cracticus torquatus* (Close and Jaensch 1984; Reid and Fleming 1992). These changes were attributed to "*grazing by sheep and cattle, the spread of modern (as distinct from aboriginal) settlements, hunting with firearms, and the trapping of parrots*" (Close and Jaensch 1984).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

GULF COASTAL



Major land uses.
This bioregion mainly comprises pastoral leasehold (65% of the extent), for extensive grazing by cattle. Aboriginal lands comprise most of the rest (27%) (Connors *et al.* 1996). There is a significant port and mining venture around Borroloola.

Conservation areas.
Conservation reserves comprise 0.5% of the bioregion (Connors *et al.* 1996).

Condition and threats.
Pastoralism, especially on marginal lands, is leading to some changes in vegetation, and to some erosion (Holmes 1986; Tothill and Gillies 1992; Morton *et al.* 1995).

Feral goats and cattle appear to be having substantial impacts on the one island where present (Johnson and Kerle 1991). Cane toads *Bufo marinus* have invaded recently, apparently to the detriment of quolls and to some goanna, snake and turtle species, but impacts on the rest of the fauna appear to be relatively minor (Freeland and Kerin 1988; Catling *et al.* 1999). Feral cats are common on the mainland portion of this bioregion, and have been reported from one island (Johnson and Kerle 1991).

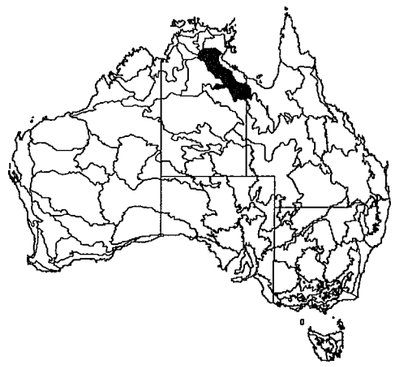
Current fire regimes may be too frequent and/or extensive, leading to some damage to at least monsoon rainforest patches (Johnson and Kerle 1991; Russell-Smith and Bowman 1992).

Changes in biodiversity.

Johnson and Kerle (1991) noted the presence of a number of mammal species (including the brush-tailed phascogale *Phascogale tapoatafa*, northern quoll *Dasyurus hallucatus*, brush-tailed rabbit-rat *Conilurus penicillatus*, carpentarian antechinus *Pseudantechinus mimulus* and canefield rat *Rattus sordidus*) on the Pellew Islands, which have apparently become extinct recently on the mainland portion of this bioregion. The common brushtail possum *Trichosurus vulpecula* and northern brown bandicoot *Isoodon macrourus* have also declined in abundance and range on the mainland portion of this bioregion (Johnson and Southgate 1990; Johnson and Kerle 1991).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

GULF FALL AND UPLANDS



There has been no comprehensive overview of threats or trends in status of biodiversity in this bioregion, although existing information is summarised in Connors *et al.* (1996).

Major land uses.
Most (66%) of this relatively rugged bioregion is pastoral leasehold land, much of it marginal or nonviable (Holmes 1990). There are also extensive areas of Aboriginal freehold (26%). There is one large mining enterprise and many smaller operations in the bioregion.

Conservation areas.
The bioregion is currently unreserved, although a large National Park (Limmen Gate) is awaiting proclamation and will constitute about 7% of the bioregion area.

Condition and threats.
Holmes (1986) reported substantial areas were degraded because of overstocking by cattle.

Russell-Smith and Bowman (1992) reported that monsoon rainforests in this bioregion were being degraded by inappropriate fire regimes, weeds, and feral animals. Inappropriate fire regimes (principally extensive late dry season fires) are also now reducing the floristic diversity of heathland vegetation in sandstone plateau and escarpment areas (Russell-Smith *et al.* 1998) and hence the abundance and distribution of the fauna associated with these, including the Carpentarian Grass-wren *Amytornis dorotheae* (McKean and Martin 1989).

The rocky ranges of this bioregion were recognised as a significant biological refuge by Morton *et al.* (1995), who also noted that these required "better cattle management, as well as improved fire management".

Changes in biodiversity.
The Northern Cypress-Pine *Callitris intratropica*, a subdominant tree across much of this bioregion, has suffered (and is continuing to suffer) catastrophic population crashes in the many areas where traditional Aboriginal fire regimes have been changed recently (Bowman and Panton 1993; Price and Bowman 1994). This change is unusually obvious for this species (because dead trees remain evident), but comparable changes may have occurred for many less conspicuous plant species.

Several bird (e.g. partridge pigeon *Geophaps smithii*: Braithwaite and Werner 1987) and mammal species (e.g. golden-backed tree-rat *Mesembriomys macrurus*, golden bandicoot *Isoodon auratus*, northern brown bandicoot *I. macrourus*, northern quoll *Dasyurus hallucatus*, brushtail possum *Trichosurus vulpecula*: Parker 1973; Johnson and Southgate 1990; Johnson and Kerle 1991) appear to have become extinct or much rarer in this bioregion over the last century, but the timing of this decline cannot be precisely defined, and it is not clear whether the declines are continuing.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

GULF PLAINS

Major land uses.
The dominant land use is cattle grazing on native pastures, with a history dating back to the 1860s (Perry 1964). Mining has also been a significant industry, with at least one large mine (Century) operating now.

Conservation areas.
2.5% of the Queensland proportion of the bioregion is in conservation reserves (Sattler and Williams 1999). None of the small (<1%) proportion in the NT is reserved (Connors *et al.* 1996).

Condition and threats.
Of the 83 regional ecosystems defined for the Queensland portion of this bioregion, three are considered endangered and 26 are considered of concern. Most (72%) of these are associated with watercourses and flood plains.

Sattler and Williams (1999) considered that:

> "the three major processes that pose a threat to biodiversity in the Gulf Plains are unsustainable grazing pressures, weed infestation and the development of ponded pastures. High total grazing pressure is causing increasing land degradation through changes in the density of ground cover and in species composition ... This is having a particular effect on riverine areas and on wetlands. Changes in stock and pasture management are leading to a reduction in seasonal burning, and a consequent increase in the density of the woody stratum ... The major weed threatening biodiversity is rubber vine *Cryptostegia grandiflora*, which now infests most major river systems ... Potential or local problem weed species include parkinsonia *Parkinsonia aculeata*, prickly acacia *Acacia nilotica*, and

> other introduced legume species. Salvinia *Salvinia molesta*, water hyacinth *Eichhornia crassipes*, calotrope *Calotropis procera*, and noogoora burr *Canthium pungens* are also locally significant ... Ponded pastures pose a threat ... to wetlands ... (through) the introduction of ponded pasture species to natural wetlands, where they displace most native wetland plants and animals. A secondary concern is the impact of retaining walls on floodplain hydrology .... Clearing of gidgee *Acacia cambagei* communities is occurring."

Changes in biodiversity.
Garnett and Crowley (1995b, 1995c, 1997) describe major declines and local extinctions of the Golden-shouldered Parrot *Psephotus chrysopterygius* across the Gulf portion of its range, and attributed this decline to habitat change (principally invasion of grassland areas by *Melaleuca*) caused by altered fire regimes over the last century.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

HAMPTON

Some consideration of the status of biodiversity in this small bioregion is included within the substantial wildlife survey of the Nullabor region (McKenzie and Robinson 1987).

Major land uses.
Much of this bioregion remains undeveloped. Pastoral leases (principally for sheep grazing) occupy about a half of the area. Although the earliest pastoral enterprise commenced in 1871, most pastoral development in the area is relatively recent (1960s).

Conservation areas.
More than 10% of the bioregion is reserved, although the "diversity of the Hampton Range mallee-scrubs and coastal Mallees and woodlands, are poorly represented" (Thackway and Cresswell 1995). In the Western Australian portion of the bioregion, none of the 7 recognised vegetation types are unreserved, but four types (57%) are represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Six introduced mammals are now well established in the bioregion (McKenzie and Robinson 1987). The earliest records of these included house mouse *Mus musculus* in 1931, fox *Vulpes vulpes* in 1911, rabbits *Oryctolagus cuniculus* in 1894, and cats *Felis catus* in 1896 (with 200 released in 1899 to attempt to control the rabbit plagues).

McKenzie and Robinson (1987) noted that the region was suffering "continuing degradation ... by rabbits and invasive weeds". They also noted "destruction of caves by visitors".

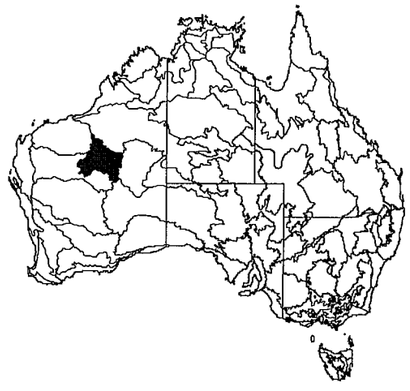
Changes in biodiversity.

Evidence from subfossil material (Baynes 1987) and early collections demonstrate that there has been a dramatic change in the mammal fauna of the Hampton bioregion since European colonisation. McKenzie and Robinson (1987) document recent records for 13 native mammal species from this bioregion, compared with 43 species known to be present at the time of European colonisation. Of the original non-bat mammal fauna, 85% are unrecorded in recent studies, and are probably now regionally extinct. The period of decline for these species is difficult to pinpoint, but appeared to have occurred mostly before 1940. In contrast to this assessment of substantial loss for this bioregion, the State of the Environment Reference Group (1998) reported only 0-1 regional extinctions for marsupials and rodents.

McKenzie and Robinson (1987) did not discuss changes in the bird, reptile or frog fauna, other than noting that the Masked Owl *Tyto novaehollandiae* was regionally extinct. A recent decline in the Nullabor Quail-thrush *Cinclosoma cinnamomeum alisteri* was reported by Burbidge and Pedler (1993), due to degradation of chenopod shrublands through overgrazing by rabbits, livestock, weed invasion and fire.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

LITTLE SANDY DESERT



Major land uses.
This bioregion is very sparsely populated. Most of the lands are devoted to Aboriginal use. There is some mining activity and exploration.

Conservation areas.
Conservation reserves comprise <10% of the bioregional area, with the only substantial reserve on its northern margin (Thackway and Cresswell 1995). Seven (25%) of the bioregion's 28 recognised vegetation types are unreserved, with a further 16 types (57%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
The main management problems for biodiversity across this bioregion are feral herbivores (notably camels), feral cats and foxes, and altered fire regimes (Burbidge and Pearson 1989; Pearson 1991; Short *et al.* 1998).

Weed problems present include buffel grass *Cenchrus ciliaris* (Department of Conservation and Land Management, WA. 1999).

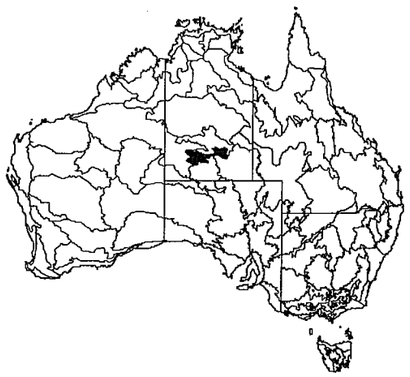
Changes in biodiversity.
There has been a major loss of mammals from this bioregion (Burbidge and McKenzie 1983; Burbidge *et al.* 1988; State of the Environment Reference Group 1998), with extinctions peaking around 40-50 years ago, and including western quoll *Dasyurus geoffroii*, red-tailed phascogale *Phascogale calura*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, pig-footed bandicoot *Chaeropus ecaudatus*, lesser bilby *Macrotis leucera*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *B. lesueur*, central hare-wallaby *Lagorchestes asomatus*, crescent nailtail wallaby *Onychogalea lunata*, ghost bat *Macroderma gigas* and lesser stick-nest rat *Leporillus*

apicalis, but some now extinct species persisting a little later (mala *Lagorchestes hirsutus*), and declines continuing for some still extant species (mulgara *Dasycercus cristicauda*, marsupial mole *Notoryctes typhlops*, bilby *Macrotis lagotis*, brushtailed possum *Trichosurus vulpecula*, spectacled hare-wallaby *Lagorchestes conspicillatus*).

Among birds, at least the bush stone-curlew is probably declining in this bioregion (Reid and Fleming 1992).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

MACDONNELL RANGES



Major land uses.
Pastoral use (for extensive cattle grazing) is the dominant land use of this bioregion (occupying 59% of its extent). Aboriginal freehold land comprises 31%. Tourism is a major industry.

Conservation areas.
Conservation reserves comprise 9% of the bioregion.

Condition and threats.
Morton *et al.* (1995) list exotic vertebrates, primarily horses, rabbits, donkeys, foxes and feral cats as the major biodiversity management problems. They also considered that "tourist impacts are likely to escalate, leading to possible pollution of the few permanent waterholes ... exotic plants such as tamarisk, buffel grass, and couch are in danger of spreading. Fire represents a risk to mature hummock grass communities." Latz *et al.* (1981) similarly listed major management problems as fire, feral animals, erosion and tourist impacts.

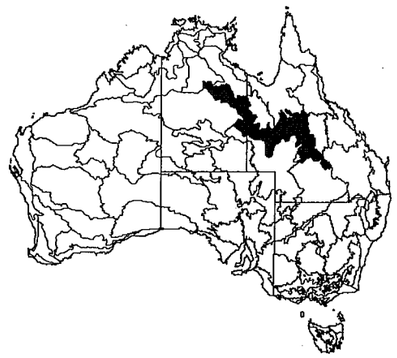
Current fire regimes are leading to decline in the extent and richness of mulga communities, and threatening some relict plant populations (Bowman *et al.* 1994; Latz 1995, 1996).

Changes in biodiversity.
The MacDonnell Ranges is recognised as a major refuge area, accommodating many isolated and disjunct populations, and many endemic species (Keast 1959; Morton *et al.* 1995; Latz 1996). The main factor which has historically provided this refuge (rugged topography) also offers some protection from many current threatening processes.

However, it does not shield the biota from some recent threats (such as feral predators), and landscape-wide changes in other processes (e.g. changed fire regimes) are eroding the distinctive biota. The most notable losses have been among the native terrestrial mammals. Fifteen species (42%) of the native land mammal fauna (mulgara *Dasycercus cristicauda*, western quoll *Dasyurus geoffroii*, red-tailed phascogale *Phascogale calura*, mala *Lagorchestes hirsutus*, crescent nailtail wallaby *Onychogalea lunata*, pig-footed bandicoot *Chaeropus ecaudatus*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, bilby *Macrotis lagotis*, lesser bilby *M. leucera*, lesser stick-nest rat *Leporillus apicalis*, short-tailed hopping-mouse *Notomys amplus*, long-tailed hopping-mouse *Notomys longicaudatus*, Alice Springs mouse *Pseudomys fieldi* and pale field-rat *Rattus tunneyi*) and the ghost bat *Macroderma gigas* have become regionally extinct over the last 100 years (Gibson and Cole 1996). Several surviving species, including black-footed rock-wallaby *Petrogale lateralis*, spectacled hare-wallaby *Lagorchestes conspicillatus*, brushtail possum *Trichosurus vulpecula* and central rock-rat *Zyzomys pedunculatus*, have undergone substantial contractions in range or reduction in total population, and this decline is generally ongoing (Lundie-Jenkins and Findlay 1994; Gibson and Cole 1996; Cole and Woinarski in press).

Although Briggs and Leigh (1996) considered that the bioregion contained no plant taxa now presumed extinct, Cowie *et al.* (2000) considered that *Eriocaulon pygmaeum* had disappeared from this bioregion.

MITCHELL GRASS DOWNS



Reviews of parts of the biodiversity of this bioregion are presented in Fisher (1999) for the Northern Territory, and Johnson (1997) for fauna in the Queensland portion of the bioregion.

Major land uses.
More than 90% of the bioregion is used for extensive grazing of sheep (in the Queensland portion of the bioregion) and cattle (in both Queensland and the Northern Territory). Land tenure is mainly leasehold, with freehold more commonly in the south-east of the bioregion.

Conservation areas.
Conservation reserves constitute 1.05% of the Queensland portion of the bioregion and 0.5% in the Northern Territory portion (Fisher 1999; Sattler and Williams 1999).

Condition and threats.
Of 53 regional ecosystems defined for the Queensland portion of the bioregion, 2 are considered endangered and 10 of concern (Sattler and Williams 1999). These threatened ecosystems are mainly in the southeast (Queensland) of the bioregion, where land clearing and the spread of exotic pasture species has been most extensive. Across the rest of the bioregion, the most extreme threats are in ecosystems on drainage lines, where grazing pressure is greatest and where there has been major invasions by environmental weeds (Sattler and Williams 1999).

Sattler and Williams (1999) considered that the major threats to the biodiversity in this region were "total grazing pressure, feral predators, exotic weed species, and vegetation clearing and associated introduction of exotic pasture". Artificial water sources have allowed spread of livestock across the bioregion, and the declining gradient in stock use at increasing distances from these waterpoints is closely correlated with the abundance of

some native animal and plant species. In the less intensively developed Northern Territory portion of the bioregion, Fisher (1999) estimated that 80% of the grasslands are now within 5 km of artificial water points, and only 1.5% is more than 8 km distant. Wilson and Purdie (1990) noted that localised areas such as riparian strips, alluvial plains and waterholes are often heavily impacted by total grazing pressure, as evidenced by extensive areas of bare ground and trampling.

Clearing, particularly of gidgee *Acacia cambagei* and brigalow *A. harpophylla* communities, has been extensive in the southeast of the bioregion, and typically has been followed by replacement of native species with the exotic buffel grass *Cenchrus ciliaris* (Sattler and Williams 1999).

Large areas of grassland (especially riparian areas) have been invaded by the exotic weeds prickly acacia *Acacia nilotica*, mesquite *Prosopis* spp., and parkinsonia *Parkinsonia aculeata* (Sattler and Williams 1999).

Populations of feral animals including goats, pigs, horses, camels, rabbits, cats and foxes occur across the bioregion, with very high densities of feral cats associated with many of the watersources (Sattler and Williams 1999).

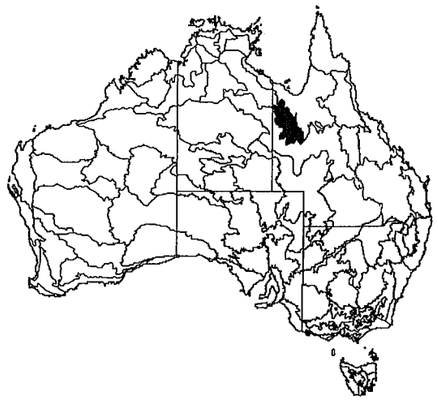
Changes in biodiversity.
The bilby *Macrotis lagotis* is now restricted to a relict population in the bioregion (Southgate 1990; Gordon *et al.* 1990). The Julia Creek dunnart *Sminthopsis douglasi*, which is almost endemic to this bioregion, is recognised as endangered, most probably by habitat change due to intensive grazing (Woolley 1992). The population of one of the characteristic species of this bioregion, the flock bronzewing *Phaps histrionica*, has undergone a series of major fluctuations over the last century, but probably with a generally downward trend (Franklin 1999). In the Queensland portion of the bioregion, regional extinctions have occurred for at least the grass owl *Tyto capensis* (Storr 1984; Schodde and Mason 1980), with declines also for at least spectacled hare-wallaby *Lagorchestes conspicillatus* and kowari *Dasyuroides byrnei* (Johnson 1997). For the Northern Territory component of the bioregion, Fisher (1999) estimated that at least four animal species (the lizards *Delma tincta* and *Ctenotus pulchellus*, the snake *Demansia torquata* and the little button-quail *Turnix velox*) and two plant species (*Astrebla squarrosa* and *A. pectinata*) had declined in total population by at least 50% since the advent of pastoralism, with declines expected to continue with increasing intensity of pastoral use. Pastoral impacts have also included an increase in the relative abundance of annual grasses (e.g. *Brachyachne convergens, Panicum laevinode*) at the expense of perennial grasses. A range of animal species favoured by short grass, open areas and increased occurrence of permanent water (e.g. galah, crested pigeon, Australian pratincole) have increased in distribution and abundance (Parker 1970; Fisher 1999).

Grazing may have a pronounced impact on plant species composition in the mitchell grasslands of Queensland, although this impact may be difficult to disentangle from

floristic responses to broad climatic and substrate variation, and responses to recent climatic events (Orr 1980; Fensham *et al.* 1999).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

MOUNT ISA INLIER



Note:
This bioregion is listed as "Northwest Highlands" in Sattler and Williams (1999).

Major land uses.
Extensive cattle grazing is the dominant land use. Mining is more localised but is a major industry.

Conservation areas.
5.3% of the bioregion is included within conservation reserves (Sattler and Williams 1999).

Condition and threats.
Three of 41 regional ecosystems defined for the bioregion are considered endangered. These three are all associated with the larger watercourses and springs, and are endangered because grazing pressure ahs focussed on these environments, leading to severe land degradation (Sattler and Wiliams 1999). A further 13 of the regional ecosystems are defined as "of concern", and are usually parts of the broader landscape that are extensively grazed (Sattler and Wiliams 1999).

Sattler and Williams (1999) also noted that:

> "lower parts of the landscape are often subject to relatively heavy grazing pressure. On the sandier soils, particularly on alluvial terraces, buffel grass *Cenchrus ciliaris* has become naturalised and replaced native pastures in most areas. The high fuel loads have resulted in hotter fires which appear to be reducing the density and diversity of native flora. The consequences of these changes on fauna are unknown. Mining activities have locally significant impacts

> on regional ecosystems through direct disturbance, smelter emissions, erosion and weed spread."

Mining activities have generally relatively localised impacts. The most detailed research concerns the impact upon biodiversity of sulphur dioxide emissions from mining activity at Mt Isa (Griffiths 1998). This work demonstrated major changes in plant, ant, reptile and bird species composition and richness from high impact zone (up to 15 km downwind from the smelter) to natural levels, with generally few, widespread and exotic species dominating the areas around the high emission area.

Horton (1976) provides a popular account of the wildlife of this bioregion, and describes some of the threatening processes, most notably high numbers of feral animals (cats, dogs, and pigs), but also fire ("there is no systematic burning"), weeds, gradual impacts of relatively low numbers of livestock, and mining of some particular environments (notably extraction from creek beds of sand for concrete making).

Changes in biodiversity.
Horton (1976) considered that populations of macropods had declined substantially since European settlement.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

MULGA LANDS

The biodiversity and condition of the Queensland portion of this large bioregion is summarised in Sattler and Williams (1999).

Major land uses.
Pastoralism (extensive grazing by sheep and cattle) is the dominant land use. Horticulture currently occupies a relatively small proportion of the area, but there are proposals for substantial expansion (Kingsford 1999a). Mining and oil and gas production occur, but are currently relatively localised

Conservation areas.
Conservation reserves comprise 2.4% of the Queensland extent of the bioregion, where they sample almost 70% of the regional ecosystems described (Sattler and Williams 1999). Only 1.1% of the NSW portion of the bioregion is reserved (Benson 1999).

Condition and threats.
The Mulga Lands is regarded as the most degraded bioregion in Queensland, and among the rangelands generally (Sattler and Williams 1999). For the area west of the Warrego River in Queensland, Mills *et al.* (1989) rated more than two-thirds of properties as showing signs of serious land degradation. The condition is generally similar in the New South Wales portion of the bioregion (Benson 1991; Pickard 1991; Lunney 1994). The symptoms of degradation include marked floristic change (generally with decreasing cover of palatable perennial grasses), marked structural change (often with increase of "woody weeds"), soil loss, and loss of ecological function (Morrisey 1984; Mills 1986; Beale *et al.* 1986; Passmore and Brown 1992; Lunney 1994; Tongway and Ludwig 1995;

Wilson 1997). This condition is due largely to over-stocking, grazing by feral animals (principally rabbits and goats) and inappropriate fire regimes.

Vegetation clearance is widespread in parts of the Queensland portion of the bioregion (particularly of eucalypt woodlands and *Acacia* woodlands in the higher rainfall eastern fringe of the bioregion) (Sattler and Williams 1999), but only 0.5% of the NSW portion is cleared (Benson 1999). The impacts upon biodiversity of this clearing are generally exacerbated by sowing with buffel grass *Cenchrus ciliaris* (Silcock 1986; Wilson 1997), which has spread widely across the bioregion. Some other potentially serious environmental weeds (including rubber vine *Cryptostegia grandiflora*, mother of millions *Bryophyllum tubiflorum* and parkinsonia *Parkinsonia aculeata*) are currently more localised in the bioregion (Sattler and Williams 1999).

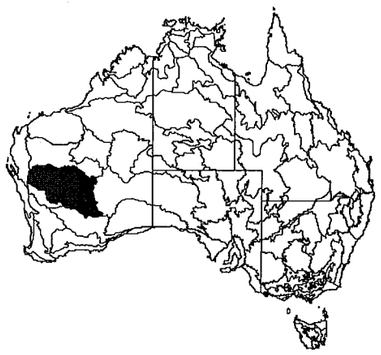
Introduced predators (foxes and cats) and feral goats are widespread.

Of the 66 regional ecosystems defined for the Queensland Mulga Lands, Sattler and Williams (1999) rated five as "endangered", based on their diminution, deterioration and ongoing threat.

Changes in biodiversity.
Sattler and Williams (1999) considered that only one animal species (the western quoll *Dasyurus geoffroii*) had become extinct in the Queensland portion of this bioregion, but they also noted major declines for a range of other species, including bilby *Macrotis lagotis* (Southgate 1990), night parrot *Pezoporus occidentalis*, plains-wanderer *Pedionomus torquatus*, plains rat *Pseudomys australis* and kowari *Dasyuroides byrnei*. In the New South Wales portion of the bioregion, regional extinctions have included greater stick-nest rat *Leporillus conditor*, plains rat *Pseudomys australis*, bilby *Macrotis lagotis*, burrowing bettong *Bettongia lesueur* and brush-tailed bettong *B. penicillata* (Dickman 1993,1994).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

MURCHISON



Major land uses.
Pastoralism (principally extensive grazing by sheep) is the dominant land industry, with a history extending back to the 1860s and 1870s (Curry *et al.* 1994). Over-stocking and drought led to severe losses (from around 840,000 sheep to 250,000 sheep) in the late 1930s (Curry *et al.* 1994). Mining is also a major industry, particularly on greenstone belts in the southeastern portion of the bioregion (Pringle *et al.* (1994).

Conservation areas.
Conservation reserves comprise <1% of the bioregion (Thackway and Cresswell 1995). 73 (62%) of the bioregion's 117 recognised vegetation types are unreserved, with a further 36 types (31%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Pastoral impacts have led to "widespread changes and patchy degradation of the native vegetation" over the last century (Mabbutt *et al.* 1963; Saunders and Curry 1990; Wilcox and Cunningham 1994; Pringle *et al.* 1994). In the Murchison-Meekatharra area, 75% of saltbush (*Atriplex* spp.) and 25% of acacias had been destroyed by 1940 (Curry *et al.* 1994). A detailed assessment of the western half of this bioregion noted that 42% of vegetation was in "poor to very poor condition", with considerable losses of perennial plants or, in some cases, marked increases in cover of unpalatable species ("woody weeds") with the worst affected vegetation being "wash" systems supporting mulga shrublands on hardpan, preferentially grazed systems on greenstones and internally drained systems; and that 1.8% of the area was "severely degraded and eroded", mostly on alluvial land systems with high pastoral potential (Curry *et al.* 1994). Most of the riparian vegetation in this bioregion is rated as in "poor" condition, due to very heavy grazing pressure (Water and Rivers Commission 1997). For mulga shrublands on hardpan, they noted that ungrazed areas had significantly greater density of perennial

species, palatable woody perennials, number of perennial species and number of palatable species, than comparable grazed areas. This situation is broadly similar in the eastern part of the bioregion, where Pringle *et al.* (1994) reported that 0.5% of the area was "severely degraded and eroded" (with this percentage increasing to 28% for some land systems); and that 28% of sites sampled had perennial vegetation in "poor or very poor condition", with the most frequently observed impacts of pastoralism being loss of perennial species richness and plant density, with decrease in cover also pronounced for the most susceptible vegetation type, chenopod shrublands.

Saunders and Curry (1990) noted that thick-billed grass-wrens and the habitat they were dependent upon (chenopod thickets in drainages below auriferous ranges) were affected by "a combination of preferential overgrazing by sheep and cattle, invasion by rabbits, decreases in small marsupials, increases in large marsupials, the proximity of a heavily populated mining industry and the introduction of feral predators". In the more extensive mulga shrublands, they noted that the "commonest symptom of grazing-induced change (has been) altered or lost populations of understorey shrubs and perennial herbs". Beard (1974) reported that change in fire regime and grazing has led to some change in understorey and decline in mulga.

Localised weed problems exist, including the saffron thistle *Carthamus lanatus*, thornapple *Datura stramonium*, mexican poppy *Argemone ochroleuca* and bathurst burr *Xanthium spinosum* (Pringle *et al.* 1994). Buffel grass *Cenchrus ciliaris* is more widespread, and, while stabilising some highly eroded areas, is now forming a stable disclimax across many vegetation types, displacing native species (Department of Conservation and Land Management, WA. 1999).

Mining activity has had at least localised impacts, "*with abandoned pits, waste heaps, rubbish dumps and vegetation loss illustrating the long-term effects of mining and exploration between the 1890s and 1970s. Vegetation and drainage patterns have been altered and soil erosion occurs on a localised level.*" (State of the Environment Reporting Unit 1997).

Feral goats are common and widespread and have contributed to degradation in many areas (Freudenberger 1993; Pringle *et al.* 1994). Other exotic animal pests include foxes, feral cats, wild dogs, rabbits and camels (Pringle *et al.* 1994).

Changes in biodiversity.
Saunders and Curry (1990) examined change in the bird species composition in this bioregion from 1896 to 1988. Of 118 bird species (excluding water birds and vagrants) recorded, three species (night parrot, scarlet-chested parrot, and thick-billed grass-wren) have become regionally extinct over this period, and a further 5 species have suffered substantial decline (malleefowl, little button-quail *Turnix velox*, white-winged fairy-wren *Malurus leucopterus*, rufous fieldwren, grey currawong). In contrast, three species have colonised over the last century (Bourke's parrot, banded plover, red-tailed black cockatoo), and 18 species have increased in range or abundance (including emu

Dromaius novaehollandiae, wedge-tailed eagle *Aquila audax*, inland dotterel *Charadrius australis*, crested pigeon *Ocyphaps lophotes*, galah, welcome swallow *Hirundo neoxena*, grey-crowned babbler *Pomatostomus temporalis*, yellow-rumped thornbill *Acanthiza chrysorrhoa*, banded whiteface *Aphelocephala nigricincta*, spiny-cheeked honeyeater *Acanthegenys rufogularis*, zebra finch *Taeniopygia guttata*, magpie-lark, black-faced wood-swallow *Artamus cinereus*, pied butcherbird, western bowerbird *Chlamydera guttata*, little crow *Corvus bennetti* and torresian crow *C. orru*).

Saunders and Curry (1990) considered that the bird fauna now largely stable, with changes (notably regional extinctions) occurring predominantly "before or around 1910". They also noted that the "the major post-settlement impact upon the avifauna has been the vastly increased availability of permanent water supplies on which the pastoral industry itself depends", with this change leading to increases among a variety of mainly resident bird species.

Mammal extinctions from the bioregion include lesser stick-nest rat *Leporillus apicalis*, numbat *Myrmecobius fasciatus* and bilby *Macrotis lagotis* (Pringle *et al.* 1994).

Two plant species are presumed extinct from this bioregion (Briggs and Leigh 1996).

(MURRAY-DARLING DEPRESSION)

Note: The Victorian portion, and parts of the South Australian portion, of this bioregion is not considered within the rangelands.

Major land uses.
Pastoralism (extensive grazing by sheep) is the dominant land use. There are also large areas devoted to horticulture.

Conservation areas.
3.6% of the NSW portion of the bioregion is included within conservation reserves (Benson 1999). 14.6% of the South Australian portion of this bioregion is reserved (Thackway and Cresswell 1995).

Condition and threats.
Over-grazing has caused substantial areas of degradation (Benson 1991; Pickard 1991; Pickard and Norris 1994). Clearing for agriculture has been substantial on loamy soils and along the main river channels (Noble *et al.* 1990; Benson 1991; Cambell 1994), with 7.7% of the NSW portion of the bioregion cleared (Benson 1999). Changed fire regimes have led to major environmental changes affecting species composition and population structure of many plants, and the abundance of many animal species (Noble *et al.* 1980).

Changes in biodiversity.
This bioregion has suffered extensive changes in biodiversity in the period since European settlement. This is most evident in the regional extinction of about 27 mammal species (mostly bandicoots, larger dasyurids, smaller macropods and larger rodents) (Southgate 1990; Dickman and Read 1992; Dickman 1993, 1994; Dickman *et al.* 1993; Denny 1994). There has also been substantial change in the bird fauna, with probable regional extinction for two species (night parrot *Pezoporus occidentalis* and thick-billed

grasswren *Amytornis textilis*), declines for around 60-100 other bird taxa and increases for 50-80 taxa (McAllan 1987; Smith and Smith 1994).

One native plant (*Acanthocladum dockeri*) is known to have disappeared from this bioregion (Briggs and Leigh 1996).

NORTHERN KIMBERLEY

There has been no comprehensive overview of the biodiversity of this bioregion, but many major reviews of particular environments (McKenzie *et al.* 1991) or areas within the bioregion (Miles and Burbidge 1975; Kabay and Burbidge 1977; Burbidge and McKenzie 1978; Anon 1981; Burbidge *et al.* 1991).

Major land uses.
The North Kimberley bioregion is extremely sparsely populated. Most land is either Aboriginal reserve or pastoral (extensive grazing for cattle production). There are some major areas designated for mining, although mineral development has so far been limited. Tourism is an increasingly important industry.

Conservation areas.
Conservation reserves comprise >10% of the bioregion (Thackway and Cresswell 1995). 12 (41%) of the bioregion's 29 recognised vegetation types are unreserved, with a further 13 types (45%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
This bioregion has been relatively little disrupted since European settlement. The most pervasive problem is probably feral and semi-feral cattle and pigs, which have caused at least localised damage to riparian areas and monsoon rainforest patches (McKenzie and Belbin 1991; Friend *et al.* 1991; Burbidge *et al.* 1991), but most of the riparian vegetation in this bioregion is rated as in "good" or "excellent" condition (Water and Rivers Commission 1997).

Changes in the traditional fire regime (to more extensive fires in the late dry season) appear to be affecting monsoon rainforests and a range of other fire-sensitive plant species and environments, and leading to changes in the floristics and structure of at least

the understorey in the spatially dominant eucalypt savanna woodlands (Hnatiuk 1977; Clayton-Greene and Beard 1985; McKenzie and Belbin 1991).

Mining and tourism may have had localised impacts on biodiversity, and more dispersed impacts through development of track networks (Hnatiuk and Kenneally 1981).

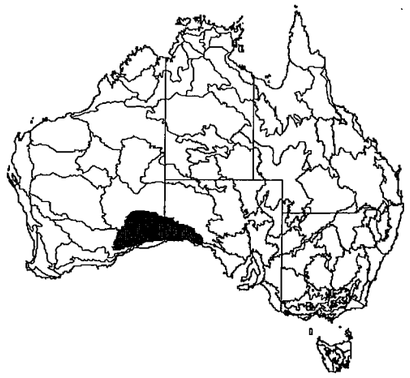
Localised weed problems exist, including spread of buffel grass *Cenchrus ciliaris* (Department of Conservation and Land Management, WA. 1999

Changes in biodiversity.
This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996). However, the Northern Cypress-Pine *Callitris intratropica*, a dominant or subdominant tree across much of this bioregion, has suffered (and is continuing to suffer) catastrophic population crashes in the many areas where traditional Aboriginal fire regimes have been changed recently (Bowman and Panton 1993; Price and Bowman 1994). This change is unusually obvious for this species (because dead trees remain evident), but comparable changes may have occurred for many less conspicuous plant species.

Burbidge and McKenzie (1989) reported that no mammal species had declined or been lost from the North Kimberley, but in some contradiction, they reported the comments of a long-term Aboriginal resident who noted the "recent disappearance of several mammal (species)" from the lower rainfall parts of this bioregion. The State of the Environment Reference Group (1998) reported 0-1 regional extinctions for marsupial and rodent species.

The western subspecies of partridge pigeon *Geophaps smithii blaauwi* has declined in abundance and range, probably because of changes in the fire regime (Johnstone 1981).

NULLARBOR



Consideration of the status of biodiversity in this bioregion is exceptionally well grounded, courtesy of a substantial bioregional wildlife survey (McKenzie and Robinson 1987).

Major land uses.
Much of this bioregion remains undeveloped. Pastoral leases (for sheep grazing) occupy about one-third of the area, principally in the near coastal edge in Western Australia. Although the earliest pastoral enterprise commenced in 1858, most pastoral development in the area is relatively recent (1960s).

Conservation areas.
Reserves comprise 17% of the Western Australian portion of this bioregion (State of the Environment Reporting Unit 1997), and 58% (if including "regional reserves") or 15% (with regional reserves excluded) of the South Australian portion (Thackway and Cresswell 1995). In the Western Australian portion of the bioregion, nine (41%) of the 22 recognised vegetation types are unreserved, with a further 12 types (55%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
An examination of land use and capability in the Western Australian section of this bioregion concluded that 40% of the area was in poor condition, with pasture degradation due to the combined effects of rabbits, fire and drought (Trotman 1974, in McKenzie and Robinson 1987). A major component and marker of this degradation has been the elimination of perennial shrubs (especially the dominant chenopod *Maireana sedifolia*), over large areas, principally due to ringbarking by rabbits (Beard 1975). Mismanagement of pastoralism has also led to overgrazing and degradation in parts (Conservation Through Reserves Committee 1974). McKenzie and Robinson (1987) noted that the

Nullabor region was suffering "continuing degradation ... by rabbits and invasive weeds", with dongas (natural depressions) particularly badly degraded by rabbits.

The State of the Environment Reporting Unit (1997) noted that "owing to the lack of natural barriers and its extreme aridity, the Nullabor has particular problems with introduced plants and animals. Wards weed, in particular, is spreading dramatically, possible as a result of uncontrolled vehicle access".

Fire regimes have also changed dramatically since European settlement, with a fine scale mosaic now replaced by "many large wild fires" (State of the Environment Reporting Unit 1997).

Changes in biodiversity.
Evidence from subfossil material (Baynes 1987) and early collections demonstrates that there has been a dramatic change in the mammal fauna of the Nullabor bioregion since European colonisation. McKenzie and Robinson (1987) document recent records for 21 native mammal species from this bioregion. Eleven previously-recorded native mammal species (i.e. 46% of the original non-bat native mammal fauna) were unrecorded in recent studies, and are probably now regionally extinct. Of these species, 10 (the dasyurids *Antechinomys laniger, Dasycercus cristicauda* and *Dasyurus geoffroii*, the bandicoots *Macrotis lagotis* and *Perameles bougainville*, the small macropods *Bettongia lesueur, Bettongia penicillata* and *Onychogalea lunata*, and the rodents *Leporillus conditor* and *Notomys fuscus*) have not been recorded more recently than 1940 (although this date should be regarded as not precisely marking any endpoint, as there was almost no zoological activity in the region between 1940 and 1960). The period of decline for these species is difficult to pinpoint, but Finlayson (1958) noted that the bettong *Bettongia lesueur* "diminished markedly ... before European influence had become appreciable". The decline may have been later for *Bettongia penicillata*, for which there was a large trade in the Adelaide meat markets around 1904 (Wood Jones 1924); for *Perameles bougainville*, which was reported to be plentiful from 1928 to 1936 (Brooker 1977); for *Leporillus conditor*, for which numerous active nests were recorded in 1921, and which was last reported in 1938; and for *Notomys fuscus*, which was "not uncommon" around Ooldea (Wood Jones 1925). In contrast to this assessment of substantial loss, the State of the Environment Reference Group (1998) reported only 2-3 regional extinctions for marsupial and rodent species.

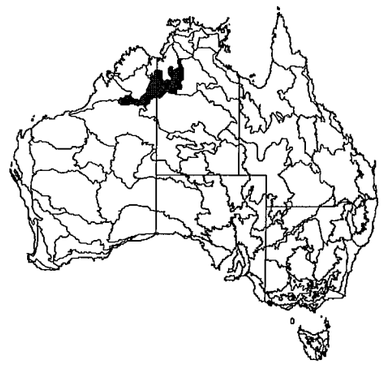
Seven introduced mammals are now well established on the Nullabor (McKenzie and Robinson 1987). The earliest records of these included house mouse *Mus musculus* in 1931, fox *Vulpes vulpes* on the southern edge of the Nullabor in 1911, but not spreading through the region until about 1930, rabbits *Oryctolagus cuniculus* in 1894, and cats *Felis catus* in 1896 (with 200 released in 1899 to attempt to control the rabbit plagues).

McKenzie and Robinson (1987) did not discuss changes in the bird, reptile or frog fauna, other than noting that the masked owl *Tyto novaehollandiae* was regionally extinct. A recent decline in the Nullabor quail-thrush *Cinclosoma cinnamomeum alisteri* was

reported by Burbidge and Pedler (1993), due to degradation of chenopod shrublands through overgrazing by rabbits, livestock, weed invasion and fire. Reid and Fleming (1992) noted that the Naretha blue bonnet *Northiella haematogaster narethae*, redthroat *Pyrrholaemus brunneus* and rufous fieldwren *Calamanthus campestris*, all species associated with chenopod shrublands, had also declined in this bioregion, almost to the point of regional extinction for the redthroat. They also considered that the chiming wedgebill *Psophodes occidentalis* was declining in the region.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

ORD-VICTORIA PLAINS



There has been no comprehensive overview of threats or trends in status of biodiversity in this bioregion, although existing information for the Northern Territory portion (=56% of the bioregion) is summarised in Connors *et al.* (1996).

Major land uses.
The bioregion is principally pastoral leasehold lands (83% of the NT portion), devoted to extensive grazing by cattle. Aboriginal freehold lands constitute a small proportion of the NT area (8%). There is a major diamond mine at Argyle. Dams on the Ord River provide water for large horticultural developments around Kununurra, at the northern edge of this bioregion. Tourism (notably to the Bungle Bungle range) is a major industry.

Conservation areas.
In the NT portion of the bioregion, conservation reserves comprise 5% of the bioregion (mostly in rocky unproductive areas) (Connors *et al.* 1996). In the Western Australian portion, conservation reserves comprise <10% of the bioregion, again with a major bias away from more fertile lowland areas. In the Western Australian portion of the bioregion, 56 (79%) of the 71 recognised vegetation types are unreserved, with a further 11 types (15%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Extensive sheet and gully erosion, and spread of undesirable plant species, has been widely reported for this bioregion (Stewart *et al.* 1970; Aldrick *et al.* 1978; Condon 1986; Winter 1990). For example, Boekel (1980a) noted that "*there is considerable evidence of environmental degradation. Erosion is widespread on the riverbanks. Introduced species such as Parkinsonia arcuata, Rubberbush, and a wide variety of burrs and prickles are widespread and completely dominate some areas, particularly along the riverbanks and watercourses ... Feral cats and donkeys are abundant.*" Degradation,

especially along the main rivers, followed rapidly from the initial establishment of pastoralism (Riddett 1990). Most of the riparian vegetation in this bioregion is rated as in "poor" condition, due to very heavy grazing pressure (Water and Rivers Commission 1997), and the rivers themselves rated as generally "degraded" (State of the Environment Reference Group 1998).

Land condition has probably gradually improved over the last few decades as stocking levels have been set more sustainably. Very high densities of feral donkeys occur over much of this bioregion, and these contribute substantially to overgrazing (Freeland and Choquenot 1990). Localised weed problems exist, including spread of buffel grass *Cenchrus ciliaris*, bellyache bush *Jatropha gossypifolia*, noogoora burr *Xanthium strumarium*, and parkinsonia *Parkinsonia aculeata* (Department of Conservation and Land Management, WA. 1999).

Fire regimes in this bioregion have changed markedly since the disruption to traditional Aboriginal management, with fewer fires in lowland grazing areas and more fires (or more hot extensive fires) in rocky areas (Craig 1999).

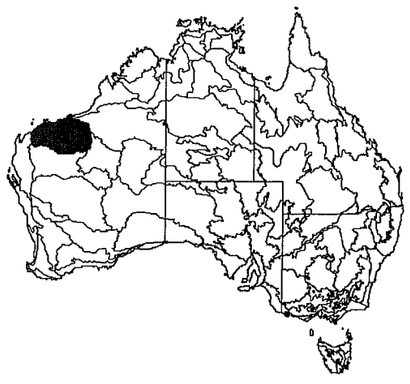
Changes in biodiversity.
Small and medium-sized mammals which appear to have become regionally extinct or appreciably less common since European contact in this bioregion include golden bandicoot, northern brown bandicoot, northern quoll, brushtailed possum and brush-tailed phascogale (Kitchener 1978; Woinarski 1992). In contrast to this assessment of substantial loss, the State of the Environment Reference Group (1998) reported only 0-1 regional extinctions for marsupial and rodent species.

Two riparian birds, the white-browed robin *Poecilodryas superciliosa* and purple-crowned fairy-wren *Malurus coronatus*, have declined along extensive stretches of major rivers (Smith and Johnstone 1977; Boekel 1979,1980*a*; Rowley 1993), although there is some evidence of at least localised recovery for both species.

There have been some extensive and substantial changes in vegetation structure in parts of the bioregion, most notably with increased occurrence of woody species in grassland areas.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

PILBARA



Major land uses.
Pastoralism (principally extensive grazing by cattle and sheep) is the dominant land uses. Mining is a major industry.

Conservation areas.
Conservation reserves comprise <5% of the bioregion area (Thackway and Cresswell 1995). 51 (59%) of the bioregion's 87 recognised vegetation types are unreserved, with a further 26 types (30%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Over-grazing has caused land degradation in parts of the bioregion (Suijendorp 1955; Ealey 1967; Newsome 1975): much of the damage was done historically when stock numbers were much higher. The most fertile and productive areas (e.g. black soil plains and river frontages) have been the most severely degraded (State of the Environment Reporting Unit 1997*b*). Van Vreeswyck *et al.* (in press) report that 0.18% of the area is in "extreme landscape deterioration, with degraded pastures and moderate or severe erosion", and 12% of the area was rated in "poor" land condition, with the highest proportion of poor condition being for land systems with moderately high or high pastoral values.

Payne *et al.* (1988) provided a detailed assessment of land condition in the south of this bioregion: they noted that vegetation types of low pastoral value (e.g. hard spinifex (*Triodia wiseana* and/or *T. lanigera*) grasslands on rugged and stony areas; hard spinifex grasslands on sandplains; mulga open woodlands/tall shrublands with short grass-forb understorey; soft spinifex (*T. pungens* and/or *T. schinzii*) grasslands) were generally in good or fair condition; mulga creekline vegetation was intensively grazed and in generally fair (but with some poor) condition, with sheet and gutter erosion in degraded

areas; stony chenopod vegetation had moderate pastoral value and condition varying from good to very poor, "with almost complete loss of desirable shrubs in the latter case"; saltbush (principally *Atriplex bunburyana*) vegetation was intensively grazed and typically in poor to extremely degraded condition (with almost complete loss of shrubs and severe deflation and scalding of the soil surface); tussock grasslands dominated by *Eragrostis* species were of moderate pastoral value and generally in fair condition, but with depletion or disappearance of the most sensitive desirable species; *Cassia* - short grass vegetation was of moderate pastoral value and generally in good condition, except for localised overgrazed areas which have suffered considerable loss of desirable shrubs; bluebush (*Maireana, Chenopodium* and *Rhagodia* spp.) shrublands were of high pastoral value and generally in fair condition (although with localised areas of quite severe erosion); vegetation now dominated by the exotic buffel grass *Cenchrus ciliaris* was of high pastoral value and generally in good or fair range condition; tussock grasslands dominated by *Chrysopogon fallax* was of high pastoral value and variable condition, with areas not subject to frequent flooding generally in fair to very poor condition (with dead *Eucalyptus coolabah* and severe surface sheeting and wind scalding resulting in bare flats which may extend 3 km).

Most of the riparian vegetation in this bioregion is rated as in "good" or "fair" condition (Water and Rivers Commission 1997).

Changed fire regimes since European settlement have led to "a rapid reduction of the area of mulga woodland as successive fires encroach further into the stands, killing the mulga and allowing invasion by communities dominated by spinifex" (Start 1986).

Introduced predators (foxes and cats) are widespread, including on some of the offshore islands (Morton *et al.* 1995). Feral donkeys, camels and goats have contributed to land degradation (State of the Environment Reporting Unit 1997*b*). Weeds present include buffel grass *Cenchrus ciliaris* and salvinia *Salvinia molesta* (Department of Conservation and Land Management, WA. 1999).

Changes in biodiversity.
The State of the Environment Reference Group (1998) reported regional extinctions for 4-5 marsupial and rodent species. Several mammal species (such as burrowing bettong *Bettongia lesueur* and golden bandicoot *Isoodon auratus*) which have disappeared from all or almost all of the mainland part of this bioregion still persist on offshore islands (notably Barrow Island) (Burbidge 1989). There is some evidence of ongoing decline in medium-sized mammals which have persisted on the mainland, such as the northern quoll *Dasyurus hallucatus*, mulgara *Dasycercus cristicauda* and bilby *Macrotis lagotis* (Dunlop and Sawle 1983).

There have been major increases in the abundance of some large macropods, notably the Euro *Macropus robustus*, due to proliferation of artificial water sources, and environmental changes associated with livestock grazing (Ealey 1967; Newsome 1975).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

PINE – CREEK ARNHEM

There has been no comprehensive overview of threats or trends in status of biodiversity in this bioregion, although existing information is summarised in Connors *et al.* (1996).

Major land uses.
This bioregion comprises a relatively broad mix of land uses. Pastoral leaseholds comprise 22% of the bioregion, Aboriginal freehold lands 39%, conservation reserves 31% (most of which is leased back from Aboriginal lands), and "other" (including rural freehold blocks around Darwin and horticultural areas) 9%. There are several large mining ventures (mostly for uranium and gold) in the bioregion. Tourism (particularly to Kakadu and Litchfield NPs and to smaller reserves in the Darwin-Kakadu area) is a major industry. There are large and rapidly expanding areas of horticultural production, principally for mangoes, rambutans, and grain sorghum. Many of the pastoral enterprises include grazing on improved exotic pastures.

Conservation areas.
This bioregion includes most of the large Kakadu and Nitmiluk NPs, part of Litchfield NP, and many smaller reserves, with a total area comprising 31% of the bioregion.

Condition and threats.
Russell-Smith and Bowman (1992) reported that monsoon rainforests in this bioregion were being degraded by inappropriate fire regimes, weeds, and feral animals. Inappropriate fire regimes (principally extensive late dry season fires) are also now reducing the floristic diversity of heathland vegetation in sandstone plateau and escarpment areas (Russell-Smith *et al.* 1998) and hence the abundance and distribution of the fauna associated with these, including the Leichhardt Grasshopper *Petasida ephippigera* (Lowe 1995).

A range of weed species is common across much of the bioregion, although probably no single species is having an especially major effect. Several grass and other pasture

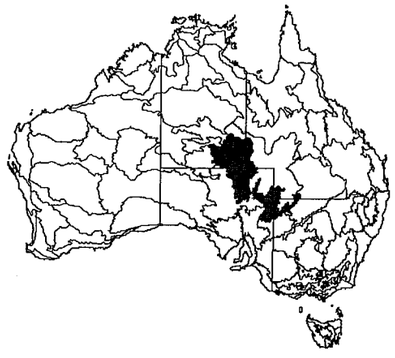
species introduced to support more intensive pastoralism have spread widely through the bioregion. Feral animals (principally pigs, cattle and water buffalo) are widespread. There may be localised and off-site impacts of mining. Some sites are also exposed to highly intensive tourism pressures.

Changes in biodiversity.
There is little baseline information published for this bioregion, which renders extremely difficult any assessment of biodiversity change. At least several larger rodents (e.g. brush-tailed rabbit-rat *Conilurus penicillatus*) and small to medium sized dasyurids (e.g. northern quoll *Dasyurus hallucatus* and brush-tailed phascogale *Phascogale tapoatafa*) have declined over the last century (Woinarski *in press*), but the timing and extent of this decline is difficult to define.

Obligate re-seeder woody plant species are suffering major declines in sandstone heathlands because of recent changes in fire regimes (Russell-Smith *et al.* 1998).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996), however the Northern Cypress-Pine *Callitris intratropica*, a dominant or subdominant tree across much of this bioregion, has suffered (and is continuing to suffer) catastrophic population crashes in the many areas where traditional Aboriginal fire regimes have been changed recently (Bowman and Panton 1993; Price and Bowman 1994). This change is unusually obvious for this species (because dead trees remain evident), but comparable changes may have occurred for many less conspicuous plant species.

SIMPSON – STRZELECKI DUNEFIELDS



This bioregion extends across four jurisdictions. Information on its biodiversity and condition is summarised in Tyler *et al.* (1990) for the South Australia portion, Gibson and Cole (1988) for the Northern Territory portion, and Sattler and Williams (1999) for the Queensland portion (within the discussion there of Channel Country bioregion).

Major land uses.
Pastoralism (extensive grazing by sheep and cattle) is the dominant land use (e.g. occupying 30% of the Northern Territory portion: Connors *et al.* 1996). There are some extensive areas of Aboriginal lands (28% of the Northern Territory portion).

Conservation areas.
A relatively high proportion of this bioregion is reserved, including 29% of the Queensland portion (of 34,347km^2), 53% (including regional reserves) of the 116,580 km^2 in South Australia, 6% of the 21,000 km^2 in New South Wales, but only 0.03% of the 106,000 km^2 in the Northern Territory (Thackway and Cresswell 1995; Connors *et al.* 1996; Sattler and Williams 1999; Benson 1999).

Condition and threats.
Pech and Graetz (1982) recorded that rabbits were "devastating" parts of the desert areas in this bioregion. For the Queensland portion of the bioregion, Sattler and Williams (1999) also noted that grazing by feral animals, particularly rabbits but also camels, pigs and goats was widespread, with impact particularly on waterholes. They also noted other major threats were feral predators (foxes and cats), changed fire regimes and mining (with localised impacts).

In the Northern Territory portion of the bioregion, Gibson and Cole (1988) noted that major management problems were fire, feral animals and erosion.

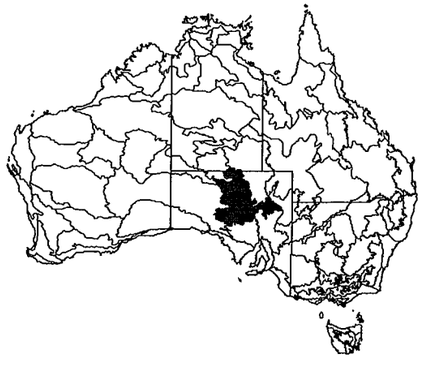
Boyland (1984) discussed weed occurrence in the Queensland portion of the bioregion, and noted that the most significant weed infestations involved *Acacia farnesiana*, parkinsonia *Parkinsonia aculeata*, bathurst burr *Xanthium spinosum*, noogoora burr *X. strumarium*, buffel grass *Cenchrus ciliaris* and feathertop rhodes grass *Chloris virgata*.

Changes in biodiversity.
A relatively high number of threatened plants and animals persist in this bioregion, albeit generally with declining range or abundance (Sattler and Williams 1999).

Of around 36 species of native terrestrial mammals present in the Simpson Desert at the time of European colonisation, ten are probably now regionally extinct (including western quoll *Dasyurus geoffroii*, golden bandicoot *Isoodon auratus*, pig-footed bandicoot *Chaeropus ecaudatus*, lesser bilby *Macrotis leucura*, desert rat-kangaroo *Caloprymnus campestris*, burrowing bettong *Bettongia lesueur*, spectacled hare-wallaby *Lagorchestes conspicillatus*, crescent nailtail wallaby *Onychogalea lunata*, lesser stick-nest rat *Leporillus apicalis* and short-tailed hopping-mouse *Notomys amplus*), and six others are presumed to have declined substantially (including kowari *Dasycercus byrnei*, ampurta *Dasycercus hillieri*, bilby *Macrotis lagotis,* plains rat *Pseudomys australis*, fawn hopping-mouse *Notomys cervinus* and dusky hopping-mouse *N. fuscus*) (Finlayson 1961; Watts and Aslin 1974; Gibson and Cole 1988; Kemper 1990; Carr and Robinson 1997; Brandle *et al.* 1999; Moseby *et al.* 1999; Robinson *et al.* in press). The ghost bat *Macroderma gigas* and night parrot *Pezoporus occidentalis* may also be regionally extinct (Churchill and Helman 1990; McFarland 1992). Populations of larger macropods have increased, especially where artificial water sources have been established (Benson 1999).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

STONY PLAINS



Major land uses.
Pastoralism (mostly extensive grazing by sheep) is the dominant industry. Mining is also important.

Conservation areas.
Around 5.2% of the bioregion is included within conservation reserves (Thackway and Cresswell 1995; Connors *et al.* 1996), although this represents a highly biased sample of environments present.

Condition and threats.
There are substantial areas of land degradation due to overgrazing by livestock and rabbits (Wilcox and Cunningham 1994). A high proportion of plants, birds and ants show a distinct increaser or decreaser response to grazing pressure (James *et al.* in press).

Mound springs may be under particular threat, from degradation due to grazing, extraction of artesian waters, weed invasion and recreational use (Zeidler and Ponder 1989).

Changes in biodiversity.
Of around 36 species of native terrestrial mammals present in the bioregion at the time of European colonisation, ten are probably now regionally extinct (including western quoll *Dasyurus geoffroii*, golden bandicoot *Isoodon auratus*, pig-footed bandicoot *Chaeropus ecaudatus*, lesser bilby *Macrotis leucura*, desert rat-kangaroo *Caloprymnus campestris*, burrowing bettong *Bettongia lesueur*, crescent nailtail wallaby *Onychogalea lunata*, lesser stick-nest rat *Leporillus apicalis*, greater stick-nest rat *L. conditor* and short-tailed hopping-mouse *Notomys amplus*), and six others are presumed to have declined substantially (including kowari *Dasycercus byrnei*, ampurta *Dasycercus hillieri*, bilby

Macrotis lagotis, plains rat *Pseudomys australis*, fawn hopping-mouse *Notomys cervinus* and dusky hopping-mouse *N. fuscus*) (Finlayson 1961; Watts and Aslin 1974; Kemper 1990; Southgate 1990; Carr and Robinson 1997; Brandle *et al.* 1999; Moseby *et al.* 1999; Robinson *et al.* in press).

Comparison of recent bird records with those reported between 1873 and 1945 suggest that Australian bustard *Ardeotis australis* and bush stone-curlew *Burhinus grallarius* have definitely declined; and chestnut quail-thrush *Cinclosoma castanotus*, scarlet-chested parrot *Neophema splendida* and redthroat *Pyrrholaemus brunneus* have probably declined (Storr 1977; Close and Jaensch 1984; Reid and Fleming 1992). In contrast, there have been increases for at least black kite *Milvus migrans*, crested pigeon *Ocyphaps lophotes*, galah *Cacatua roseicapilla*, magpie-lark *Grallina cyanoleuca*, magpie *Gymnorhina tibicen*, common bronzewing *Phaps chalcoptera* and grey butcherbird *Cracticus torquatus* (Close and Jaensch 1984; Reid and Fleming 1992). These changes were attributed to "*grazing by sheep and cattle, the spread of modern (as distinct from aboriginal) settlements, hunting with firearms, and the trapping of parrots*" (Close and Jaensch 1984).

The bronzeback legless lizard *Ophidocephalus taeniatus* has declined in parts of its limited range, possibly due to decrease in ground litter because of grazing (Ehmann 1992).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

STURT PLATEAU

There has been no comprehensive overview of threats or trends in status of biodiversity in this bioregion, although existing information is summarised in Connors *et al.* (1996), and a comprehensive review of the bioregion's biodiversity status and threatening processes is now underway (A. Fisher, PWCNT).

Major land uses.
This bioregion consists primarily of pastoral leasehold land, devoted to extensive cattle grazing on native pastures (76% of the bioregion), with a large extent (19%) of Aboriginal freehold land, mainly in the arid southwest of the bioregion. The bioregion is sparsely settled. Pastoral productivity is notably far less than that of the mitchell grasslands to the immediate southeast.

Conservation areas.
Only a small part of one small conservation reserve on the far northern edge of this bioregion is the only reserved area, providing a total reserved extent of <0.1% of the bioregion.

Condition and threats.
Changed fire regimes may be altering the relative extent of different vegetation types (notably disadvantaging Lancewood *Acacia shirleyi* woodlands: Woinarski and Fisher 1995), and the structural and floristic composition across a range of environments.

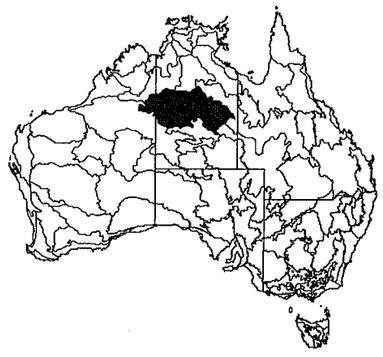
The northern boundary of the distribution of the fox occurs in this bioregion, and fox-free areas here may coincide with locations of relative security for populations of bilby and other threatened mammals (R. Southgate *pers. comm.*). Feral cats are widespread.

A broad range of weed species is present in the bioregion, most notably including Parkinsonia *Parkinsonia aculeata*, Noogoora Burr *Xanthium strumarium*, Bellyache Bush *Jatropha gossypifolia*, and Calotrope *Calotropis procera*. The introduction of a range of improved pasture grasses is being undertaken to provide for proposed increased stocking densities.

Changes in biodiversity.
There is only a very limited historical record for the biodiversity of the region. However, the little information available suggests the loss of, at least, western quoll *Dasyurus geoffroii*, brushtail possum *Trichosurus vulpecula*, golden-backed tree-rat *Mesembriomys macrurus* and golden bandicoot *Isoodon auratus* (Parker 1973; Burbidge *et al.* 1990). Several mammals (notably bilby and spectacled hare-wallaby *Lagorchestes conspicillatus*) which have declined precipitously, or are now regionally extinct, in more arid regions to the immediate south have persisted in this bioregion.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

TANAMI



Connors *et al.* (1996) provides an overview of biodiversity information and threats for the Northern Territory portion of this bioregion (=92% of its extent). Gibson (1986) provides a focused study of faunal biodiversity for most of the bioregion.

Major land uses.
The bioregion mostly comprises Aboriginal freehold land (64% of the NT portion), with smaller areas of pastoral leasehold around the margins of the Tanami Desert proper. There are large mining ventures (mostly for gold), including at Tanami and Tennant Creek.

Conservation areas.
Conservation reserves comprise less than 0.5% of the bioregion (Connors *et al.* 1996). In the (small) Western Australian portion of the bioregion, 16 (70%) of the 23 recognised vegetation types are unreserved, with a further six types (26%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
The fire regime has changed from the intricate mosaic associated with Aboriginal land management to one of less frequent but more extensive and destructive fires (Bolton and Latz 1978; Lundie-Jenkins 1993).

Feral cats and foxes are abundant across the bioregion, and are a major threat to, at least, small and medium-sized mammals (Lundie-Jenkins *et al.* 1993; Gibson *et al.* 1994; Paltridge 1998). Cats were present in the area prior to at least 1900, and foxes from around 1950. (Gibson 1986).

Rabbits entered the region around 1910, camels after 1928, goats after 1946, donkeys after 1930, and horses around 1940s. Camels remain relatively common, but goats, donkeys, horses and rabbits are either uncommon or localised (Gibson 1986; Morton *et al.* 1995). House mice are abundant and widespread.

Connors *et al.* (1996) recorded 21 weed species present in the bioregion, including buffel grass *Cenchrus ciliaris*, couch grass *Cynodon dactylon*, bellyache bush *Jatropha gossypifolia*, calotrope *Calotropis procera*, parkinsonia *Parkinsonia aculeata*, and noogoora burr *Xanthium strumarium*.

Changes in biodiversity.
There has been a substantial rate of regional extinction of small and medium-sized mammals, including western quoll *Dasyurus geoffroii*, golden bandicoot *Isoodon auratus*, desert bandicoot *Perameles eremiana*, pig-footed bandicoot *Chaeropus ecaudatus*, brush-tailed bettong *Bettongia penicillata*, burrowing bettong *Bettongia lesueur*, mala *Lagorchestes hirsutus*, central hare-wallaby *L. asomatus*, central rock-rat *Zyzomys pedunculatus*, long-tailed hopping-mouse *Notomys longicaudatus* and short-tailed hopping-mouse *N. amplus* (Gibson 1986; Burbidge *et al.* 1988), with probably ongoing decline for other species including greater bilby *Macrotis lagotis*, common brushtail possum *Trichosurus vulpecula*, black-footed rock-wallaby *Petrogale lateralis* (Gibson 1986; Burbidge *et al.* 1988).

The night parrot *Pezoporus occidentalis* may be extinct in this region, and the princess parrot *Polytelis alexandrae* has declined in the region (Gibson 1986; Blyth and Burbidge 1997).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

TOP END COASTAL

There has been no comprehensive overview of threats or trends in status of biodiversity in this bioregion, although existing information is summarised in Connors *et al.* (1996).

Major land uses.
Most (76%) of this bioregion is Aboriginal freehold land. Pastoral leaseholds (mostly for extensive grazing by cattle and, less so, water buffalo) occupy 8% of the area. There are significant horticultural enterprises (mostly fruit trees). This bioregion includes the city of Darwin, whose population makes up about one-sixth of the total population of Australia's rangelands.

Conservation areas.
Conservation reserves constitute 16% of the bioregion.

Condition and threats.
Clearing for urban expansion and horticultural development is a major threat in the Darwin hinterland. There have been extensive plantings of introduced pasture grasses in parts of the region, with rapid and deliberate or accidental spread of the environmental weeds mission grass *Pennisetum polystachion*, gamba grass *Andropogon gayanus* and para grass *Brachiaria mutica* (Whitehead *et al.* 1990; Fensham and Cowie 1998; Whitehead 1999). The high fuel loads associated with these species leads to more severe fires, and their usurpation of some environments may disadvantage both native understorey species and animals which are intimately associated with particular native plants (Whitehead 1999). The exotic woody shrub *Mimosa pigra* has invaded much of the floodplain areas, leading to (at least) pronounced structural changes in this environment (Lonsdale 1993; Cook *et al.* 1996). A major pulp plantation scheme is proposed for the Tiwi Islands, which will require the clearing of at least 30,000 ha of native forest (First Management Corporation 1999).

The floodplain environments are threatened by saltwater intrusion, which may cause extensive alteration of these environments from grasslands/sedgelands and *Melaleuca* swamps to saline flats and mangroves (Whitehead 1999).

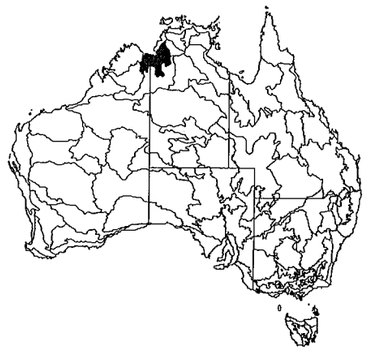
A number of feral animals are widespread, including cats, water buffalo, pigs, and cattle (Letts *et al.* 1979; Bayliss and Yeomans 1989; Freeland 1990). The buffalo, pigs and cattle are causing widespread damage to, at least, monsoon rainforest patches (Russell-Smith and Bowman 1992), and to some fauna (Friend and Taylor 1984).

Changes in fire regime have led to degradation of monsoon rainforests (Russell-Smith and Bowman 1992), and have probably changed the floristics and structure of eucalypt forests (Fensham 1990; Bowman and Panton 1995).

Changes in biodiversity.
In contrast to most other rangeland bioregions, no species is known to have suffered regional extinction in the Top End Coastal bioregion, and indeed many species which have declined elsewhere continue to be abundant here (Frith and Calaby 1974). However, the brush-tailed rabbit-rat *Conilurus penicillatus* has declined (Woinarski *in press*), and there is some evidence also for decline in the brush-tailed phascogale *Phascogale tapoatafa*, golden-backed tree-rat *Mesembriomys macrurus*, northern quoll *Dasyurus hallucatus*, pale field-rat *Rattus tunneyi* and golden bandicoot *Isoodon auratus*.

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

VICTORIA BONAPARTE



Major land uses.
Pastoralism (extensive grazing by cattle) is the dominant land use (occupying 59% of the Northern Territory portion of this bioregion), but there are also large areas devoted to horticulture (the Ord Irrigation Scheme) and military training (notably on Bradshaw station), and 19% of the Northern Territory portion is Aboriginal land (Connors *et al.* 1996). Tourism is a major industry.

Conservation areas.
Conservation reserves comprise 13% of the Northern Territory portion and <10% of the Western Australian portions of this bioregion (Thackway and Cresswell 1995; Connors *et al.* 1996). In the Western Australian portion of the bioregion, 12 (38%) of the 32 recognised vegetation types are unreserved, with a further 15 types (47%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Extensive sheet and gully erosion, and spread of undesirable plant species, has been reported for parts of this bioregion (Stewart *et al.* 1970; Aldrick *et al.* 1978; Condon 1986; Winter 1990). Degradation, especially along the main rivers, followed rapidly from the initial establishment of pastoralism (Riddett 1990); land condition has probably gradually improved over the last few decades as stocking levels have been set more sustainably. High densities of feral donkeys occur over parts of this bioregion, and these contribute substantially to overgrazing (Freeland and Choquenot 1990). Major localised weed problems exist, including buffel grass *Cenchrus ciliaris*, bellyache bush *Jatropha gossypifolia*, noogoora burr *Xanthium strumarium*, parkinsonia *Parkinsonia aculeata*, calotrope *Calotropis procera*, para grass *Urochloa mutica* and johnson grass *Sorghum halapense*.

Fire regimes have changed over most areas since the disruption to traditional Aboriginal management, with generally fewer but more extensive and hotter fires (O'Neill *et al.* 1993), with more substantial environmental consequences. The current fire regime has particularly affected fire-sensitive plant species and communities in sandstone ranges (Bowman 1997).

Horticultural development associated with the Ord River Irrigation Scheme has had major impacts upon biodiversity. These include permanent inundation of 74,000 ha for Lake Argyle and 2,500 ha for Lake Kununurra (Lane and Lynch 1996), substantially altered flow regimes and water quality for the Ord River downstream of these dams, and clearing for horticulture of 14,000 ha of native vegetation. A proposed expansion of this scheme to the lower Keep River watershed will involve clearing of an additional 32,000 ha, and further expansion beyond this is envisaged. The biota of black soil plains has been particularly affected, although a small proportion of species has benefitted from the development of horticulture (Kinhill 2000). There is a high use of pesticides associated with horticultural development, and some reported cases of high mortalities of non-target wildlife species (Kinhill 2000).

Changes in biodiversity.
Small and medium-sized mammals which appear to have become regionally extinct or appreciably less common since European contact in this bioregion include golden bandicoot, northern brown bandicoot, northern quoll, brushtailed possum and brush-tailed phascogale (Kitchener 1978).

Two riparian birds, the white-browed robin *Poecilodryas superciliosa* and purple-crowned fairy-wren *Malurus coronatus*, have declined along extensive stretches of major rivers (Smith and Johnstone 1977; Boekel 1979,1980*a*; Rowley 1993), although there is some evidence of at least localised recovery for both species.

There have been some extensive changes in vegetation structure across parts of the pastoral areas in the bioregion, most notably with increased occurrence of woody species in grassland areas. Developments associated with the Ord River Irrigation Scheme have been generally disadvantageous to the biota of blacksoil plains, but have benefitted some aquatic and riparian species (e.g. cumbungi *Typha domingensis*, Eurasian coot *Fulica atra*, hardhead *Aythya australis*, pied cormorant *Phalacrocorax varius*: Lane and Lynch 1996), and sugar cane plantations have favoured some species associated with either tall rank grass (e.g. star finch *Neochmia ruficauda*) or open areas (Australian bustard *Ardeotis australis*).

This bioregion is not known to have contained any presumed extinct plant species (Briggs and Leigh 1996).

YALGOO

Major land uses.
Pastoralism (principally extensive grazing by sheep) is the predominant land use, with a history extending back to the 1860s (Payne *et al.* 1998). Gold mining and sandalwood harvesting have been important historically, and some agricultural diversification (including stone fruit orchards) is developing (Payne *et al.* 1998).

Conservation areas.
Less than 1% is reserved, with only one significant reserve at the eastern end of the bioregion (Thackway and Cresswell 19995). 31 (48%) of the bioregion's 64 recognised vegetation types are unreserved, with a further 26 types (41%) represented by <10% of their area (Hopkins *et al.* 1996).

Condition and threats.
Payne *et al.* (1998) reported that 0.2% of the area was "severely degraded and eroded" (with this percentage increasing to 22% for some land systems); and that 23% of sites sampled had perennial vegetation in "poor or very poor condition", with the most frequently observed impacts of pastoralism being loss of perennial species richness and plant density, with decrease in cover also pronounced for the most susceptible vegetation type, chenopod shrublands.

Weed problems include generally localised infestations of Victorian tea-tree *Leptospermum laevigatum*, saffron thistle *Carthamus lanatus* and patersons curse *Echium plantagineum* and gorteria *Gorteria personata* (Payne *et al.* 1998; Department of Conservation and Land Management, WA. 1999). Feral goats, foxes and feral cats are abundant throughout the bioregion, and rabbits are generally uncommon (Payne *et al.* 1998). The extensive spread of the introduced buffel grass *Cenchrus ciliaris* was recognised by Payne *et al.* (1998) as a threat to native vegetation.

Changes in biodiversity.

Payne *et al.* (1998) considered that 11 or 12 native mammal species had become extinct in this bioregion (although their study area included also more arid areas to the immediate northeast). These losses include mulgara *Dasycercus cristicauda*, red-tailed phascogale *Phascogale calura*, pig-footed bandicoot *Chaeropus ecaudatus*, western barred bandicoot *Perameles bougainville*, greater stick-nest rat *Leporillus conditor*, lesser stick-nest rat *L. apicalis*, short-tailed hopping-mouse *Notomys amplus*, desert mouse *Pseudomys desertor* and shark bay mouse *P. fieldii*. Counterpoised to these losses, large macropods have become increasingly abundant, largely because of greater access to water and control of dingos (Payne *et al.* 1998).

Bird species which are thought to have decreased in this area include mallee fowl *Leipoa ocellata*, chiming wedgebill *Psophodes occidentalis*, rufous fieldwren *Calamanthus campestris*, thick-billed grass-wren *Amytornis textilis* and white-winged fairy-wren *Malurus leucopterus* (Payne *et al.* 1998).

No plant species is known to have disappeared from the bioregion, although Payne *et al.* (1998) noted that the distribution of highly palatable species such as *Maireana platycarpa* has been reduced, and that recruitment of trees such as *Santalum spicatum* and *Acacia papyrocarpa* has been substantially reduced because of grazing pressure on seedlings and juveniles.

One plant species is presumed extinct from this bioregion (Briggs and Leigh 1996).

Appendix B.

Collation of results of plant species responses from grazing studies in Australian rangelands.

Not all of the results tabulated here were tested statistically in the citation listed.
Lifeform categories: AG Annual grasses, AH Annual herbs, PG Perennial grasses, PH Perennial forbs, S shrubs, T trees.

Broad Habitat	State	Family	Species	Lifeform	INC/DEC	Reference
Chenopod/ Acacia shrubland	NSW	Mimosaceae	*Acacia aneura*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Mimosaceae	*Acacia brachystachya*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Mimosaceae	*Acacia victoriae*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Sterculiaceae	*Brachychiton populneus*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Myoporaceae	*Eremophila bowmanii latifolia*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Myoporaceae	*Eremophila sturtii*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Myrtaceae	*Eucalyptus opaca*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Myrtaceae	*Eucalyptus terminalis*	T	DEC	Landsberg et al. (1997) NSW and Qld
Chenopod/ Acacia shrubland	NSW	Proteaceae	*Hakea ivoryi*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Santalaceae	*Santalum lanceolatum*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Caesalpiniaceae	*Senna artemisioides artemisioides*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	NSW	Caesalpiniaceae	*Senna artemisioides sturtii*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Mimosaceae	*Acacia aneura*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Apocynaceae	*Alstonia constricta*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Rubiaceae	*Canthium latifolium*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Sapindaceae	*Dodonaea petiolaris*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Myoporaceae	*Eremophila longifolia*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Myrtaceae	*Eucalyptus populnea*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Myrtaceae	*Eucalyptus thozetiana*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Proteaceae	*Grevillea striata*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Proteaceae	*Hakea leucoptera*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Meliaceae	*Owenia acidula*	T	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	Qld	Caesalpiniaceae	*Senna artemisioides aff. sturtii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Caesalpiniaceae	*Senna artemisioides artemisioides*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Caesalpiniaceae	*Senna artemisioides oligophylla*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	**Schismus barbatus*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	**Sonchus oleraceus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	*Abutilon halophilum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Portulacaceae	*Anacampseros australiana*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Atriplex cf. macropterocarpa*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Atriplex spongiosa*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Atriplex vesicaria*	S	INC	Landsberg et al. (1997) SA and Wa
Chenopod/ Acacia shrubland	SA	Nyctaginaceae	*Boerhavia coccinea*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Brachycome lineariloba*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Calotis hispidula*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Gentianaceae	*Centaurium spicatum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Convolvulaceae	*Convolvulus erubescens*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Apiaceae	*Daucus glochidiatus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Dissocarpus biflorus*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Dissocarpus paradoxus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Eriochlamys behrii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Geraniaceae	*Erodium crinitum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Geraniaceae	*Erodium cygnorum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Euphorbiaceae	*Euphorbia eremophila*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Frankeniaceae	*Frankenia cordata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Frankeniaceae	*Frankenia plicata*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Gnephosis arachnoidea*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Iseilema membranaceum*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Brassicaceae	*Lepidium muelleri-ferdinandii*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Brassicaceae	*Lepidium phlebopetalum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Fabaceae	*Lotus cruentus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Maireana appressa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Minuria cunninghamii*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Minuria denticulata*	PH	INC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	SA	Molluginaceae	*Mollugo cerviana*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Solanaceae	*Nicotiana velutina*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Osteocarpum dipterocarpum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Plantaginaceae	*Plantago turrifera*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Podolepis davisiana*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Fabaceae	*Psoralea cinerea*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Rhodanthe corymbiflora*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Rhodanthe floribunda*	AH	DEC	Landsberg et al. (1997) SA and WA
Chenopod/ Acacia shrubland	SA	Asteraceae	*Rhodanthe stricta*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Salsola kali*	AH	DEC	Landsberg et al. (1997)SA and Wa
Chenopod/ Acacia shrubland	SA	Asteraceae	*Schoenia ayersii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena brachyptera*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena cuneata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena decurrens*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena diacantha*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena eriacantha*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena ventricosa*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerostegia medullosa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	*Sida fibulifera*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Solanaceae	*Solanum quadriloculatum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Sporobolus actinocladus*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Sporobolus caroli*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Brassicaceae	*Stenopetalum lineare*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Stipa scabra*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Anthericaceae	*Thysanotus baueri*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Vittadinia eremaea*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Vittadinia pterochaeta*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Zygophyllaceae	*Zygophyllum simile*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Brassicaceae	**Carrichtera annua*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	**Centaurea ?solstitialis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	**Centaurea melitensis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	**Centaurea sp63*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	**Critesion murinum*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	**Medicago sp66*	AH	INC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	WA	Aizoaceae	**Mesembryanthemum ?aitonis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	**Sonchus oleraceus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Mimosaceae	*Acacia ramulosa*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Mimosaceae	*Acacia sclerosperma*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Mimosaceae	*Acacia tetragonophylla*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Mimosaceae	*Acacia victoriae*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Mimosaceae	*Acacia xiphophylla*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Sapindaceae	*Alectryon oleifolius*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Angianthus conocephalus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex acutibractea*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex bunburyana*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex semilunaris*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Brachycome ciliaris*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Chenopodium gaudichaudianum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Nyctaginaceae	*Commicarpus australis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Enchylaena tomentosa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Myoporaceae	*Eremophila forrestii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Myoporaceae	*Eremophila maitlandi*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Myoporaceae	*Eremophila strongylophylla*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Frankeniaceae	*Frankenia pauciflora*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Proteaceae	*Hakea preissii*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Halosarcia indica leiostachya*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Hibiscus sturtii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Oleaceae	*Jasminum calcareum*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana carnosa*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana platycarpa*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana polypterygia*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana turbinata*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Solanaceae	*Nicotiana occidentalis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Thymelaeaceae	*Pimelea microcephala*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Plantaginaceae	*Plantago cunninghamii*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Plantaginaceae	*Plantago turrifera*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Podolepis rugata*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus murrayi*	S	INC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus obovatus*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus polystachyus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Rhagodia eremaea*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Rhodanthe stricta*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Santalaceae	*Santalum acuminatum*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Goodeniaceae	*Scaevola spinescens*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena ?patenticuspis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena patenticuspis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena recurvicuspis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Caesalpiniaceae	*Senna artemisioides helmsii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Caesalpiniaceae	*Senna artemisioides sturtii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Caesalpiniaceae	*Senna sp115*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Sida calyxhymenia*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Sida spodochroma*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Solanaceae	*Solanum lasiophyllum*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Solanaceae	*Solanum orbiculatum orbiculatum*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Stipa sp36*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Stipa sp70*	PG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Swainsona sp61*	Forb	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Convolvulaceae	*unidentified sp135*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Vittadinia nullarborensis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Vittadinia sp30*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Zygophyllaceae	*Zygophyllum eremaea*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asphodelaceae	**Asphodelus fistulosus*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	**Cenchrus ciliaris*	PG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	**Chloris virgata*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	**Rostraria pumila*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Abutilon otocarpum*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Mimosaceae	*Acacia sclerosperma*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Amaranthus mitchellii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Angianthus acrohyalinus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Aristida contorta*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex bunburyana*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex codonocarpa*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex holocarpa*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex semilunaris*	PH	INC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Atriplex vesicaria*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Brachycome oncocarpa*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Portulacaceae	*Calandrinia eremaea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Portulacaceae	*Calandrinia pumila*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Calotis hispidula*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Calotis multicaulis*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Euphorbiaceae	*Chamaesyce drummondii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Chenopodium eremaea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Chenopodium gaudichaudianum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Chenopodium melanocarpum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Nyctaginaceae	*Commicarpus australis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Convolvulaceae	*Convolvulus erubescens*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Tiliaceae	*Corchorus parviflorus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Tiliaceae	*Corchorus sidoides*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Crassulaceae	*Crassula colorata*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Convolvulaceae	*Cuscata planiflora*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Dactyloctenium radulans*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Apiaceae	*Daucus glochidiatus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Enchylaena tomentosa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Enteropogon acicularis*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Eragrostis dielsii*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Eragrostis eriopoda*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Eragrostis falcata*	PG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Eragrostis lanipes*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Eragrostis sp154*	Grass	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Myoporaceae	*Eremophila maitlandi*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Eriachne helmsii*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Geraniaceae	*Erodium crinitum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Euphorbiaceae	*Euphorbia boopthana*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Cyperaceae	*Fimbristylis sp070*	Forb	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Frankeniaceae	*Frankenia pauciflora*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Glycine clandestina*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Gnephosis brevifolia*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Gnephosis gynotricha*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Goodeniaceae	*Goodenia ?berardiana*	AH	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	WA	Goodeniaceae	*Goodenia ?filiformis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Boraginaceae	*Heliotropium asperrimum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Indigofera georgei*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Oleaceae	*Jasminum calcareum*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Lawrencia densiflora*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Brassicaceae	*Lepidium ?rotundum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Campanulaceae	*Lobelia heterophylla*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana carnosa*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana lanosa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Maireana platycarpa*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asclepiadaceae	*Marsdenia australis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Solanaceae	*Nicotiana occidentalis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Othonna gregorii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Paractaenum novae-hollandiae*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Pogonolepis stricta*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Psammagrostis wiseana*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus ?villosiflorus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus gaudichaudii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus obovatus*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Amaranthaceae	*Ptilotus polystachyus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Rhodanthe maryonii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asclepiadaceae	*Rhyncharrhena linearis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Salsola kali*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Schoenia ayersii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Schoenia filifolia filifolia*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena cf. diacantha*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena eurotioides*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena gardneri*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena recurvicuspis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena stylosa*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Chenopodiaceae	*Sclerolaena tridens*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Senecio glossanthus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Caesalpiniaceae	*Senna artemisioides sturtii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Sida calyxhymenia*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Sida kingii*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Malvaceae	*Sida sp138*	PH	INC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	WA	Malvaceae	*Sida sp142*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Solanaceae	*Solanum lasiophyllum*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Brassicaceae	*Stenopetalum anfractum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Streptoglossa cylindriceps*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Swainsona ?microphylla*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Swainsona oliveri*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Swainsona pterostylis*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Fabaceae	*Swainsona sp071*	Forb	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Aizoaceae	*Tetragonia eremaea*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Tragus australianus*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Zygophyllaceae	*Tribulus ?terrestris*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Juncaginaceae	*Triglochin calcitrapum*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Poaceae	*Triraphis mollis*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Asteraceae	*Waitzia citrina*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	WA	Zygophyllaceae	*Zygophyllum eremaea*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Brassicaceae	**Carrichtera annua*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	**Carthamus lanatus*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Polygonaceae	**Emex australis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	**Malva parviflora*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	**Schismus barbatus*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Brassicaceae	**Sisymbrium erysimoides*	AG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	**Sonchus oleraceus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Mimosaceae	*Acacia aneura*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Mimosaceae	*Acacia burkittii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Mimosaceae	*Acacia oswaldii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Mimosaceae	*Acacia ramulosa*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Casuarinaceae	*Allocasuarina helmsii*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Aristida contorta*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Atriplex vesicaria*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Brachycome ciliaris*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Portulacaceae	*Calandrinia sp+10*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Calotis hispidula*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Centipeda minima*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Chenopodium cristatum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Chenopodium melanocarpum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Chthonocephalus pseudevax*	AH	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	SA	Convolvulaceae	*Convolvulus erubescens*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Convolvulaceae	*Convolvulus remotus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Danthonia caespitosa*	PG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Apiaceae	*Daucus glochidiatus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Dissocarpus biflorus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Dissocarpus paradoxus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Sapindaceae	*Dodonaea viscosa angustissima*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Enneapogon avenaceus*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Enneapogon cylindricus*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Enneapogon polyphyllus*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Eragrostis dielsii*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Geraniaceae	*Erodium crinitum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Geraniaceae	*Erodium cygnorum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Euphorbiaceae	*Euphorbia eremophila*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Santalaceae	*Exocarpos sparteus*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Gnephosis arachnoidea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Gnephosis tenuissima*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Goodeniaceae	*Goodenia cycloptera*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	*Hibiscus sp+47*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	*Hibiscus sp+47*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Brassicaceae	*Lepidium phlebopetalum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Loranthaceae	*Lysiana murrayi*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Maireana astrotricha*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Maireana integra*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Maireana sclerolaenoides*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Maireana sedifolia*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Malacocera tricornis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Myriocephalus stuartii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Boraginaceae	*Omphalolappula concava*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Thymelaeaceae	*Pimelea microcephala*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Amaranthaceae	*Ptilotus obovatus*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Pycnosorus pleiocephalus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Rhodanthe floribunda*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Rhodanthe pygmaea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Santalaceae	*Santalum spicatum*	T	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Schoenia ramosissima*	AH	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	SA	Chenopodiaceae	*Sclerolaena decurrens*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Senecio lautus dissectifolius*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	*Sida fibulifera*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Malvaceae	*Sida intricata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Solanaceae	*Solanum ellipticum*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Stipa variabilis*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Aizoaceae	*Tetragonia eremaea*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Anthericaceae	*Thysanotus baueri*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Tripogon loliiformis*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Poaceae	*Triraphis mollis*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Vittadinia cuneata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Vittadinia eremaea*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Asteraceae	*Vittadinia sp+92*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Zygophyllaceae	*Zygophyllum apiculatum*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Zygophyllaceae	*Zygophyllum billardierei*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	SA	Zygophyllaceae	*Zygophyllum simile*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	**Malvastrum americanum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Convolvulaceae	*?Convolvulus sp334*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Apiaceae	*?Hydrocotyle sp346*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Abutilon fraseri*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Abutilon malvifolium*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Abutilon otocarpum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Mimosaceae	*Acacia cambagei*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Amaranthaceae	*Alternanthera denticulata*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Amaranthaceae	*Amaranthus mitchellii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Atriplex angulata*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Atriplex fissivalvis*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Atriplex holocarpa*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Atriplex lindleyi conduplicata*	S	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Atriplex vesicaria macrocystidia*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Nyctaginaceae	*Boerhavia dominii*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Brachiaria gilesii*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Brachycome ciliaris*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asphodelaceae	*Bulbine alata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Portulacaceae	*Calandrinia eremaea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Calotis hispidula*	AH	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	Qld	Asteraceae	*Calotis inermis*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Calotis plumulifera*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Centipeda thespidioides*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Euphorbiaceae	*Chamaesyce drummondii*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Euphorbiaceae	*Chamaesyce sp372*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Chenopodium cristatum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Chenopodium melanocarpum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Crassulaceae	*Crassula colorata*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Crassulaceae	*Crassula sieberiana*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Cyperaceae	*Cyperus ?rigidellus*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Dactyloctenium radulans*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Apiaceae	*Daucus glochidiatus*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Dichromochlamys dentatifolia*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Enchylaena tomentosa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Enneapogon polyphyllus*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Enteropogon acicularis*	PG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Myoporaceae	*Eremophila ?goodwinii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Myoporaceae	*Eremophila oppositifolia rubra*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Geraniaceae	*Erodium crinitum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Cyperaceae	*Fimbristylis dichotoma*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Gnephosis arachnoidea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Goodeniaceae	*Goodenia berardiana*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Goodeniaceae	*Goodenia fascicularis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Hibiscus sp322*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Hyalosperma semisterile*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Ixiochlamys nana*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Ixiolaena chloroleuca*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Brassicaceae	*Lepidium oxytrichum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Maireana cf. integra*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Maireana coronata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Maireana georgei*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Maireana pyramidata*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Maireana schistocarpa*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Maireana triptera*	S	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Malacocera tricornis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asclepiadaceae	*Marsdenia australis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Neobassia proceriflora*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Solanaceae	*Nicotiana occidentalis*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Osteocarpum dipterocarpum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Osteocarpum pentapterum*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Paspalidium gracile*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Thymelaeaceae	*Pimelea simplex*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Plantaginaceae	*Plantago turrifera*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Portulacaceae	*Portulaca oleracea*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Fabaceae	*Psoralea australasica*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Amaranthaceae	*Ptilotus gaudichaudii*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Amaranthaceae	*Ptilotus helipteroides var. helipteroides*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Amaranthaceae	*Ptilotus nobilis var. nobilis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Amaranthaceae	*Ptilotus obovatus*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Rhagodia spinescens*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Rhodanthe floribunda*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Rhodanthe microglossa*	AH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Rhodanthe stricta*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Acanthaceae	*Rostellularia adscendens*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Salsola kali*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Santalaceae	*Santalum lanceolatum*	T	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena articulata*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena bicornis var. horrida*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena calcarata*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena glabra*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena lanicuspis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena longcuspis*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerolaena parallelicuspis*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chenopodiaceae	*Sclerostegia tenuis*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Caesalpiniaceae	*Senna artemisioides cf. helmsii*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Caesalpiniaceae	*Senna artemisioides zygophylla*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Sida everistiana*	PH	DEC	Landsberg et al. (1997)

Chenopod/ Acacia shrubland	Qld	Malvaceae	*Sida fibulifera*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Sida goniocarpa*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*Sida species nov. "q"*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Solanaceae	*Solanum ellipticum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Solanaceae	*Solanum quadriloculatum*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Chloanthaceae	*Spartothamnella puberula*	S	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Sporobolus actinocladus*	PG	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Sporobolus caroli*	PG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Brassicaceae	*Stenopetalum ?velutinum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Brassicaceae	*Stenopetalum sp343*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Streptoglossa adscendens*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Fabaceae	*Swainsona campylantha*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Fabaceae	*Swainsona murrayana*	PH	INC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Aizoaceae	*Tetragonia tetragonioides*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Aizoaceae	*Trianthema triquetra*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Juncaginaceae	*Triglochin calcitrapum*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Poaceae	*Tripogon loliiformis*	AG	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Malvaceae	*unidentified sp314*	*unidentified sp314*	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Vittadinia dissecta var. hirta*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Vittadinia eremaea*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Asteraceae	*Vittadinia sp328*	PH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Campanulaceae	*Wahlenbergia sp+13*	Forb	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Zygophyllaceae	*Zygophyllum humillimum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Zygophyllaceae	*Zygophyllum iodocarpum*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Zygophyllaceae	*Zygophyllum simile*	AH	DEC	Landsberg et al. (1997)
Chenopod/ Acacia shrubland	Qld	Zygophyllaceae	*Zygophyllum sp+14*	AH	DEC	Landsberg et al. (1997)
Grassland	Qld	Nyctaginaceae	*Boerhavia dominii*	PH	INC	Fensham *et al.* (1999)
Grassland	Qld	Tiliaceae	*Corchorus trilocularis*	PH	INC	Fensham *et al.* (1999)
Grassland	Qld	Poaceae	*Dichanthium queenslandicum*	PG	DEC	Fensham *et al.* (1999)
Grassland	Qld	Poaceae	*Dichanthium sericeum*	PG	DEC	Fensham *et al.* (1999)
Grassland	Qld	Fabaceae	*Glycine latifolia*	PH	DEC	Fensham *et al.* (1999)
Grassland	Qld	Poaceae	*Iseilema vaginiflorum*	AG	INC	Fensham *et al.* (1999)
Grassland	Qld	Poaceae	*Panicum decompositum*	PG	DEC	Fensham *et al.* (1999)
Grassland	Qld	Asteraceae	*Parthenium hysterophorus*	AH	INC	Fensham *et al.* (1999)

Grassland	Qld	Euphorbiaceae	*Phyllanthus maderaspatensis*	AH	INC	Fensham *et al.* (1999)
Grassland	Qld	Malvaceae	*Sida spinosa*	AH	INC	Fensham *et al.* (1999)
Grassland	NT	Mimosaceae	*Acacia kempeana*	S	DEC	Foran *et al.*(1985)
Grassland	NT	Asteraceae	*Brachycome ciliaris*	PH	DEC	Foran (1986)
Grassland	NT	Asteraceae	*Calotis hispidula*	AH	DEC	Foran (1986)
Grassland	NT	Chenopodiaceae	*Chenopodium cristatum*	AH	INC	Foran *et al.*(1985)
Grassland	NT	Cucurbitaceae	*Citrullus colocyniths**	AH	DEC	Foran (1986)
Grassland	NT	Poaceae	*Dactylotenium radulans*	AG	INC	Foran *et al.*(1985), Foran (1986)
Grassland	NT	Poaceae	*Enneapogon* sp(p)?.	PG	DEC	Foran *et al.*(1985), Foran (1986)
Grassland	NT	Poaceae	*Eragrostis barrelieri**	AG	INC	Foran *et al.*(1985), Foran (1986)
Grassland	NT	Poaceae	*Eragrostis dielsii*	AG	INC	Foran (1986)
Grassland	NT	Euphorbiaceae	*Euphorbia tannensis*	S	DEC	Foran (1986)
Grassland	NT	Goodeniaceae	*Goodenia mitchellii*	AH	INC	Foran (1986)
Grassland	NT	Chenopodiaceae	*Maireana scleroptera*	AH	INC	Foran (1986)
Grassland	NT	Malvaceae	*Malvastrum americanum**	PH	INC	Foran et al.(1985), Foran (1986)
Grassland	NT	Euphorbiaceae	*Phyllanthus rhytidospermus*	AH	INC	Foran *et al.*(1985), Foran (1986)
Grassland	NT	Portulacaceae	*Portulaca oleracea*	AH	INC	Foran *et al.*(1985)
Grassland	NT	Amaranthaceae	*Ptilotus atriplicifolius*	AH	DEC	Foran (1986)
Grassland	NT	Chenopodiaceae	*Salsola kali*	AH	DEC	Foran (1986)
Grassland	NT	Malvaceae	*Sida* sp(p)?	AH	INC	Foran (1986)
Grassland	NT	Solanaceae	*Solanum ellipticum*	PH	DEC	Foran (1986)
Grassland	NT	Fabaceae	*Swainsona burkei*	AH	INC	Foran *et al.*(1985), Foran (1986)
Grassland	NT	Fabaceae	*Tephrosoa* sp(p)?	PH	INC	Foran (1986)
Grassland	NT	Poaceae	*Tripogon loliformis*	AG	INC	Foran (1986)
Grassland	Qld	Malvaceae	*Abutilon malvifolium*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Fabaceae	*Alysicarpus rugosus*	AH	DEC	Orr (1980)
Grassland	Qld	Chenopodiaceae	*Amaranthus mitchellii*	AH	INC	Orr (1980)
Grassland	Qld	Poaceae	*Aristida anthoxanthoides*	AG	DEC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Aristida latifolia*	PG	DEC	Orr (1981), Foran and Bastin (1984)

Grassland	Qld	Poaceae	*Astrebla pectinata*	PG	INC	Foran and Bastin (1984)
Grassland	Qld	Asteraceae	*Blumea diffusa sens. lat.*	AH	DEC	Hall and Lee (1980)
Grassland	Qld	Nyctaginaceae	*Boerhavia diffusa*	PH	DEC	Orr (1980)
Grassland	Qld	Nyctaginaceae	*Boerhavia diffusa*	PH	INC	Bowman et al. (1997)
Grassland	Qld	Poaceae	*Brachyachne convergens*	AG	DEC	Orr (1980)
Grassland	Qld	Poaceae	*Chrysopogon fallax*	PG	DEC	Foran and Bastin (1984)
Grassland	Qld	Capparaceae	*Cleome* sp. aff. *C.viscosa*	PH	DEC	Hall and Lee (1980)
Grassland	Qld	Tiliaceae	*Corchorus trilocularis*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Fabaceae	*Crotalaria linifolia*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Fabaceae	*Crotalaria trifoliastrum*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Cyperaceae	*Cyperus bifax*	PH	DEC	Orr (1980)
Grassland	Qld	Cyperaceae	*Cyperus difformis*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Cyperaceae	*Cyperus gilesii*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Cyperaceae	*Cyperus iria*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Dactyloctenium radulans*	AG	INC	Hall and Lee (1980), Orr (1981), Orr and Evenson (1984)
Grassland	Qld	Poaceae	*Dichanthium sericeum*	PG	DEC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Dichantium annulatum*	PG	DEC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Digitaria ctenantha*	AG	INC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Echinochloa colona**	AG	INC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Enneapogon avenaceus*	AG	INC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Eriochloa crebra*	PG	INC	Hall and Lee (1980)
Grassland	Qld	Euphorbiaceae	*Euphorbia drummondii*	AH	DEC	Orr (1980)
Grassland	Qld	Asteraceae	*Flaveria australasica*	AH	DEC	Hall and Lee (1980)
Grassland	Qld	Amaranthaceae	*Gomphrena conica*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Goodeniaceae	*Goodenia strangfordii*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Fabaceae	*Indigofera parviflora*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Poaceae	*Iseilema membranaceum*	AG	DEC	Orr 1981, Orr (1980)
Grassland	Qld	Poaceae	*Iseilema vaginiflorum*	AG	INC	Foran and Bastin (1984)
Grassland	Qld	Malvaceae	*Malvastrum americanum**	PH	INC	Hall and Lee (1980), (Orr 1981), Orr (1980)
Grassland	Qld	Mimosaceae	*Neptunia gracilis*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Mimosaceae	*Neptunia monosperma*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Convolvulaceae	*Operculina turpethum*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Euphorbiaceae	*Phyllanthus maderaspatensis*	AH	DEC	Orr (1980)

Grassland	Qld	Caryophyllaceae	*Polycarpaea glabra*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Portulacaceae	*Portulaca* sp.	AH	INC	Hall and Lee (1980)
Grassland	Qld	Fabaceae	*Rhynchosia minima*	PH	DEC	Orr (1981), Orr (1980)
Grassland	Qld	Acanthaceae	*Rostellularia adscendens*	PH	DEC	Hall and Lee (1980)
Grassland	Qld	Chenopodiaceae	*Salsola kali*	AH	INC	Hall and Lee (1980), Orr (1981)
Grassland	Qld	Chenopodiaceae	*Salsola kali*	AH	DEC	Bowman *et al.* (1997)
Grassland	Qld	Chenopodiaceae	*Sclerolaena birchii*	AH	INC	Bowman *et al.* (1997)
Grassland	Qld	Chenopodiaceae	*Sclerolaena muricata*	AH	INC	Bowman *et al.* (1997)
Grassland	Qld	Malvaceae	*Sida filiformis sens. lat.*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Malvaceae	*Sida rohlenae*	AH	INC	Hall and Lee (1980)
Grassland	Qld	Fabaceae	*Tephrosia* sp.	PH	INC	Hall and Lee (1980)
Grassland	Qld	Zygophyllaceae	*Tribulus terrestris*	AH	INC	Orr (1980)
Grassland	Qld	Fabaceae	*Vigna lanceolata*	PH	INC	Hall and Lee (1980)
Grassland	Qld	Asteraceae	*Xanthium pungens**	AH	INC	Hall and Lee (1980)
Mulga	NSW	Poaceae	*Aristida calycina*	PG	DEC	Landsberg et al. (1997)
Mulga	NSW	Chenopodiaceae	*Atriplex sp220*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Asteraceae	*Calotis cuneifolia*	PH	DEC	Landsberg et al. (1997) NSW and Qld
Mulga	NSW	Asteraceae	*Centipeda thespidioides*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Chenopodiaceae	*Chenopodium cristatum*	AH	INC	Landsberg et al. (1997) NSW and Qld
Mulga	NSW	Poaceae	*Chloris ?pectinata*	AG	DEC	Landsberg et al. (1997)
Mulga	NSW	Poaceae	*Digitaria brownii*	PG	INC	Landsberg et al. (1997)
Mulga	NSW	Poaceae	*Digitaria coenicola*	PG	DEC	Landsberg et al. (1997)
Mulga	NSW	Chenopodiaceae	*Einadia nutans*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Chenopodiaceae	*Enchylaena tomentosa*	S	DEC	Landsberg et al. (1997)
Mulga	NSW	Poaceae	*Eragrostis lacunaria*	AG	DEC	Landsberg et al. (1997) NSW and Qld
Mulga	NSW	Myoporaceae	*Eremophila bowmanii bowmanii*	S	INC	Landsberg et al. (1997)
Mulga	NSW	Proteaceae	*Hakea ivoryi*	T	INC	Landsberg et al. (1997)
Mulga	NSW	Chenopodiaceae	*Maireana ?pyramidata*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Poaceae	*Monachather paradoxa*	PG	DEC	Landsberg et al. (1997) NSw and Qld
Mulga	NSW	Oxalidaceae	*Oxalis ?radicosa*	AH	DEC	Landsberg et al. (1997)
Mulga	NSW	Thymelaeaceae	*Pimelea trichostachya*	PH	INC	Landsberg et al. (1997)

Mulga	NSW	Asteraceae	*Pterocaulon sphacelatum*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Chenopodiaceae	*Rhagodia ?spinescens*	S	DEC	Landsberg et al. (1997)
Mulga	NSW	Caesalpiniaceae	*Senna artemisioides filifolia*	S	INC	Landsberg et al. (1997)
Mulga	NSW	Malvaceae	*Sida fibulifera*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Solanaceae	*Solanum ellipticum*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Solanaceae	*Solanum quadriloculatum*	PH	DEC	Landsberg et al. (1997)
Mulga	NSW	Campanulaceae	*Wahlenbergia ?tumidifructa*	AH	INC	Landsberg et al. (1997)
Mulga	NT	Mimosaceae	*Acacia aneura*	T	DEC	Landsberg et al. (1997)
Mulga	NT	Mimosaceae	*Acacia tetragonophylla*	S	DEC	Landsberg et al. (1997)
Mulga	NT	Poaceae	*Aristida contorta*	PG	INC	Landsberg et al. (1997) NT and NSw
Mulga	NT	Poaceae	*Aristida obscura*	PG	DEC	Landsberg et al. (1997) NT and NSW
Mulga	NT	Asteraceae	*Bracteantha viscosa*	AH	DEC	Landsberg et al. (1997)
Mulga	NT	Asteraceae	*Calotis hispidula*	AH	INC	Landsberg et al. (1997)
Mulga	NT	Chenopodiaceae	*Chenopodium melanocarpum*	AH	INC	Landsberg et al. (1997)
Mulga	NT	Myoporaceae	*Eremophila gilesii*	S	DEC	Landsberg et al. (1997)
Mulga	NT	Myoporaceae	*Eremophila latrobei*	S	INC	Landsberg et al. (1997)
Mulga	NT	Euphorbiaceae	*Euphorbia eremophila*	PH	DEC	Landsberg et al. (1997)
Mulga	NT	Asteraceae	*Leucochrysum stipitata*	AH	DEC	Landsberg et al. (1997)
Mulga	NT	Chenopodiaceae	*Maireana tomentosa*	S	DEC	Landsberg et al. (1997)
Mulga	NT	Chenopodiaceae	*Maireana villosa*	S	DEC	Landsberg et al. (1997) NT and Qld
Mulga	NT	Asteraceae	*Minuria leptophylla*	AH	DEC	Landsberg et al. (1997)
Mulga	NT	Portulacaceae	*Portulaca filifolia*	AH	DEC	Landsberg et al. (1997) NT and Qld
Mulga	NT	Amaranthaceae	*Ptilotus obovatus*	PH	DEC	Landsberg et al. (1997)
Mulga	NT	Asclepiadaceae	*Rhyncharrhena linearis*	PH	DEC	Landsberg et al. (1997)
Mulga	NT	Chenopodiaceae	*Sclerolaena johnsonii*	PH	INC	Landsberg et al. (1997)
Mulga	NT	Caesalpiniaceae	*Senna artemisioides artemisioides*	S	INC	Landsberg et al. (1997) NT and NSw
Mulga	NT	Solanaceae	*Solanum esuriale*	PH	INC	Landsberg et al. (1997) NT and Qld
Mulga	NT	Solanaceae	*Solanum quadriloculatum*	PH	INC	Landsberg et al. (1997)
Mulga	NT	Chloanthaceae	*Spartothamnella teucriiflora*	S	DEC	Landsberg et al. (1997)
Mulga	NT	Poaceae	*Tragus australianus*	AG	INC	Landsberg et al. (1997)

Mulga	NT	Poaceae	*Tripogon loliiformis*	AG	DEC	Landsberg et al. (1997)
Mulga	NT	Asteraceae	*Vittadinia sp113*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	**Bidens bipinnata*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	**Malvastrum americanum*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Oxalidaceae	**Oxalis corniculata*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Abutilon ?fraseri*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Abutilon leucopetalum*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Abutilon macrum*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Abutilon malvifolium*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Abutilon otocarpum*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Mimosaceae	*Acacia ?brachystachya*	T	INC	Landsberg et al. (1997)
Mulga	Qld	Mimosaceae	*Acacia aneura*	T	INC	Landsberg et al. (1997) NSW and Qld
Mulga	Qld	Poaceae	*Amphipogon caricinus*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Aristida latifolia*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Austrochloris dicanthioides*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Nyctaginaceae	*Boerhavia repleta*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Brachiaria gilesii*	AG	DEC	Landsberg et al. (1997)
Mulga	Qld	Asphodelaceae	*Bulbine alata*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Portulacaceae	*Calandrinia eremaea*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Portulacaceae	*Calandrinia ptychosperma*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Calocephalus knappi*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Calotis inermis*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Calotis plumulifera*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Euphorbiaceae	*Chamaesyce drummondii*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Chenopodium melanocarpum*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Chloris pectinata*	AG	INC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Chrysocephalum sp167*	Forb	INC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Chthonocephalus pseudovax*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Tiliaceae	*Corchorus sp005*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Crassulaceae	*Crassula colorata*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Amaryllidaceae	*Crinum flaccidum*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Dactyloctenium radulans*	AG	DEC	Landsberg et al. (1997)
Mulga	Qld	Apiaceae	*Daucus glochidiatus*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Phormiaceae	*Dianella longifolia var. porracea*	PH	DEC	Landsberg et al. (1997)

Mulga	Qld	Poaceae	*Dichanthium sericeum*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Digitaria ammophila*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Digitaria brownii*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Dysphania glomulifera*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Dysphania rhadinostachya inflata*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Enchylaena tomentosa*	S	INC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Enteropogon acicularis*	PG	INC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eragrostis basedowii*	AG	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eragrostis dielsii*	AG	INC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eragrostis eriopoda*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eragrostis microcarpa*	PG	INC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eragrostis xerophila*	PG	INC	Landsberg et al. (1997)
Mulga	Qld	Myoporaceae	*Eremophila bowmanii*	S	DEC	Landsberg et al. (1997)
Mulga	Qld	Myoporaceae	*Eremophila gilesii*	S	INC	Landsberg et al. (1997)
Mulga	Qld	Myoporaceae	*Eremophila longifolia*	S	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eriachne pulchella*	AG	INC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Eriochloa creba*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Geraniaceae	*Erodium crinitum*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Cyperaceae	*Fimbristylis dichotoma*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Fabaceae	*Glycine canescens*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Gnephosis arachnoidea*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Goodeniaceae	*Goodenia berardiana*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Goodeniaceae	*Goodenia cycloptera*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Goodeniaceae	*Goodenia glauca*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Goodeniaceae	*Goodenia lunata*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Goodeniaceae	*Goodenia pinnatifida*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Boraginaceae	*Heliotropium tenuifolium*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Hyalosperma semisterile*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Brassicaceae	*Lepidium ?muelleri-ferdinandii*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Brassicaceae	*Lepidium oxytrichum*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Brassicaceae	*Lepidium phlebopetalum*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Marsileaceae	*Marsilea drummondii*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Solanaceae	*Nicotiana velutina*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Panicum effusum*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Euphorbiaceae	*Phyllanthus lacunellus*	PH	DEC	Landsberg et al. (1997)

Mulga	Qld	Thymelaeaceae	*Pimelea elongata*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Thymelaeaceae	*Pimelea simplex*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Portulacaceae	*Portulaca oleracea*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Amaranthaceae	*Ptilotus gaudichaudii*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Amaranthaceae	*Ptilotus helipteroides var. helipteroides*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Amaranthaceae	*Ptilotus macrocephalus macrocephalus*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Rhagodia spinescens*	S	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Rhodanthe floribunda*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Fabaceae	*Rhynchosia ?australis*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Asteraceae	*Rutidosis helichrysoides*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Salsola kali*	AH	INC	Landsberg et al. (1997)
Mulga	Qld	Asclepiadaceae	*Sarcostemma australe*	S	INC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Sclerolaena cornishiana*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*Sclerolaena diacantha*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Caesalpiniaceae	*Senna artemisioides aff.helmsii x aff.oligophylla*	S	DEC	Landsberg et al. (1997)
Mulga	Qld	Caesalpiniaceae	*Senna artemisioides artemisioides*	S	DEC	Landsberg et al. (1997)
Mulga	Qld	Caesalpiniaceae	*Senna artemisioides oligophylla*	S	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Sida cunninghamii*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Sida fibulifera*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Sida platycalyx*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Sida species nov. "q" aff. trichopoda*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Malvaceae	*Sida species nov. aff. filiformis*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Solanaceae	*Solanum ellipticum*	PH	INC	Landsberg et al. (1997)
Mulga	Qld	Caryophyllaceae	*Spergularia sp276*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Sporobolus actinocladus*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Brassicaceae	*Stenopetalum nutans*	AH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Themeda australis*	PG	DEC	Landsberg et al. (1997)
Mulga	Qld	Apiaceae	*Trachymene ochracea*	PH	DEC	Landsberg et al. (1997)
Mulga	Qld	Poaceae	*Tragus australianus*	AG	DEC	Landsberg et al. (1997)
Mulga	Qld	Anthericaceae	*Tricoryne elatior*	PH	DEC	Landsberg et al. (1997)

Mulga	Qld	Poaceae	*Tripogon loliiformis*	AG	INC	Landsberg et al. (1997)
Mulga	Qld	Chenopodiaceae	*unidentified sp236*	*unidentified sp236*	DEC	Landsberg et al. (1997)
Tropical eucalypt woodland	Qld	Asteraceae	*Acanthospermum hispidum**	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Amaranthaceae	*Alternanthera nana*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Aristida* (section *Aristida*)	PG	DEC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Poaceae	*Aristida* (section *Arthratherum*)	PG	DEC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Poaceae	*Aristida* (section *Calycinae*)	PG	DEC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Poaceae	*Aristida sp(p)?*	PG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Bidens bipinnata**	AH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Nyctaginaceae	*Boerhavia dominii*	PH	INC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Nyctaginaceae	*Boerhavia schomburgkina*	PH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Bothriochloa pertusa**	PG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Acanthaceae	*Brunoniella acaulis*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Fabaceae	*Cajanus scarabaeoides*	PH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Camptacra barbata*	AH	DEC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Camptacra barbata*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Capillipedium parviflorum*	PG	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Caesalpiniaceae	*Chamaecrista rotundifolia**	AH	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Commelinaceae	*Commelina cyanea*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Fabaceae	*Crotalaria medicaginea*	PH	INC	Fensham and Skull (1999), McIvor (1998)
Tropical eucalypt woodland	Qld	Fabaceae	*Crotalaria mitchellii*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Cymbopogon refractus*	PG	DEC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Cyperaceae	*Cyperus* sp(p)?	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Fabaceae	*Desmodium varians*	PH	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Poaceae	*Dichanthium sericeum*	PG	INC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Digitaria ciliaris**	AG	INC	Fensham and Skull (1999), McIvor (1998)

Tropical eucalypt woodland	Qld	Poaceae	*Echinochloa colona**	AG	INC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Enneapogon polyphyllus*	AG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Eragrostis spp.*	Grass	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Euphorbiaceae	*Euphorbia* sp(p)?	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Convolvulaceae	*Evolvulus alsinoides*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Cyperaceae	*Fimbristylis* sp(p)?	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Tiliaceae	*Grewia retusifolia*	S	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Heteropogon contortus*	PG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Malvaceae	*Hibiscus meraukensis*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Fabaceae	*Indigofera linifolia*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Fabaceae	*Indigofera linnaei*	AH	INC	McIntyre (1996) McIvor (1998)
Tropical eucalypt woodland	Qld	Convolvulaceae	*Ipomoea plebeia*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Convolvulaceae	*Ipomoea polymorpha*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Xanthorrhoeaceae	*Lomandra longifolia*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Asclepiadaceae	*Marsdenia viridiflora*	V	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Sterculiaceae	*Melhania oblongifolia*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Melinis repens**	PG	DEC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Poaceae	*Melinis repens**	PG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Panicum effusum*	PG	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Euphorbiaceae	*Phyllanthus* sp(p)?	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Euphorbiaceae	*Phyllanthus virgatus*	AH	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Portulacaceae	*Portulaca oleracea*	AH	INC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Portulacaceae	*Portulaca pilosa**	AH	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Portulacaceae	*Portulacca* sp(p)?	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Pterocaulon redolens*	PH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Acanthaceae	*Rostellularia adscendens*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Acanthaceae	*Rostellularia adscendens*	PH	INC	McIvor (1998)

Tropical eucalypt woodland	Qld	Cyperaceae	*Scleria mackaviensis*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Sehima nervosum*	PG	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Malvaceae	*Sida spinosa*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Sigesbeckia orientalis**	AH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Solanaceae	*Solanum ellipticum*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Poaceae	*Sporobolus australasicus*	AG	INC	Fensham and Skull (1999), McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Themeda triandra*	PG	DEC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Tragus australianus*	AG	INC	Fensham and Skull (1999), McIvor (1998), McIntyre (1996)
Tropical eucalypt woodland	Qld	Poaceae	*Tripogon loliformis*	AG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Poaceae	*Urochloa panicoides**	PG	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Vernonia cineria*	PH	DEC	Fensham and Skull (1999)
Tropical eucalypt woodland	Qld	Asteraceae	*Vernonia cineria*	PH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Fabaceae	*Vigna lanceolata*	PH	DEC	McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Vittadinia pustulata*	PH	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Asteraceae	*Wedelia spilanthoides*	AH	INC	McIvor (1998)
Tropical eucalypt woodland	Qld	Fabaceae	*Zornia dyctiocarpa*	PH	INC	McIntyre (1996)
Tropical eucalypt woodland	Qld	Fabaceae	*Zornia muriculata*	PH	INC	McIntyre (1996), McIvor (1998)
Tropical eucalypt woodland	Qld	Asteraceae	*Zornia* sp(p)?.	PH	INC	Fensham and Skull (1999)