

Western Arnhem Plateau

Location and Description

The sandstone plateau of western Arnhem Land extends over an area of about 32 000 km². Its distinction – in geology, topography and biodiversity - from the surrounding lowlands is so marked that it is recognised as comprising its own entire bioregion (Arnhem Plateau). The centre of the plateau lies about 350 km east-south-east of Darwin. No large human population centres or major roads occur within it. The Arnhem Land plateau is topographically complex, including sheer escarpments (especially on its western perimeter), deep narrow gorges, spectacular waterfalls, and the headwaters of some of the largest river systems in the Northern Territory, including the Katherine (Daly), Mary, South Alligator, East Alligator, and Mann Rivers, plus tributaries of the Roper River.

Tenure and Land Use

A straight north-south tenure line dissects the plateau, with the western portion (about 30% of the plateau area) within Kakadu National Park (Aboriginal lands leased to Parks Australia) and Nitmiluk National Park, and the eastern portion within Arnhem Land Aboriginal Land Trust. Much of this latter area will be incorporated within the proposed Warddeken Indigenous Protected Area. The main land use within the plateau is Indigenous, and other uses include conservation, tourism and mining.

Significance Rating

International Significance

Ecological Values

The plateau of western Arnhem Land is the most significant region in the NT for biodiversity. It contains far more of the NT's endemic species than anywhere else (including at least 160 plant species found nowhere else; Woinarski *et al.* 2006), and many plants and animals of outstanding biogeographic and scientific interest. It harbours an unusually high number (at least 32) of threatened species, many of which are being detrimentally affected by the fire regimes currently prevailing in the region. The Arnhem Land plateau also supports a high proportion of the NT's rainforest estate, including almost all of the distinctive rainforest associations dominated by the endemic tree *Allosyncarpia ternata*. The rugged nature of this bioregion affords its biota some protection from threatening processes that have affected biodiversity elsewhere.

Management Issues

The frequency and extent of fire, particularly those in the late dry season, is the most significant management issue in this area. The management of these fires is currently constrained by limited capacity, population and resourcing within much of the area, and the need for coordinated management actions among neighbouring regions. There is also an increasing incursion of weeds and feral animals (particularly Water Buffalo, pig and Cane Toad) present in the area.

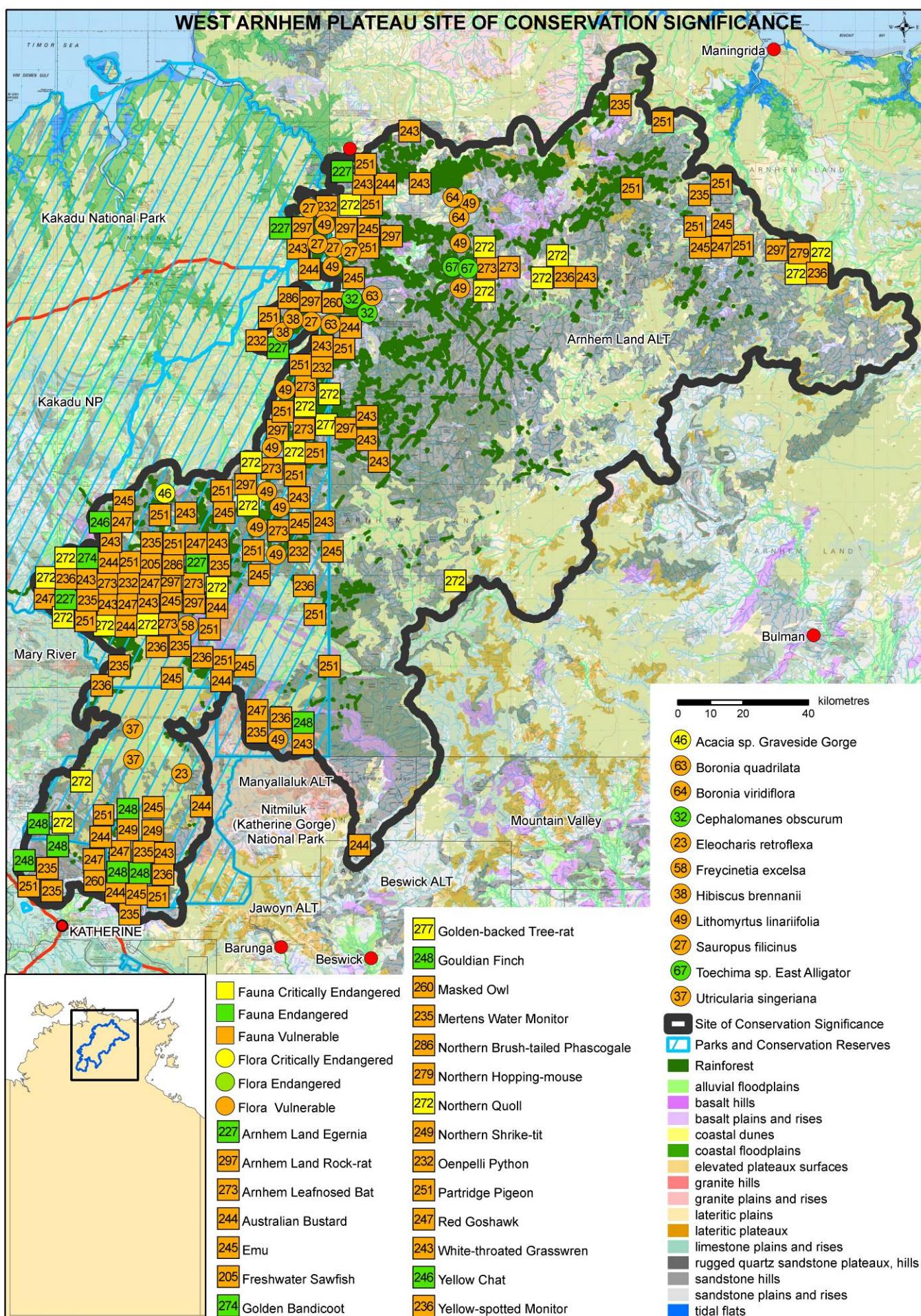


Condition

By most standards, the environments of this site are in good to near-pristine condition. For example, the proportion of exotic:total plant species is generally low (c.4.5%), and the incidence of exotic plants is also low, but probably increasing. With the exception of some former mines (notably Nabarlek) and ongoing exploration, there has been remarkably little development within the site. Feral animals appear to be increasing in numbers and extent, causing at least localised habitat degradation (particularly upland wetlands) and declines in native species. The current fire regime is leading to extensive declines of some fire-sensitive plant species, sandstone heathlands and, possibly, rainforests.

Current Conservation Initiatives

About 20% of this site is included within Kakadu National Park. This portion is managed through Kakadu's Plan of Management, most recently revised in 2007. Kakadu has also recently prepared a specific fire management plan for this area. Much of the plateau to the east of the Kakadu border has recently been proposed as Warddeken Indigenous Protected Area, and a Plan of Management for this area is in development. Currently Indigenous ranger groups based from Maningrida, Gunbalanya and Kabulwarnamyo, Bulman and Katherine provide fire and other management for extensive parts of the plateau, with some coordination developed through the Tropical Savannas CRC, Bushfires Council and the Northern Land Council, through the Western Arnhem Land Fire Abatement and Fire Plan. Other management activities undertaken by Indigenous ranger groups include feral animal control, protection of cultural sites and maintenance of Indigenous ecological knowledge, and implementation of a carbon credit trading program.



LOCATION	SOCS Number	16 (NT Parks and Conservation Masterplan Map Number 15)
	Latitude/Longitude	13° 11' South, 133° 15' East (at centre)
	Bioregion	Arnhem Plateau (75%), Pine Creek (16%), Central Arnhem (8%), Daly Basin (1%)
	Description	<p>This site is generally well-defined from the surrounding lowlands by its geological and topographic distinctiveness. It comprises an extensive, rugged and ancient sandstone massif, tilted to form a spectacular escarpment on its western edge. Its bounds are far less well defined to the east, but land system mapping is used to define the boundary of the site, which extends to the south-west to include the rugged sandstone gorge system of Nitmiluk National Park.</p> <p>The significance of the plateau for biogeography, endemic and relic species is due largely to its unusually long (>100 million years) and unbroken presence in this landscape, whereas much of the surrounding lowlands was inundated at least twice as recently as the Pleistocene (Needman 1988; Duretto and Ladiges 1997).</p> <p>The site borders three other sites of high conservation significance in the NT; Alligator Rivers Coastal Floodplain to the north-west, Maningrida Coastal Habitats to the north-east and Yinberrie Hills in the south-west.</p>
THREATENED SPECIES	Significance Rating	<p>International Significance</p> <p>32 threatened species are reported from this site. * indicates the species is endemic to the site.</p> <p>Plants</p> <ul style="list-style-type: none"> ▪ <i>Acacia</i> sp. Gravestide Gorge (CR/CR)* ▪ <i>Boronia quadrilata</i> (VU/VU)* ▪ <i>Boronia viridiflora</i> (VU/VU)* ▪ <i>Cephalomanes obscurum</i> (-/EN) ▪ <i>Eleocharis retroflexa</i> (VU/DD) ▪ <i>Freycinetia excelsa</i> (-/VU) ▪ <i>Hibiscus brennanii</i> (VU/VU)* ▪ <i>Lithomyrtus linearifolia</i> (-/VU) ▪ <i>Sauvagesia filicina</i> (VU/DD)* ▪ <i>Toechima</i> sp. East Alligator (EN/EN)* ▪ <i>Utricularia singeriana</i> (-/VU) <p>Vertebrates</p> <ul style="list-style-type: none"> ▪ Australian Bustard <i>Ardeotis australis</i> (-/VU) ▪ Emu <i>Dromaius novaehollandiae</i> (-/VU) ▪ Gouldian Finch <i>Erythrura gouldiae</i> (EN/EN) ▪ Masked Owl (northern mainland subspecies) <i>Tyto novaehollandiae kimberli</i> (VU/VU) ▪ Northern (crested) Shrike-tit <i>Falcunculus frontatus whitei</i> (VU/VU) ▪ Partridge Pigeon <i>Geophaps smithii</i> (VU/VU) ▪ Red Goshawk <i>Erythrotriorchis radiatus</i> (VU/VU) ▪ White-throated Grass-wren <i>Amytornis woodwardi</i> (-/VU)* ▪ Yellow Chat (Alligator River subspecies) <i>Epthianura crocea tunneyi</i> (VU/EN) ▪ Arnhem rock-rat <i>Zyzomys maini</i> (VU/VU)* ▪ Arnhem Leaf-nosed Bat <i>Hipposideros (diadema) inornata</i> (-/VU) ▪ Golden Bandicoot <i>Isoodon auratus</i> (VU/EN) ▪ Golden-backed Tree-rat <i>Mesembriomys macrurus</i> (VU/CR) ▪ Northern Brush-tailed Phascogale <i>Phascogale pirata</i> (-/VU) ▪ Northern Hopping-mouse <i>Notomys aquilo</i> (VU/VU) ▪ Northern Quoll <i>Dasyurus hallucatus</i> (EN/CR) ▪ Arnhem Land Egernia <i>Egernia obiri</i> (EN/EN)* ▪ Oenpelli Python <i>Morelia oenpelliensis</i> (-/VU)* ▪ Merten's Water Monitor <i>Varanus mertensi</i> (-/VU) ▪ Yellow-spotted Monitor <i>Varanus panoptes</i> (-/VU) ▪ Freshwater Sawfish <i>Pristis microdon</i> (VU/VU) <p>The Golden Bandicoot probably no longer occurs in the site, as it appears to have disappeared from the NT mainland. The last confirmed record of the Golden-backed Tree-rat in the NT was from Deaf Adder Gorge (west of the site) in 1969, but credible sightings have been reported since then.</p> <p>In addition to these listed threatened species, there has been broad-scale decline of a range of other species, notably including fire-sensitive plants (e.g. Bowman 1994; Bowman and Panton 1993; Russell-Smith 2006) and small mammals. There is some evidence for decline in the extent and/or condition of rainforests (Russell-Smith and Bowman 1992; Russell-Smith <i>et al.</i> 1993), but this may be contestable (Bowman and Dingle 2006; Banfa and Bowman 2007).</p> <p>Woinarski (2004c) provides a listing of management priorities for those of these species that occur in Kakadu National Park.</p> <p>One ecological community restricted to this site, sandstone heathlands of the Arnhem Land plateau, has been nominated as a nationally threatened community. This nomination is currently (mid 2007) being assessed.</p>

ENDEMIC SPECIES	Significance Rating	International Significance
	Notes	<p>Endemic to the site: At least 160 plant species recorded from the west Arnhem Plateau are found nowhere else (Woinarski <i>et al.</i> 2006).</p> <p>20 species of vertebrates are endemic to the plateau area, including four birds (White-throated Grass-wren, White-lined Honeyeater, Chestnut-quilled Rock-pigeon and Banded Fruit-dove [although this latter has a sibling species in Indonesia]), ten reptiles (the turtle <i>Chelodina burungandjii</i>, the geckoes <i>Gehyra pamela</i>, <i>Oedura gemmata</i> and <i>Pseudoeuryceadactylus lindneri</i> and the skinks <i>Ctenotus arnhemensis</i>, <i>C. coggiai</i>, <i>C. gagudju</i>, <i>Egernia obiri</i> and <i>Menetia concinna</i>, and the Oenpelli Python), two mammals (Black Wallaroo and Arnhem Rock-rat), two fish (Midgley's grunter and Barraway's gudgeon) and two frogs (<i>Uperoleia arenicola</i> and <i>Litoria personata</i>). The richness of rock-associated fauna is unusually high within a national context (Freeland <i>et al.</i> 1988).</p> <p>Andersen <i>et al.</i> (2000) recorded 11 grasshopper species that were "restricted to sandstone country of the Arnhem escarpment and plateau", but noted also that their collections were far from comprehensive; and there has been relatively little systematic survey of the terrestrial invertebrates of this area.</p> <p>The freshwater invertebrate fauna of western Arnhem Land plateau also appears to comprise a substantial and significant endemic component, although quantification of this is currently hampered by very limited collection and taxonomic scrutiny (such limitations are now being addressed by a range of collaborative studies involving eriss). The fauna includes an endemic family of shrimps, the Kakaducarididae, comprising two endemic genera (Page <i>et al.</i> 2008), as well as an endemic genus of phreatoicidean isopod (<i>Eophreatoicus</i>) that has exceptional species-level diversity (Dr G Wilson, Australian Museum, pers. comm.). Most of these macro-crustacean species have very restricted distributions, often limited to single streams, seeps or springs.</p> <p>Endemic to the NT: At least 370 plant species recorded in this site are only found in the NT.</p> <p>Other: As well as the large number of species that are endemic to the site, several species found in the site are restricted to the site within the NT but are also found in other states.</p>
WILDLIFE AGGREGATIONS	Significance Rating	Regional Significance
	Marine turtles	Not applicable
WETLANDS	Seabirds	No major aggregations recorded
	Waterbirds	The site includes a network of wetlands, including some (relatively small) persistent and ephemeral swamps, headwater pools and the upper reaches of some large rivers; but these generally do not support rich waterbird aggregations.
WETLANDS	Shorebirds	No major aggregations recorded
	Other aggregations	<p>The site includes some large roosts of flying-foxes and natural cave systems and abandoned mine adits are known to support some aggregations of microchiropteran bats (D. Milne, NRETAS, pers. comm.).</p> <p>Rainforests and gorge systems provide seasonal refuges for aggregations of some butterfly species and other invertebrates (e.g. Monteith 1982).</p>
WETLANDS	Significance Rating	National Significance (possible International)
	Ramsar criteria met	<p>The Ramsar listing of Kakadu and encompasses all the wetlands of that portion of the Arnhem Plateau within Kakadu National Park, recognising in particular the natural integrity of the wetland systems, the spectacular waterfalls and gorges, and the distinctive biota, including very many endemic aquatic invertebrates.</p> <p>ID 5AU002: Kakadu (Stage I and components of Stage III). Criteria met: 1a, 1b, 1c, 2a, 2b, 3a, 3b, 3c.</p> <p>ID 5AU030: Kakadu National Park (Stage II). Criteria met: 1a, 1c, 2b, 3a, 3b, 3c.</p>
	DIWA criteria met	<p>The Western Arnhem Plateau includes parts of two sites listed as wetlands of national significance in the Directory of Important Wetlands in Australia (DIWA): Katherine River Gorge (NT018 meets criteria 1, 2, 6 and includes DIWA wetland type B1); and Kakadu National Park (ID NT017; meets criteria 1, 3, 4, 5, 7 and 8 and includes DIWA wetland types: A1, A2, A5, A6, A7, A8, A9, B1, B2, B3, B9, B10, B14, B17 and C1).</p> <p>The Kakadu National Park DIWA site includes large areas of floodplain that are not part of the Western Arnhem Plateau and it is not straightforward to disentangle the values of the Arnhem Plateau component of the DIWA site from those of its lowland components. Indeed much of the value of the Kakadu DIWA site is in its incorporation of entire or near-entire catchments for major rivers from headwaters to mouth.</p>
	Notes	<p>The plateau wetlands support a rich assemblage of aquatic biota, including very many endemic invertebrates (Bruce 1993; Bruce and Short 1993; Finlayson <i>et al.</i> 2006), reflecting a long and enduring period of isolation, due in part to topographic barriers preventing upstream movement of lowland aquatic fauna. The upland watercourses also support an endemic turtle and an isolated population of dwarfed freshwater crocodiles.</p> <p>Kakadu National Park (Stage I and II) have been identified as priority High Conservation Value Aquatic Ecosystems (Commonwealth of Australia 2008) and as targets for investment in the Caring for our Country Business Plan 2009-2010.</p>
	Rivers	The Arnhem Plateau area is critical for wetland systems across much of the Top End, as it contains a high proportion of the headwaters of many large river systems, including the Katherine (Daly), Mary, South Alligator, East Alligator and Mann Rivers, as well as an important proportion of the Roper River.

	Significance Rating	International Significance
FLORA	Notes	<p>The Arnhem Plateau- Alligator Rivers region is recognised nationally (Crisp <i>et al.</i> 2001) and internationally (Ingwesen 1995) as a centre of plant species diversity and endemism (Russell-Smith 2006; Woinarski <i>et al.</i> 2006).</p> <p>Rainforest: The Arnhem Land plateau supports 119 500 ha of rainforest and comprises a high proportion (43%) of the Territory's rainforest estate, including most of the distinctive rainforest associations dominated by the endemic tree <i>Allosyncarpia ternata</i> (Russell-Smith <i>et al.</i> 1993).</p> <p>Restricted vegetation communities: The plateau also provides the most extensive areas, and the most diverse representations, of the NT's heathlands, a plant community comprising a high proportion of fire-sensitive shrubs (Specht 1958; Russell-Smith <i>et al.</i> 2002).</p> <p>Restricted range species: Many plant species found on the plateau are relictual (such as species in the genera <i>Drummondita</i>, <i>Hildergardia</i> and <i>Podocarpus</i>) and many species are known only from one or few populations within a range of <1-10 km². Some groups have radiated extensively (e.g. <i>Styliodium</i>, <i>Micraira</i>, <i>Spermacoce</i>, <i>Eriocalon</i>), resulting in this bioregion being a major centre of biodiversity (Carlquist 1979; Leach 2000; Harwood and Dessein 2005; Woinarski <i>et al.</i> 2006).</p>
OTHER ENVIRONMENTAL VALUES		<p>The western portion of this site included within Kakadu National Park, has UNESCO World Heritage listing for outstanding cultural and natural universal values (UNESCO).</p> <p>The Arnhem Plateau is listed on the Register of the National Estate as part of the Alligator Rivers Region and Kakadu National Park sites for the natural and cultural values (Australian Heritage Council).</p> <p>Numerous gorges, vine thickets and other landscapes within the Plateau are included on the Register of the National Estate for their natural values including: the Alligator Rivers Region, Boulder Gorge Jungle, Tin Can Creek Area, Upper East Alligator River Area, Gimbat / Goodparla Pastoral Leases (former), Kakadu National Park, Rainforest Gorge Jungle, Miyarrin Jungle, Kooplpin Gorge Area, Jim Jim Falls Area, Twin Falls Area, UDP Falls Area, Marrawal Plateau, Nitmiluk National Park (1978 boundary), Tristicha Trifaria Sites, Edith Falls Reserve (former), Acacia Helicophylla Sites, Hibiscus Menzelii Sites, Calytrix Faucicula Sites, and Calytrix Verticillata Sites (Australian Heritage Council).</p> <p>Much of the eastern portion of the plateau will be incorporated in the proposed Warddeken Indigenous Protected Area (Warddeken Land Management Limited in prep.)</p> <p>The plateau area is proposed to be nominated by Birds Australia as an internationally-recognised <i>Important Bird Area</i> (G. Dutson in prep.) due to the occurrence of numerous endemic and threatened bird species.</p> <p>Twenty nine species recorded from this site are listed under international conventions or bilateral agreements protecting migratory species.</p> <p>This site is also significant for the extraordinarily rich rock art, which contains many representations of plants and animals, and offers a valuable set of evidence of environmental histories and biotic changes over time (e.g. Brandl 1972; Calaby and Lewis 1977; Murray and Chaloupka 1984). Indigenous environmental knowledge remains strong, and is providing important information about management and conservation (e.g. Telfer 2006; Telfer and Garde 2006).</p>
MANAGEMENT ISSUES		<p>Fire: This site contains many species and environments that are fire-sensitive, and that are generally declining under current fire regimes. The main management problem is the high incidence of extensive late dry season fires – for example in 2004 and 2006 late dry season fires burnt over 80% of the plateau (Petty <i>et al.</i> 2007). Early and strategic preventative fire management may reduce the frequency, intensity and extent of such destructive fires.</p> <p>Feral animals: This site has significant, and probably expanding (because largely unchecked) populations of feral Water Buffalo, pig and Cane Toad, all of which may reduce environmental quality and/or lead to population reductions in some native species. Water buffalo are having severe impacts on upland wetlands and drainage lines (P. Cooke, Wardeken Land Management Ltd., pers. comm.). Feral cats are also widespread, but probably in relatively low numbers. Feral horse and donkey present some localised management problems. There may be an increasing incidence of European Honey Bees, possibly with some impacts on native bees.</p> <p>Weeds: One Weed of National Significance (<i>Mesquite Prosopis pallida</i>), 12 Category A and B weeds, and four undeclared but problematic environmental weeds (high priority weeds: Smith 2001) are recorded from this site. The incidence of weeds in this site however, is generally low, but there are localised outbreaks of <i>Hyptis suaveolens</i>, especially in areas with high feral buffalo densities. Incursions of pasture grasses (especially mission <i>Pennisetum</i> sp. and gamba grasses <i>Andropogon gayanus</i>) may be the most substantial potential weed problem.</p> <p>Other: There is some mining exploration in this site, with localised impacts.</p> <p>A major factor in the conservation of this area is the limited number of people and management resources (Bowman and Prior 2004; Bowman <i>et al.</i> 2001, 2004).</p> <p>Given the very limited range of some endemic species and the fire-sensitivity of some environments, climate change (especially mediated through consequential changes in fire regimes) may threaten some species and environments.</p>

MANAGEMENT INFORMATION	NRM groups	Manwurru Rangers (Kabulwarnamyo), Mimal Rangers (Bulman), Djelk Rangers (Maningrida), Adjumarllarl Rangers (Gunbulanya), Jawoyn Rangers (Katherine) (Northern Land Council 2006).
	Protected areas	Kakadu National Park (6357 km ² / 22% of site); Nitmiluk (Katherine Gorge) National Park (2315 km ² / 8% of site). The proposed Warddeken Indigenous Protected Area includes much of the north-eastern part of the site.
	Current management plans	<p>Site-specific plans: Kakadu National Park: Arnhem Land Plateau draft fire management plan (Petty et al. 2007); Nitmiluk (Katherine Gorge) National Park Plan of Management (PWCNT 2002); Kakadu National Park Management Plan 2007-2014 (Kakadu Board of Management 2007); Warddeken Indigenous Protected Area - Draft Management Plan 2008 (Warddeken Land Management Limited in prep.).</p> <p>National recovery plans for threatened species: <i>Boronia quadrilata</i> and <i>B. viridiflora</i> (Liddle 2007); Gouldian Finch (O'Malley 2006); shrike-tit, masked owl and partridge pigeon (Woinarski 2004a); Northern Hopping-mouse (Woinarski 2004b); Golden-backed Tree-rat (Palmer et al. 2003); Northern Quoll (Hill and Ward in prep.).</p> <p>Other management plans: Australian Weeds Strategy (NRMMC 2007); Threat Abatement Plan for Predation by Feral Cats (Environment Australia 1999); Threat Abatement Plan for Predation, habitat degradation, competition and disease transmission by feral pigs (DEH 2005); FIREPLAN: Fire management for the savanna community (Russell-Smith et al. in press).</p>
	Monitoring programs and research projects	<p>Detailed fire mapping and on-ground monitoring of fuel loads at almost 90 permanent plots by Bushfires NT as part of the Tropical Savannas CRC West Arnhem Land Fire Abatement Project (Russell-Smith et al. in press.) http://savanna.ntu.edu.au/research/projects/fireplan.html, and continuous mapping of fire in the tropical savannas under the North Australia Fire Information Project http://www.firenorth.org.au/nafi/app/init.jsp.</p> <p>Regular (5-year interval) monitoring of vegetation and fauna has been conducted in a series of 30-50 permanent fire plots in each of Kakadu National Park (Edwards et al. 2003) and Nitmiluk National Park. Monitoring plots have been established for several threatened plants (Kerrigan 2003, 2004; Cowie 2005; D. Liddle, NRETAS unpubl.).</p> <p>Some irregular monitoring of the extent of rainforest patches, and the survivorship of some rainforest plants has been reported (Bowman and Dingle 2006; Banfa and Bowman 2007; Prior et al. 2007).</p>
	Management recommendations	<p>Develop coordinated and strategic fire management in the bioregion using latest technology, research, and collaboration between landholders and other stakeholders (NRETA 2005).</p> <p>Continue building capacity and awareness in local communities about fire management through the Arnhem Land Fire Abatement project (NRETA 2005)</p> <p>Provide additional financial and other resources to expand the capacity of community-based rangers to manage threatening processes; reduce the impacts of these threatening processes (including feral animals); and prevent the incursions of others (including major weeds) (NRETA 2005).</p> <p>Maintain and expand monitoring programs for threatened species, fire-sensitive vegetation, and environments generally.</p>
KEY REFERENCES	Papers and reports	<p>Russell-Smith J. (1991). Classification, species richness and environmental relations of monsoon rain forest in northern Australia. <i>Journal of Vegetation Science</i> 2: 259-278.</p> <p>Warddeken Land Management Limited (in prep.) <i>Warddeken Indigenous Protected Area, Arnhem Land Plateau Northern Territory – Draft Management Plan 2008</i>.</p> <p>Woinarski, J.C.Z., Hempel, C., Cowie, I., Brennan, K., Kerrigan, R., Leach, G., and Russell-Smith, J. (2006). Distributional patterns of plant species endemic to the Northern Territory, Australia. <i>Australian Journal of Botany</i> 54, 627-640.</p>
Contributors	John Woinarski, Biodiversity Conservation, NRETAS, Darwin	