IUCN Conservation Outlook Assessment 2017 **(archived)**
Finalised on 10 November 2017

Please note: this is an archived Conservation Outlook Assessment for Kakadu National Park. To access the most up-to-date Conservation Outlook Assessment for this site, please visit https://www.worldheritageoutlook.iucn.org.

Kakadu National Park

SITE INFORMATION

Country:
Australia
Inscribed in: 1992
Criteria:
(i) (vi) (vii) (ix) (x)

Site description:
This unique archaeological and ethnological reserve, located in the Northern Territory, has been inhabited continuously for more than 40,000 years. The cave paintings, rock carvings and archaeological sites record the skills and way of life of the region’s inhabitants, from the hunter-gatherers of prehistoric times to the Aboriginal people still living there. It is a unique example of a complex of ecosystems, including tidal flats, floodplains, lowlands and plateaux, and provides a habitat for a wide range of rare or endemic species of plants and animals. © UNESCO

SUMMARY

2017 Conservation Outlook

Significant concern

This large and extremely spectacular biodiversity-rich property faces a great number of challenges, in part known thanks to the great amount of research and monitoring that has been undertaken at the site. An important documented decline in many species of small mammals as well as some birds, other species, and critical habitats, the unfortunate recent arrival of cane toads, and the existence of a uranium mine in an enclave of the property are negative factors which will take time to remedy. Positive developments include the relinquishing of one mining lease-hold and incorporation of this area within the property, and the successful management of invasive species such as mimosa and some feral animals. While recognising both positive and negative management elements , given the unknown effects of climate change (effects of which have started to be experienced), the conservation outlook for this outstanding property remains as being of Significant Concern.

Current state and trend of VALUES

High Concern
Trend: Deteriorating

Despite the large size and effective management of the property, a significant decline in small mammals, some birds, and possibly other species has been observed since inscription. The problem is complex with potential causes, predation and over-grazing by feral animals, and (or a combination of these). The arrival of cane toads to the park in 2001 was a negative development, as has been the Ranger uranium mine, though it represents a small area adjacent to the 20,000 square kilometre park, and it is monitored closely by the Supervising Scientist. On the other hand, vast areas of the property are still in excellent structural condition and park management is sincere in dealing with all these challenges. However, until deteriorating trends to the current state of World

Heritage values are reversed, the situation must be assessed as of High Concern.

Overall THREATS

High Threat

Current threats include predation and habitat damage by alien plants and animals, and uncontrolled wildfire, which at times act synergistically to increase the damage caused to the values of the property. Potential threats caused by climate change may result in sea level rise and saltwater intrusion, the risk of increased frequency and intensity of wildfire, storms or drought or change in the chemical composition of seawater, all of which would impact the property greatly. New or increased invasions of alien species including pathogens and disease, again compounded by climate change, are another real risk. Mining has been viewed as one of the principal threats to the property given that a uranium mine operates in an enclave within the property and uranium ore has to be transported through the property, posing risk of radioactive contamination. On the other hand, the values of the property are well conserved and park management is attempting to deal appropriately and professionally with these challenges.

Overall PROTECTION and MANAGEMENT

Mostly Effective

Protection and management in Kakadu is mostly effective and involves dedicated management planning and qualified staff; investment in research and monitoring, however, needs to be both systematised (given high staff turnover) and better resourced. Possibly due to factors beyond management control, including climate change, some biodiversity values in the park are declining, and monitoring and research to assess, understand and reverse these trends is under way. While there are some tensions on the ground, both between the different Indigenous groups who live in Kakadu and those groups and park management, in general the park management response to a wide range of challenges is sincere and often effective.

FULL ASSESSMENT

Description of values

Values

World Heritage values

- **Great natural beauty and sweeping landscapes**
  Criterion:(vii)

  Kakadu National Park has a wide variety of landscapes from mangrove-fringed tidal plains in the north, to vast floodplains, lowland hills and sandstone cliffs of the Arnhem Land escarpment. The escarpment consists of vertical and stepped cliff faces up to 330 metres high and extends in a jagged and unbroken line for hundreds of kilometres. The plateau areas behind the escarpment are inaccessible by vehicle and contain vast areas with no human infrastructure and limited public access. The views from the plateau are breath-taking (SoOUV, 2013).

- **Vast congregations of migratory waterbirds**
  Criterion:(vii)

  The large areas of internationally important wetlands in the central and northern regions provide habitat for millions of migratory waterbirds during the dry season, peaking from August to October (IUCN, 1981, 1992; Nomination, 1991; SoOUV, 2013). Waterbird abundance on the Kakadu National Park floodplains has been estimated at around 450-1600 birds/km2 in the dry season and 60-180 in the wet season, with magpie geese (Anseranas semipalmata) making up around 70% of the total. (Pettit et al., 2011).

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Large and relatively intact landscape allowing continued evolutionary processes

Criterion:(ix)

The park has significant elements of four major river systems of tropical Australia. Kakadu's ancient escarpment and stone country span more than two billion years of geological history, whereas the floodplains are geographically recent, dynamic environments, shaped by changing sea levels and big floods every wet season. The floodplains illustrate the ecological and geomorphological effects that have accompanied Holocene climate change and sea level rise. The Kakadu region has had relatively little impact from European settlement, by comparison with much of the Australian continent. With extensive and relatively unmodified natural vegetation and largely intact faunal composition, the park provides a unique opportunity to investigate large-scale evolutionary processes in a relatively undisturbed landscape (SoOUV, 2013).

► Conservation of significant habitats

Criterion:(x)

The park is unique in protecting almost the entire catchment of a large tropical river, conserving one of the widest range of significant habitats in tropical northern Australia (SoOUV, 2013). Several important plant communities are restricted to the park, including those associated with Eucalyptus koolpinensis, the heath vegetation on the margins of the Marrawal Plateau, and woodland containing Terminalia platyptera or snake plains (Nomination, 1991). One extensive habitat occurring in the park, sandstone heaths of the Arnhem Plateau (formally known as the Arnhem Plateau Sandstone Shrubland Complex), is listed as an Endangered Community under national legislation, with contemporary fire regimes recognised as the key threatening process (CoA, 2012).

► Threatened, endemic and relict plants

Criterion:(x)

Kakadu is the one of the most diverse and floristically intact area of northern Australia with more than 1,600 plant species recorded from the park. There are at least 200 plant species that are endemic to the Kakadu area (including the stone country of western Arnhem Land), making it one of Australia's

centres of endemism for plants (Woinarski et al. 2006). Four species of plants are listed as threatened under national legislation or by IUCN (DNP 2016a).

► Threatened, endemic and relict mammals

Criterion:(x)

The park contains about one quarter of the land mammal species found in Australia, with more than 64 recorded species (77, DNP, 2007). Calaby's mouse (Pseudomys calabyi), Kakadu dunnart (Sminthopsis bindi), Arnhem Rock-rat (Zyzomys maini) and Arnhem Leaf-nosed Bat (Hipposideros inornatus) have most of their known population within the confines of the park. Other significant species include, Nabarlek (Petrogale concinna); ghost bat (Macroderma gigas); brush-tailed phascogale (Phascogale tapoatafa); and northern brushtail possum (Trichosurus arnhemensis). Marine and coastal habitats support a substantial dugong (Dugong dugong) population (Nomination, 1991; IUCN, 1992).
Seventeen mammal species are listed as being threatened under national or IUCN listing criteria, of which five are probably no longer present in the park (J. Woinarski pers. comm.).

► Threatened, endemic and relict birds

Criterion:(x)

Over one third of Australia’s bird species (275) have been recorded in the park (IUCN, 1992). Birds whose survival depends in part on the protection of the park include the subspecies of banded fruit dove (Ptilinopus cinctus), endemic to the Arnhem Land sandstone massif; and hooded parrot (Psephotus dissimilis. Also worthy of note are the white-throated grass- wren (Amytomis woodwardi) and the partridge pigeon (Geophaps smithii smithii) (IUCN, 1981; Nomination, 1991). Eleven bird species are listed as being threatened under national or IUCN criteria (J. Woinarski pers. comm.).

► Threatened, endemic and relict frogs

Criterion:(x)

More than 25 (27, DNP, 2007) species of frogs have been recorded from the park (IUCN, 1992). Most notable is the uncommon, large carpenter frog (Limnodynastes lignarius), which is restricted to sandstone escarpment areas between western Arnhem Land and the Kimberleys. Other rock-dwelling

endemics of the area are Copland's rock frog (Litoria coplandi), rockhole frog (Litoria meiriana), and the rarely seen masked frog (Litoria personata) (Nomination, 1991). No amphibians are listed as being threatened (Woinarski & Winderlich, 2014).

► Threatened and endemic reptiles

Criterion:(x)

The reptile fauna comprises a diverse range of species. At the time of nomination, two species of crocodile, seven species of freshwater turtle, three species of sea turtle, 77 lizard species (15 gecko species, four legless lizard species, 10 dragon species, 11 monitor species and 37 skink species) and 39 species of snake had been recorded in the park (Nomination, 1991). The number of known reptile species in the park has increased substantially since then. There are many endemic or near endemic reptile species including the Oenpelli python (Simalia oenpelliensis), yellow-snouted gecko (Lucasium occultum), dotted velvet gecko (Oedura gemmata), giant cave gecko (Pseudothecadactylus lindneri), Arnhem Phasmid Gecko (Strophurus horneri), Arnhem Land Skink (Bellatorius obiri), Jabiluka Ctenotus (Ctenotus arnhemensis), Brown-backed Ctenotus (C. coggeri), Magela Ctenotus (C. gagadju), and Jabiluka Dwarf Skink (Menetia concinna) (Woinarski et al. 2009). Kakadu contains among the most important breeding habitat in the world for the saltwater crocodile (Crocodylus porosus) and the pig-nosed turtle (Carettochelys insculpta). Marine and coastal habitats support substantial turtle populations (IUCN, 1981, 1992). At least thirteen species of reptile are listed as being threatened under national or IUCN criteria (J. Woinarski pers. comm.; Chapple et al. in press).

► Threatened, endemic and relict fish

Criterion:(x)

Fifty-nine fish species, 12 of which generally live exclusively in saltwater environments, are recorded from freshwater locations in the park. This represents approximately one-third (25% IUCN, 1992) of all fish species found in Australian freshwater (Nomination, 1991). Kakadu contains a significant portion of the total range for the exquisite rainbowfish (Melanotaenia exquisita), Mariana's or the Magela hardyhead (Craterocephalus marianae) , the sharp-nosed grunter (Syncomistes butleri)

and Midgley's grunter (Pingalla midgleyi) (Nomination, 1991). Over 246 tidal and freshwater species have been recorded in the park (DNP, 2007). Five species, two sharks and three sawfish, are listed as being Critically Endangered or Endangered under IUCN classification (Woinarski & Winderlich, 2014).

▶ **Threatened and endemic invertebrates**
Criterion:(x)

Estimates of the total invertebrate population of Kakadu range between 10, 000 and 100,000 species. More research is needed to refine this estimate. (Nomination, 1991). Known invertebrates include 55 species of termite and several hundred species of ants (IUCN, 1992; A. Andersen pers. comm.). Although the conservation status of most invertebrates in Kakadu is unknown, one species is listed as being Critically Endangered and five as Vulnerable under IUCN criteria (Woinarski & Winderlich, 2014).

Assessment information

Threats

Current Threats
High Threat

Current threats include predation and habitat damage by alien plants and animals, and uncontrolled wildfire, which at times act synergistically to increase the damage caused to World Heritage values. While there are a range of invasive fauna the most harmful are buffalo, feral pigs, cats and cane toads, which have been partially implicated in the decline in northern quoll and reptile populations over the past few decades. Mining has been viewed as one of the principal threats to the property given that a uranium mine operates in an enclave within the property and uranium ore has to be transported through the property, posing risk of radioactive contamination. With the mine set to close in 2021, this will move to the issue of rehabilitation of the land.

Since 2014 Kakadu has made very real progress against threats to its plants and animals. The Australian Government launched a strategy in November 2014 to better focus resources on Kakadu's threatened plants and wildlife. The Kakadu Threatened Species Strategy 2014-2024 was developed primarily by leading wildlife expert Professor John Woinarski, through the Northern Australia Hub of the Australian Government's National Environmental Research Program.

► Mining/ Quarrying

High Threat
Inside site, localised(<5%)
Outside site

Energy Resources of Australia's Ranger uranium mine, surrounded by Kakadu, will close in 2021. The land will be rehabilitated back to a state in keeping with the adjacent park, and seed collection within the national park in preparation for this purpose is well underway.
Mining has been viewed as one of the principal threats to the property given that a uranium mine is surrounded by the park, and that ore has to be transported through the area with the risk of radioactive contamination. In addition, safe storage of the uranium tailings is an ongoing concern. Many reports, monitoring and discussion about the uranium issue have been produced (see WHC, 1998; Environment Australia, 1999 and others in http://www.environment.gov.au/ssd/supervision/arr-mines/jabiluka.html).
Restoration of small-scale mining has been undertaken elsewhere in Kakadu (IUCN, 1992) and is ongoing in the south of the park (SOC, 2003; DNP, 2012).
The Koongarra Project Area (1,228 ha), one of the three mining leases surrounded by the park, was added to the property in 2011 (Decision 35COM 8B.49), meaning that mining at Koongarra will never be permitted.

► Tourism/ visitors/ recreation

Low Threat
Inside site, localised(<5%)
Outside site

Tourism in Kakadu provides a rare and essential source of income and employment for local communities. Tourism also contributes to the park's operational budget, allowing the managers to undertake enhanced management initiatives for fire, invasive animals and invasive weeds.
With the closure of the Ranger Mine in 2021, there is a need to ensure nature

tourism, rather than mining, provides a sustainable economic base for local communities.
Tourism in Kakadu is carefully managed to sensitively showcase the natural and cultural values to visitors, provide economic and employment opportunities for locals and improve management programs for threatening processes through increasing operational funds.
Potential impacts of more tourism opportunities and higher visitor numbers include increasing the transmission of invasive species and the risk of fire, as well as damaging landscape values with more roads, infrastructure and waste. With tourism a key driver for the local traditional owners, any potential impacts will be managed carefully into the future through Kakadu’s management plan.

► Other Ecosystem Modifications

Low Threat
Inside site, scattered(5-15%)
Outside site

It has been hypothesised that a rise in CO2 in the atmosphere is favouring woody plant growth to the detriment of treeless floodplains, important habitat for numerous species and migratory waterfowl (Bowman et al., 2008). While other factors could also be causing woody encroachment, this rapid environmental shift could be a threat to a number of values to the property.

► Invasive Non-Native/ Alien Species

High Threat
Inside site, widespread(15-50%)
Outside site

Kakadu rangers actively manage weeds in the park through several methods, including use of a biocontrol agent (a weevil) to control the weed salivinia. Para grass (Urochloa mutica) was spreading rapidly on the Magela floodplain in Kakadu National Park (Bayliss et al. 2012), with infestations on the Wildman River floodplain and smaller patches occurring on the West Alligator River and South Alligator River floodplain margins (Setterfield et al. 2013). Olive hymenachne (Hymenachne amplexicaulis) is also an increasing invasive grass on the KNP floodplains. Other invasives include mission grass (Pennisetum polystachion); gamba grass (Andropogon gayanis); Mimosa pigra, candle bush (Senna alata); calopo (Calopogonium mucunoides);

gambia pea (Crotalaria goreensis); golden shower (Cassia fistula); poinciana (Delonix regia), and coffee bush (Leucaena leucocephala) (http://www.environment.gov.au/parks/kakadu/management/programs/weeds.html). Additional invasive plants which continue to be managed include Pennisetum Pennisetum pedicillatum; bellyache bush (Jatropha gossypifolia), wild cotton (Gossypium sp.) and rubber bush (Calotropis procera) (http://www.environorth.org.au/windows/dk/dk_weeds_conservation.html, Cowie & Werner, 1987; Storrs, 1996). However, there is a high potential for weeds to enter Kakadu from Arnhem Land and adjoining pastoral properties on the western boundary. New species, such as Aleman grass (Echinochloa polystachya); olive hymenachne (Hymenachne amplexicaulis); and knobweed (Hyptis capitata) have recently been found in the park. Weeds also have the potential to be carried into the park on vehicles. There are significant weed infestations in Jabiru and other lease areas that could pose a major threat to the rest of the park if they are not effectively managed (DNP, 2007). Therefore while weeds in the park are generally well managed given the difficulty of preventing weeds from entering into the property and the number of known invasive species already affecting the property, the threat of invasive plant species on the site's values remains high.

► Temperature extremes, Storms/Flooding

High Threat
Inside site, widespread(15-50%)
Outside site

Effects of climate change can already be seen. More frequent and intense rainfall events have increased in recent years, causing greater and more frequent flooding of the river systems. Changes to salt and freshwater wetlands through saltwater intrusion have already been observed in the park over the past few decades (Hyder, 2008). A tidally-driven hydrodynamic model was developed to simulate the frequency and extent of salt water intrusion (SWI) in the Kakadu Region (Bayliss et al 2016). The model scenarios were used to assess potential loss of freshwater floodplains from climate model predictions of sea level rise and subsequent SWI. Results show that by 2030 3% of the floodplain will be exposed to SWI and 42% by 2070. All floodplains on Kakadu will be exposed to SWI by 2132 (Bayliss et al. 2017).

► Fire/ Fire Suppression

High Threat
Inside site, widespread(15-50%)
Outside site

Fire management in the park occurs in consultation and conjunction with the Binninj/Mungguy people who have managed Kakadu for generations.
Over the past few years, small mammal decline across the woodlands of Northern Australia has been attributed to an increase in widespread and intense late season wildfires.
In 2016 and 2017 Kakadu responded by undertaking an extensive program of early dry season prescribed burns. While fire is often seen as a threatening process, carefully and skilfully managed, it is the park's best landscape-scale management tool. By implementing these carefully designed and positioned prescribed burns along roads and river edges, Kakadu has created effective firebreaks that restrict the extent and therefore damage of late season fires. Following these programs, there is now much more unburnt woodland available as habitat for species. Additionally, delicate prescribed burning in the wet season is used to create finer mosaics of burnt and unburnt vegetation. These changes to fire regimes in the park are expected to create conditions that support the recovery of species populations. It will take time to see the outcomes, but Kakadu National Park is working with the Northern Territory Department of Environment and Natural Resources to put in place a new long-term monitoring program that will enable changes in fauna populations to be detected.
The cessation of traditional indigenous floodplain burning practices in the past (McGregor et al. 2010), is thought likely to have contributed to the widespread increase in aquatic grasses and in particular the invasive paragrass, on the floodplain (Bayliss et al. 2006). In more recent times, there have been efforts to reintroduce traditional fire management to areas such as the Kakadu wetlands (MacGregor and others 2010).

► Invasive Non-Native/ Alien Species

High Threat
Inside site, widespread(15-50%)
Outside site

The management objective for feral animals in Kakadu is to limit, as far as

possible, their adverse effects on the environment while taking into account the views and economic interests of its Aboriginal Traditional Owners. (http://www.environment.gov.au/parks/kakadu/management/programs/feral-animals.html).
In early 2017, a large feral animal culling program was undertaken in southern Kakadu following extensive consultation with Traditional Owners. Approximately 6,000 animals were culled, with some meat being returned to Traditional Owners for food. Further culling was undertaken in October 2017 with approximately 2,900 culled (nearly 9,000 for the year).
A feral animal working group, made up of Kakadu Traditional Owners, has developed a set of feral animal management protocols to improve the management of feral animals in Kakadu. These protocols set out the ways in which feral animals are managed in Kakadu, including provisions for economic opportunities for Bininj/Mungguy.

While management responses to these threats are generally appropriate, the impact of invasive animals on World Heritage values is so great that the threat level must be assessed at high. It would be very high if good management was not in place.
Invasive animals in the property include Asian water buffalo, cattle, pigs, horses, donkeys, cats, dogs, rats, mice, house geckos and European bees. Cane toads were recorded in Kakadu for the first time in early 2001.
While all the invasive animals may impact the park’s World Heritage values, possibly the most harmful are feral cats, buffalo and pigs; as well as cane toads, which have been partially implicated in the decline in northern quolls, goanna and snake populations over the past few decades (Woinarski et al. 2001; Palmer et al. 2003; Doody et al., 2007; Woinarski et al. 2007; Burbridge et al., 2009; Woinarski et al., 2010).
Feral pigs are now widespread consumers of plants, especially sedges (primarily Eleocaris dulcis), competing directly with waterbirds such as magpie geese (Anseranas semipalmata) and brolgas (Grus rubicunda) (Bayliss et al., 2006, Pettit et al. 2011). There is growing concern that feral cat predation, particularly in interaction with the effects of extensive fires on habitat conditions, is a very significant threatening process (Ziembicki et al., 2015).
Kakadu is undertaking a trial of different methods for feral cat management throughout the park.

Potential Threats

High Threat

Potential threats caused by climate change will result in sea level rise, the risk of increased fire frequency and intensity fire, storms or drought or change in the chemical composition of seawater, all of which would impact World Heritage values greatly. New or increased populations of alien species including pathogens and disease, again compounded by climate change, are another real risk. Pastoral development and an increasing tourism industry may add to the pressure on park values.

► Other

Low Threat
Inside site, extent of threat not known

Unlike many other World Heritage sites in Australia, specific diseases have not been signalled as affecting biodiversity in the park. However, the potential for novel diseases or pathogens to enter the park remains and accordingly the park has risk preparedness plans in place (DNP, 2007).

► Temperature extremes, Other

Very High Threat
Inside site, extent of threat not known

The park’s wetlands are susceptible to saltwater intrusion from future changes in climate and sea levels. Saltwater intrusion can lead to the conversion of freshwater paperbark (Melaleuca spp.) swamps into extensions of the mangrove margin. Die-back of some Melaleuca has been observed in Kakadu’s northern wetlands. Saltwater intrusion and/or inappropriate fire regimes associated with weed invasions are possible contributory factors (SOC, 2003). Recent studies indicate that extensive areas of Kakadu’s floodplains and wetlands are highly likely to be inundated in coming decades (Asbridge & Lucas, 2016; Pettit et al., 2016).

► Temperature extremes

Very High Threat

Inside site, throughout(>50%)
Outside site

Climate change has the potential to affect every World Heritage value in the property at a large scale. For example, if sea level rises, the floodplain is likely to be significantly affected and here is potential for saltwater incursions into freshwater ecosystems. Climate change may also change fire seasons and regimes, and create increased potential for the spread of exotic flora and fauna. Park managers are implementing a climate change strategy that includes a range of adaptation, mitigation and communication actions to manage the anticipated changes. A challenge identified in 2003 is whether management will be able to cope with unpredictable changes in temperature, storm frequency, flooding, drought and changes in sea water composition to conserve the World Heritage values (SOC, 2003) – the strategy adopted in Kakadu is the adoption of management practices that maximise ecological resilience to increase capacity to adapt as climate change manifests (DNP, 2017).

Protection and management

Assessing Protection and Management

► Relationships with local people

Some Concern

The joint management arrangements between the traditional Aboriginal land-owners and park management has, in the past, been highlighted as exemplary, “a model of effective park management” (IUCN, 1992). The park’s traditional owners constitute a majority of Board members (SoOUV, 2013). A program recently undertaken by the park authorities has focused on hearing and understanding the aspirations of the contemporary traditional owners and has already resulted in changes to the Board of management processes. Challenges remain to increase the level of Indigenous employment and training. A Joint Management Team to better address these concerns and challenges is being established in 2017-18.

► Legal framework

Highly Effective

The property is well protected by legislation and is co-managed with the Aboriginal traditional owners, which is an essential aspect of the management system. The Director of National Parks performs functions and exercises powers under the Environment Protection and Biodiversity Conservation Act 1999 in accordance with the park's management plan and relevant decisions of the Kakadu National Park Board of Management. These arrangements ensure that the park has effective legal protection, a sound planning framework and that management issues are addressed (SoOUV, 2013). Other national legislation relevant to the management of Kakadu National Park includes: Australian Heritage Commission Act 1974; Aboriginal and Torres Strait Islander Heritage Protection Act 1984; Native Title Act 1993; Aboriginal Land Rights (Northern Territory) Act 1976; and Jabiru Town Development Authority Act 1978 (SOC, 2003).

► Enforcement

Highly Effective

Enforcement of the relevant laws and regulations is effective.

► Integration into regional and national planning systems

Highly Effective

The Director of National Park's Annual Report shows there is good integration into regional and national planning systems (DNP, 2017).

► Management system

Highly Effective

The park is guided by the Kakadu National Park Management Plan 2016-2026. Other significant management documents: Tourism Master Plan, District and Stone Country fire management plans, Crocodile Management Strategy, Feral Animal Management Strategy; Gunlom Mine Sites Rehabilitation Strategy, Threatened Species Strategy, Cultural Heritage Strategy, Weed Management Strategy, Climate Change Strategy, and Waste Management Strategy (DNP, 2012). As noted in that new plan, some

management strategies are being revised or under development, in line with best practice adaptive land management.

► Management effectiveness

Mostly Effective

Management effectiveness can be measured by trends for native species and threatening processes (Parr et al., 2009). While the data are not available to make a judgement for many biodiversity components, there are growing indications that there are declines in some native species and an increase in threatening processes (see worksheets 2 and 4).

► Implementation of Committee decisions and recommendations

Mostly Effective

The last SP report dates from 2003. There has been a gradual move to greater implementation of Committee decisions and recommendations. The decision by the SP and managers to integrate the 1,228 ha enclave known as the Koongarra Project Area into the property in 2011 is exemplary (IUCN, 2011).

► Boundaries

Mostly Effective

The straight-line boundaries of Kakadu are artificial. Although the South Alligator River drainage basin is mostly contained within the park (with the remaining small part of its headwaters in the neighbouring Warddeken Indigenous Protected Area), headwaters of other rivers lie outside. In an ideal world, ecological/hydrological criteria would allow a different configuration and might also include the drainage basin of the East Alligator River in Arnhem Land which would add additional values and integrity to Kakadu. There are also important natural values in the Cobourg Peninsula and in some of the coastal wetlands to the west of the park (IUCN, 1992). It would be useful to extend the boundaries or add buffer zones and to increase the extent of the partial buffer currently provided by other protected areas around Kakadu, but given the large size of the property, 20,000 square kilometres, this is probably unlikely. However, the issue of changing the zoning plan within the existing park and making the previous no-go wilderness area more accessible has been identified as a problem. However,

the inclusion in 2011 into the property of one of the three mineral leases that pre-exist the establishment of the park (Koongarra), and stopping mining in this site, is extremely positive (IUCN, 2011).

► Sustainable finance

Highly Effective

Funds are provided each financial year for the park from the Commonwealth Government for the effective management of the Park and to fulfil the terms and conditions of the Lease and the Plan of Management. In the 2016-17 financial year, the Australian Government made an allocation of approximately $19 million specifically for Kakadu National Park operations and capital works. Lease payments – including rental and a share of revenue generated from Park use fees and charges – are made to the Northern Land Council on behalf of the Land Trusts.
In 2016-17, 38.8 per cent of revenue generated through park passes and permits was distributed to traditional owners directly ($1.837 million), an increase of nine per cent on the previous financial year. The remaining revenue received from Park user fees and other income subsidises the Commonwealth Government's contribution to the Park (SOC, 2003). Today tourism revenue constitutes 22 per cent, or one fifth, of the park's total Budget ($4.026 million).
Director of National Parks Annual Reports are available at https://www.environment.gov.au/topics/national-parks/parks-australia/publications.

► Staff training and development

Mostly Effective

Developing staff through formal and informal training programmes is undertaken, although listed as a "major challenge" in the Annual Report (DNP, 2012).

► Sustainable use

Highly Effective

Limited sustainable use including hunting (although discouraging lead bullets) is allowed within the park with traditional landowners. A new Cultural

Heritage Strategy, after stakeholder consultations, was implemented in 2012 (DNP, 2012).

► Education and interpretation programs

Highly Effective

Numerous publications to provide educational information on the values of Kakadu National Park, including guidebooks, Park Notes, maps, information pamphlets, website http://www.environment.gov.au/parks/kakadu/index.html (SOC; 2003).

► Tourism and visitation management

Highly Effective

Interpretive programmes, guided walks and cultural activities with traditional owners at selected sites (SOC, 2003). 159,206 visitors (estimate) 2011-2012 (DNP, 2012).

► Monitoring

Highly Effective

Monitoring of invasive species, threatened species, fire monitoring, climate change, tourism (DNP, 2012).

► Research

Mostly Effective

Research including understanding decline in small mammals and potential impact of climate change on wetland and coastal environments. Numerous permits for research in the park are granted each year. Innovative research on training endangered northern quolls to avoid cane toad as prey (DNP, 2012) and trialling cat eradication methods (DNP, 2016).

Overall assessment of protection and management

Mostly Effective

Protection and management in Kakadu is mostly effective and involves dedicated management planning and qualified staff; investment in research and monitoring, however, needs to be both systematised (given high staff

turnover) and better resourced. Possibly due to factors beyond management control, including climate change, some biodiversity values in the park are declining, and monitoring and research to assess, understand and reverse these trends is under way. While there are some tensions on the ground, both between the different Indigenous groups who live in Kakadu and those groups and park management, in general the park management response to a wide range of challenges is sincere and often effective.

► Assessment of the effectiveness of protection and management in addressing threats outside the site

Some Concern

The Ranger uranium mine, external to the park, will close in 2021. This poses a challenge to rehabilitate the mine site back to a condition where it could be incorporated into the park while retaining infrastructure required for both the Aboriginal community and visitors.
Security procedures are high, and monitored by Australia's Supervising Scientist, but NGOs have cited breaches in the past. The responsibility for rehabilitating Ranger to an appropriate condition lies with the lease holder – Energy Resources of Australia and its parent company, Rio Tinto. A multi-government, multi-party working group has been established to oversee the mine's transition and closure.
Information is available about the management of protected areas bordering Kakadu; for example:
Nitmiluk National Park:
https://dtc.nt.gov.au/__data/assets/pdf_file/0009/260496/Nitmiluk-NP_Plan_July2014.pdf
Warddeken Indigenous Protected Area: https://www.warddeken.com/
There is no information on the management of the pastureland leases or the military base surrounding the property.

► Best practice examples

In the current assessment period the most pronounced improvements address enhancing tourism opportunities and visitor experiences, including:
The inaugural Taste of Kakadu food festival in May 2017. The festival boasted a program of 50 plus interactive activities across our park, such as bush food tasting, basket weaving and painting with traditional owners. 40 Bininj

(Kakadu's Aboriginal traditional owners) were employed during the event. The dry season has been the best in recent years with July up 7% on the previous year and August also up strongly. In addition, park pass revenue is up even more strongly – July revenue was up 10% - indicating increased visitation from international and interstate tourists. This can be partly attributed to the increased profile of the park, which is a result of activities like Taste of Kakadu.

Kakadu is enhancing relationships with tour operators (given that 45% of visitation occurs through this medium); supporting local tourism planning and infrastructure initiatives; working with the Northern Territory Tourism bureau; developing an on-line park visitation sales system; introducing Wi-fi to enhance visitation experience (DNP, 2016b). The promotion of economic opportunities for aboriginal landowners through commercial / contracted fire (and associated greenhouse emissions) management activities (DNP, 2016b) is a significant step forward. In the previous assessment, joint management arrangements and innovative research were highlighted. While it is fair to say that innovative biodiversity conservation research continues to be pursued by the park, including the reintroduction of northern quolls trained to avoid cane toads as prey and action research addressing delivery of fine-scale fire management, as noted previously more attention is required to deliver more effective joint management engagement. This is being addressed through the establishment of a dedicated Joint Management Team on the park in addition to the Joint Management Officer position which the park already funds.

State and trend of values

Assessing the current state and trend of values

World Heritage values

► Great natural beauty and sweeping landscapes

High Concern
Trend:Deteriorating

The Ranger uranium mine was opened in June 1998. Visual encroachment

through uranium mining and the associated incremental expansion of urban and infrastructure development in and associated with the town of Jabiru has impacted landscape values (WHC,1998). As this mine was opened well after inscription, despite the property being very large (1,980,995 ha), an enclave with a uranium mine and its associated development has had an impact on natural values in the property. On the other hand, one of three mining leaseholds, the Koongarra Project Area (1,228 ha), was incorporated into the property in 2011 (IUCN, 2011). While mining in an enclave within the property will always be seen as high concern or critical for this value until all mining activity ceases and the areas are restored, the decision of the traditional land-owners to include one of the three mining leaseholds into the property is extremely positive. The Ranger Mine will close in 2021; while this alleviates direct mining impacts, it also raises concerns regarding long-term rehabilitation issues (including leakage of sulphates into wetland systems), and significant challenges concerning the future of the Jabiru mining town infrastructure.

► Vast congregations of migratory waterbirds

Good
Trend:Stable

The floodplains have been designated a Ramsar site and an Important Bird Area (Alligator Rivers Floodplains), with estimates of some 5 million waterbirds using the area (Birdlife, s.d.). The high level of natural variability in wetland area and waterbird populations inherent over much of Australia makes the detection of trends in waterbird population sizes and relationships between these and rainfall, river flows and wetland extent, difficult to analyse robustly without sufficient long-term data (Kingsford et al., 2012). Future monitoring will be possible using the National Waterbird Database. However as there have been no reports of catastrophic declines in the waterbirds at Kakadu, for the moment this value can be assessed as stable. However, any sea level rise due to climate change will have a huge impact on these waterbirds.

► Large and relatively intact landscape allowing continued evolutionary processes

High Concern
Trend:Deteriorating

The decline in biodiversity and invasion of the property by cane toads in 2001 means that the intactness of the property has been reduced and evolutionary processes compromised. Invasive plants and other feral animals that were present since before inscription are managed and some have been reduced (DNP, 2012). Although the majority of the property is still reported to be in good shape (SOC, 2003), the recent invasion of cane toads as well as documented reductions in small mammals and some other species indicates high concern.

► Conservation of significant habitats

High Concern
Trend:Deteriorating

The majority of the property is still reported to be in good shape Dieback of some Melaleuca swamps has been observed in Kakadu’s northern wetlands. Saltwater intrusion and/or altered fire regimes associated with weed invasions are possible contributory factors (SOC, 2003). Significant fire impacts on the Endangered Arnhem Plateau Sandstone Shrubland Complex are ongoing (Russell-Smith et al., 2017).

► Threatened, endemic and relict plants

Good
Trend:Stable

No changes in native plant diversity and abundance have been reported despite declines in mammals and some birds, apart from the Melaleuca die-back mentioned above (SOC, 2003).

► Threatened, endemic and relict mammals

High Concern
Trend:Deteriorating

There has been a rapid and severe decline of the native mammal fauna in the property (Woinarski et al., 2001; 2010). Some species have probably disappeared from the park, though some, such as northern quolls, persist in small populations. The causes of decline are unclear; however initial theories suggest fire management regimes and feral cats (SoOUV, 2013; Ziembicki et al., 2015). Feral species are being managed and much improved fire regimes

are now in place; it is hoped that this will help mammal species recover.

▶ Threatened, endemic and relict birds

High Concern
Trend:Deteriorating

Partridge pigeon has been downlisted to VU since inscription of the property as populations in Kakadu have declined substantially over the last decade. This could be due to more or hotter fires, possibly due to invasion of exotic pasture grasses, particularly gamba grass (Andropogon gayanus), which reduces cover and increases predation by feral cats (Fraser et al., 2003; Garnett et al. 2011). The same problems might have caused the decline of the Gouldian finch (NT) (O'Malley, 2006) and the white-throated grass wren (VU) (Garnett et al., 2011).

▶ Threatened, endemic and relict frogs

Low Concern
Trend:Stable

There are no reports of Chytrid fungus affecting frogs on the property, although the invasion of cane toads, which can predate other smaller species of frogs, could be a problem.

▶ Threatened and endemic reptiles

Good
Trend:Deteriorating

Populations of several snake and lizard species are thought to be declining (IUCN Consultation, 2017). Monitoring confirmed steady numbers of estuarine crocodiles and nesting flatback turtles (DNP, 2012).

▶ Threatened, endemic and relict fish

Good
Trend:Stable

No changes in native fish diversity and abundance have been reported.

▶ Threatened and endemic invertebrates

Good
Trend:Stable

No changes in native invertebrate diversity and abundance have been reported, although the introduction of cane toads could impact certain invertebrates.

Summary of the Values

► **Assessment of the current state and trend of World Heritage values**

High Concern

Trend: Deteriorating

Despite the large size and effective management of the property, a significant decline in small mammals, some birds, and possibly other species has been observed since inscription. The problem is complex with potential causes, predation and over-grazing by feral animals, and (or a combination of these). The arrival of cane toads to the park in 2001 was a negative development, as has been the Ranger uranium mine, though it represents a small area adjacent to the 20,000 square kilometre park, and it is monitored closely by the Supervising Scientist. On the other hand, vast areas of the property are still in excellent structural condition and park management is sincere in dealing with all these challenges. However, until deteriorating trends to the current state of World Heritage values are reversed, the situation must be assessed as of High Concern.

Additional information

Benefits

Understanding Benefits

► **Outdoor recreation and tourism**

Kakadu National Park contributes tens of millions of dollars to the Northern Territory economy each year through tourism and purchase of significant

quantities of goods and services from local suppliers. (DNP, 2007).

▶ **Sacred natural sites or landscapes**

This large park (half the size of Switzerland) includes large wilderness area which until recently was zoned, restricting almost all access. It appears that access has not been increased.

▶ **Importance for research**

Great deal of research and education in the property which also creates jobs

▶ **Wilderness and iconic features**

Conservation of sacred sites and historical aboriginal sites

▶ **Water provision (importance for water quantity and quality)**

Water purity and catchment, soil stabilisation, coastal protection.

Summary of benefits

Due to the large size of the property and the fact that it is owned by Indigenous people who still have traditional land use rights within the property, the park is of primary benefit to the people who live within and near its borders, as well as providing significant benefits to the wider Australian and global community. In addition to nature conservation and conserving cultural and wilderness values, the property provides a wide range of ecosystem services, furnishes a wealth of scientific knowledge and provides jobs either through park management, tourism, research and education.

Projects

Compilation of active conservation projects

№	Organization/ individuals	Project duration	Brief description of Active Projects
1	Australian Government National Environmental Research Program (NERP), and ongoing National Environmental Science Program (NESP)	From: 2011 To: 2019	Ongoing National Environmental Research Programme/National Environmental Science Programme projects focusing on the potential impact of climate change on wetland and coastal environments. A NERP project, continued under NESP, assessed impacts of cat predation using an exclosure experiment: http://www.nespnorthern.edu.au/projects/nerp/research-and-management-to-reverse-the-decline-of-native-mammal-fauna/ http://www.nespnorthern.edu.au/projects/nesp/investigating-feral-cats-in-small-mammal-decline/ New research is being undertaken through NESP to assess the condition of and develop management guidelines for riparian communities Summary list of NESP Projects: • Guidelines for the management of threats to savanna riparian zones (2016–2019), including riparian responses to fire management in Kakadu • Investigating the role of feral cats in small mammal decline in Kakadu National Park (2015–2016). Continuation of the NERP cat-proof exclosure project—fauna sampling within exclosures, estimation of predator densities, cat dietary studies • Adaptive management of fire and feral animals to improve conservation of threatened species in Kakadu National Park (2016–2019) Threatened species monitoring design in Northern Australia (2015-2018). Re-designing the previous threatened species monitoring program for Kakadu, Litchfield and Gregory National Parks (“Three parks program”).
2	Charles Darwin University, Northern Territory Dept of Environment and Natural Resources	From: 1994 To: 2014	The Three Parks Savanna Fire-Effects Network (“Three parks program”) was established in 1994 to develop adaptive approaches to conservation-based fire management in regional savanna systems. The program assessed fire regimes and their impacts on plant and vertebrate biodiversity components in Kakadu, Litchfield and Gregory National Parks.
3	Kakadu NP		Kakadu National Park invasive plant monitoring and control. Includes: long-term annual monitoring of Mimosa pigra at 250 sites throughout the park and treatment of any plants found; biological control of salvinia using the salvinia weevil at key sites.

№	Organization/ individuals	Project duration	Brief description of Active Projects
4	Kakadu National Park		Kakadu National Park feral vertebrate monitoring and control, including periodic aerial culling of feral herbivores (pigs, buffalo, cattle, horses, donkeys).
5	Kakadu National Park		Fire management across the park, including implementation of Kakadu National Park Stone Country Fire Management Plan.
6	Kakadu National Park	From: 1995 To: 2017	Kakadu National Park Nesting Flatback Turtle (Natator depressus) survey on Gardangarl (Field Island)—annual monitoring and tagging of nesting indivduals.
7	Parks Australia with funding from the Threatened Species Commissioner	From: 2014 To: 2017	1. Targeting Threats from Fire, Weeds and Feral Animals: involving action to improve the conservation of Kakadu’s threatened species through intensive fire management with associated weed and feral animal control 2. Creating a Wildlife Refuge on Gardangarl (Field Island): involving practical action to improve the long-term viability of Kakadu’s threatened wildlife through the management of an island refuge 3. Expansion of the 'Toad Smart' Quolls Project: the project aimed to reintroduce ‘toad smart’ northern quolls to the Mary River District, Kakadu National Park, expanding on the toad smart quoll research conducted in Kakadu since 2010 4. Rescue Plan for Threatened Plants: involving practical steps to improve the conservation of the threatened plant species of Kakadu National Park through ex situ seed conservation

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