Threatened plants and animals in Kakadu National Park: a review and recommendations for management

John Woinarski
This report comprises three main sections. The first section is an introduction that lists the currently recognised threatened plant and animal species that occur within Kakadu National Park; describes the process and criteria for listing; notes the substantial discrepancies in lists between the last comprehensive review of Kakadu’s threatened species (1995) and this report; and notes also the substantial discrepancy between national and Northern Territory listings for threatened species occurring in Kakadu.

The second, and largest, section provides more specific information on each threatened species, noting in particular the status of each species within Kakadu National Park, as well as providing a broader conservation and management context.

The third section collates information on management and threats across the set of threatened species, and draws research and management priorities for Kakadu National Park.

The species occurring in Kakadu National Park that are listed as threatened under national and/or Northern Territory legislation are tabulated below. The current listing comprises a total of 16 plant species (of which 6 are listed at national level) and 31 animal species (of which 16 are listed at national level). An additional plant species has been nominated to be added at the next revision of the NT list. Information is also presented on four threatened plant species with records from near Kakadu, and considered reasonably likely to occur within Kakadu.

Plant species recorded from Kakadu NP and currently (August 2004) considered as threatened under the Environment Protection and Biodiversity Conservation Act 1999 and/or the Territory Parks and Wildlife Conservation Act. Note that no Kakadu plant species was listed under Federal legislation at the time of the publication of the Endangered Species Program for Kakadu ("STATUS 1995": Roeger and Russell-Smith 1995). Abbreviations: CE=Critically Endangered; EN=Endangered; VU=Vulnerable. For Northern Territory status only: DD=Data Deficient. Four species indicated are proposed to be downlisted in the next revision of Northern Territory conservation status, and one (Acacia D19063 Graveside Gorge), not previously assessed (NA), is proposed to be added to the list, as Critically Endangered (CE). Kakadu significance is an assessment of the importance of Kakadu in the overall status of the species.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>NT Status</th>
<th>EPBCA</th>
<th>STATUS 1995</th>
<th>Kakadu significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia</em> D19063 Graveside Gorge</td>
<td>NA (-&gt; CE)</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia</em> lacca</td>
<td>near threatened</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia</em> rupicola</td>
<td>near threatened</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia</em> suberosa</td>
<td>VU (-&gt;near threatened)</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia</em> verecunda</td>
<td>near threatened</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia</em> xanthastrum</td>
<td>near threatened</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Calytrix</em> insipida</td>
<td>VU (-&gt;near threatened)</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Cyps</em> armstrongii</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td><em>Dubouchezia</em> australiensis</td>
<td>EN (-&gt;VU)</td>
<td>not listed</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td><em>Gleichenia</em> discarpa</td>
<td>VU (-&gt; DD)</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td><em>Helicteres</em> D21039 linifolia</td>
<td>VU (-&gt;near threatened)</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Hibiscus</em> brevianii</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Lithomyrtus</em> linariifolia</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Malaxis</em> latifolia</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td><em>Monoboria</em> bastata</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td><em>Saururus</em> filicinus</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Utricularia</em> subulata</td>
<td>EN</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
**Animal species recorded from Kakadu NP and currently listed as threatened.** Abbreviations as in Table above, plus LC=Least Concern, NT= near threatened. The list also includes one species (ghost bat) that was listed as threatened in 1995, but has since been de-listed.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common Name</th>
<th>NT Status</th>
<th>EPBCA</th>
<th>STATUS S 1995</th>
<th>Kakadu significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taractrocera ilia ilia</td>
<td>Northern Grassdart Butterfly</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cynoglossus baterolepis</td>
<td>Freshwater Tongue Sole</td>
<td>EN (-&gt;NT)</td>
<td>not listed</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Glyphis sp.A.</td>
<td>Speartooth Shark</td>
<td>EN</td>
<td>CE</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Glyphis sp. C.</td>
<td>Northern River Shark</td>
<td>EN</td>
<td>EN</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Prittis davara</td>
<td>Dwarf Sawfish</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Prittis microdon</td>
<td>Freshwater Sawfish</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Caretta caretta</td>
<td>Loggerhead Turtle</td>
<td>EN</td>
<td>EN</td>
<td>EN</td>
<td>Low</td>
</tr>
<tr>
<td>Chelonia mydas</td>
<td>Green Turtle</td>
<td>LC</td>
<td>VU</td>
<td>VU</td>
<td>Low</td>
</tr>
<tr>
<td>Lepidobelos olivacea</td>
<td>Olive Ridley</td>
<td>DD</td>
<td>EN</td>
<td>VU</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Natator depressus</td>
<td>Flatback Turtle</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Diplodactylus occidentalis</td>
<td>Yellow-snouted Gecko</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Morelia oenpelliensis</td>
<td>Oenpelli Python</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Dromaius novaehollandiae</td>
<td>Emu</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td>Erythrotriorchis radiatus</td>
<td>Red Goshawk</td>
<td>VU</td>
<td>VU</td>
<td>VU</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Ardeotis australis</td>
<td>Australian Bustard</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td>Geophaeops smithii smithii</td>
<td>Partridge Pigeon</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Tyto novaehollandiae kimberi</td>
<td>Masked Owl</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Amytornis woodwardi</td>
<td>White-throated Grasswren</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Urophaisana eroea tunneyi</td>
<td>Yellow Chat</td>
<td>EN</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Zephyrornis (frontatits toolbox)</td>
<td>Northern Shrike-tit</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td>Erythoryncha goolbigea</td>
<td>Gouldian Finch</td>
<td>EN</td>
<td>EN</td>
<td>EN</td>
<td>Moderate</td>
</tr>
<tr>
<td>Dasyurus hallucatus</td>
<td>Northern Quoll</td>
<td>VU (EN)*</td>
<td>not listed</td>
<td>Uncertain</td>
<td></td>
</tr>
<tr>
<td>Phascogale (tapoatafa) pirata</td>
<td>Northern Brush-tailed Phascogale</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Isoodon auratus auratus</td>
<td>Golden Bandicoot</td>
<td>EN</td>
<td>VU</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Sacolaimus sacolaimans nudgei</td>
<td>Bare-rumped Sheathtail Bat</td>
<td>DD</td>
<td>CE</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Macroderma gigas</td>
<td>Ghost Bat</td>
<td>DD</td>
<td>not listed</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Hipposideros diademata inornata</td>
<td>Arnhem Leafnosed Bat</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Conilurus pluscillatus</td>
<td>Brush-tailed Rabbit-rat</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Mesembrinomys macrurus</td>
<td>Golden-backed Tree-rat</td>
<td>EN</td>
<td>VU</td>
<td>VU</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Xeromys myoides</td>
<td>Water mouse (False water-rat)</td>
<td>DD</td>
<td>VU</td>
<td>VU</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Zyzomys maini</td>
<td>Arnhem Rock-rat</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
</tbody>
</table>

* This species has recently been nominated, and is now in the process of assessment.

Most recommendations from the previous plan for a threatened species program for Kakadu NP (Roeger and Russell-Smith 1995) were achieved over the course of that planning period (1995-2002).

The threatened species comprise a very heterogeneous set. The most cohesive grouping of ecologically similar species is of a set of sandstone endemic plants, for which recent targeted surveys have provided relatively robust estimates of population size and status, quantitative baselines for an ongoing monitoring program, and explicit management recommendations. This set of species encompasses the most coherent management grouping of threatened species, typically responding negatively to frequent fire.
There are fewer groupings evident among the other listed species: although a set of four marine turtles, two sharks and two sawfish form a loose group that are threatened across their broader range by an array of factors, but relatively secure and protected from most threats within their variably significant Kakadu range. For most other species, the status and management requirements may be more idiosyncratic, thus reducing options for the management efficiency that may have been achieved had threatened species fallen into only a small set of tightly defined clusters.

The knowledge base for threatened species varies substantially. For some species (particularly for plants), there are reliable estimates of population size in Kakadu; for many others, there is relatively little information about population size. There are specific long-term monitoring programs for a few species; a baseline for subsequent monitoring has been established recently for many others; there is no monitoring program for some other species; and a monitoring program is unlikely to be feasible or cost-efficient for others. For some species, there is good information about threatening processes and response to management intervention; whereas for others such information is very limited.

This report considers, for every species, the adequacy of existing knowledge, monitoring and management advice; the extent to which Kakadu is important to the conservation of the species; the conservation status of the species; feasibility of actions; and other factors. From this consideration, it derives recommended priorities for research, management and monitoring of all threatened species.

Ten recommendations are listed here for consideration over the next planning period. These are:

1. Undertake targeted survey to define the abundance, distribution and status of those threatened species for which current status information is inadequate. Priority should be given to species listed under the EPBCA and to those other species listed under Northern Territory legislation that occur primarily or entirely within the Northern Territory.

2. Establish, implement and/or maintain specific monitoring programs that provide regular assessments of the trends in status for each threatened species in Kakadu NP, and relates such trends to management actions. Prioritisation among species should be assigned as in 1. above.

3. Maintain existing broad-scale plant and animal monitoring programs (notably the Kakadu Fire Monitoring Plots).

4. Assess the conservation status of sandstone heathland against criteria for listing as a threatened ecological community; and nominate it if appropriate.

5. Develop a strategic program for assessment of the conservation status of invertebrates in Kakadu.

6. To an appropriate extent, integrate conservation and management actions on threatened species in Kakadu with that of the broader region.

7. Enhance the entry, storage and display of threatened species data in Kakadu.

8. Continue to conduct targeted research on the response of selected threatened species to selected threatening processes and to management actions.

9. Continue to manage to mitigate those factors that detrimentally affect threatened species.

10. Enhance communication about, and reporting on, threatened species in Kakadu.
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1. INTRODUCTION

History and legislative context

Threatened species have special value and consequence for natural resource management. Their threatened status may shed light on a particular management problem, issue or inadequacy; their occurrence may imbue an area with particular conservation significance, interest or priority; their population trajectory may suggest that they are the components of biodiversity most likely to disappear; and their status attracts particular legislative and regulatory management consequences.

The occurrence of threatened species was one of the attributes used to justify the establishment of Kakadu National Park (e.g. Rose 1972; Fox et al. 1977; Senate Standing Committee on Environment, Recreation and the Arts 1988), and is one of the three natural criteria on which its World Heritage status rests:

“the most important and significant habitats where threatened species of plants and animals of outstanding universal value from the point of view of science and conservation still survive.”

As land (and sea) (joint-)managed by a Commonwealth agency, Kakadu National Park has particular obligations, under the Environment Protection and Biodiversity Conservation Act 1999, relating to the management of threatened species (sections 172 to 175, in Box 1 below).

Management of threatened species in Kakadu National Park has been complicated by a transformation of the relevant legislation and ongoing overhauls of the listings of threatened species. Such issues are generic to land managers across Australia (e.g. Productivity Commission 2003), but are given added piquancy in Kakadu NP because of the management involvement of a Commonwealth agency and the explicit status of threatened species in its World Heritage listing and obligations.

The current Plan of Management of Kakadu National Park (Kakadu Board of Management and Parks Australia 1998), covering the period 1999-2004, considered threatened species within the provisions of the Endangered Species Protection Act 1992. Compared with its replacement, the Environment Protection and Biodiversity Conservation Act 1999, the Endangered Species Protection Act 1992 provided very different (generally, less rigorous) criteria for the assessment of the threatened status of any species, and very different (typically, less onerous) requirements for managers on lands containing threatened species.

Overlapping with the 1999-2004 Plan of Management of Kakadu National Park, a specific Endangered Species Program was developed for Kakadu National Park over the period 1995-2002 by Roeger and Russell-Smith (1995). Reflecting its date of origin, that program, also, addressed species listed as threatened\(^1\) under the Endangered Species Protection Act 1992. The Kakadu species considered under this Program are listed in Table 1. The Endangered Species Program report (Roeger and Russell-Smith 1995) also gave some consideration to additional species listed (in a range of categories, such as “rare” and “notable”) under a range of then current non-regulatory sources, such as the listings of Rare or Threatened Australian Plants (“ROTAP”: Briggs and Leigh 1988), of Northern Territory Plant Species of Conservation Significance (Leach et al. 1992), and of Australian threatened plants and animals maintained by the now defunct ANZECC.

\(^1\) Note that, despite the title of the Act and the Program, both considered Vulnerable species as well as Endangered.
Box 1. Relevant sections of the **ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999**

**Section 172. Inventories of listed threatened species etc. on Commonwealth land**

1. The Minister must prepare inventories that identify, and state the abundance of, the listed threatened species, listed threatened ecological communities, listed migratory species and listed marine species on Commonwealth land.

2. Commonwealth land must be covered by an inventory:
   - within 5 years after the commencement of this Act; or
   - within 5 years after the land became Commonwealth land; whichever is later.

3. A Commonwealth agency that has an interest in Commonwealth land must provide all reasonable assistance in connection with the preparation under this section of an inventory that is to cover the land.

**Section 173. Surveys of cetaceans, listed threatened species, etc. in Commonwealth marine areas**

1. The Minister must prepare surveys that identify, and state the extent of the range of:
   - cetaceans present in Commonwealth marine areas; and
   - the listed threatened species, listed threatened ecological communities, and listed marine species in Commonwealth marine areas.

2. A Commonwealth marine area must be covered by a survey:
   - within 10 years after the commencement of this Act; or
   - within 10 years after the area became Commonwealth marine area; whichever is later.

3. A Commonwealth agency that has an interest in a Commonwealth marine area is to provide all reasonable assistance in connection with the preparation under this section of an inventory that is to cover the land.

**Section 174. Inventories and surveys to be updated**
The Minister must take reasonable steps to ensure that the inventories and surveys prepared under this Division are maintained in an up-to-date form.

**Section 175. Obligations under this Act unaffected by lack of inventories or surveys**
Obligations imposed by this Act are not affected, in their application in relation to Commonwealth land or Commonwealth marine areas, by any lack of inventories or surveys for such land or areas.

Another change since the publication of the Endangered Species Program for Kakadu National Park (Roeger and Russell-Smith 1995) has been a major revision of the principal wildlife legislation of the Northern Territory, the *Territory Parks and Wildlife Conservation Act*. Changes in that legislation introduced, for the first time, an assessment and listing process for threatened species for the Northern Territory (in which, of course, Kakadu National Park falls).
The assessment criteria for listing under the Northern Territory legislation are reasonably comparable to that of the *Environment Protection and Biodiversity Conservation Act 1999*, but there are some notable discrepancies in the two lists of threatened species. Such discrepancies arise from:

- assessments for the *Territory Parks and Wildlife Conservation Act* considering only the Northern Territory portion of a species’ range, whereas the assessment for the *Environment Protection and Biodiversity Conservation Act 1999* requires consideration of the total Australian range. There are international guidelines for considering conservation status within only one region of a species’ total range (Gardenfors *et al.* 2001). Discrepancies between State level and national-level status categorisations can arise where:
  - the national population is declining whereas the regional (in this case, Northern Territory) population remains relatively stable (arguably, the olive ridley, flatback and green turtle are such examples); or, conversely,
  - where the national population is regarded as relatively stable whereas only a small and/or declining population occurs in the Northern Territory (the golden-backed tree-rat is such an example: it remains reasonably abundant in the Kimberley, but is known in the Territory from only a handful of records (Palmer *et al.* 2003));

- the relatively minor differences in assessment criteria (Table 2) specified in the two Acts, most notably with the Northern Territory assessment being based on the explicit quantitative criteria adopted by the International Union for the Conservation of Nature (Criteria version 3.1; 2001), whereas the national criteria were defined in 1999, and less tied to explicit quantitative thresholds;

- listing “inertia”: many species now listed under the *Environment Protection and Biodiversity Conservation Act 1999* were simply moved across from the earlier listings under the *Endangered Species Protection Act 1992*, which were based on different criteria and now somewhat dated information. In some cases, the status of these species has not been revised to reflect recent advances in knowledge;

- recency of review. Listings under the *Territory Parks and Wildlife Conservation Act* are reviewed every two years, with a comprehensive review undertaken in 2003-04. There is no comparable regular review of the federal listings; and there is an inevitable administrative (and public review) lag in adding species to the Commonwealth listing.

Note that nominations for listings under both the national and Northern Territory legislation provide provisions for public comment and review; and that all nominations and listings are widely publicised.
Current lists of threatened species occurring in Kakadu

The current listing of plant and animal species occurring in Kakadu National Park, that are considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act* is given in Table 1a and 1b respectively.

**Table 1a. List of plant species recorded from Kakadu NP and currently (August 2004) considered as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or the *Territory Parks and Wildlife Conservation Act*.** Note that no Kakadu plant species were listed under Federal legislation at the time of the publication of the Endangered Species Program for Kakadu (*STATUS 1995*; Roeger and Russell-Smith 1995). Abbreviations: CE=Critically Endangered; EN=Endangered; VU=Vulnerable. For Northern Territory status only: NT=Near Threatened and DD=Data Deficient. Three species indicated are proposed to be downlisted in the next revision of Northern Territory conservation status (Kerrigan 2003). Note that this listing also includes one recently (re-)discovered species (*Acacia* D19063 Graveside Gorge) whose conservation status has not been assessed (NA) in previous considerations, but for which a listing of Critically Endangered (CE) is proposed by Kerrigan (2004) for the NT listing.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>NT Status</th>
<th>EPBCA</th>
<th>STATUS 1995</th>
<th>Kakadu significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia</em> D19063 Graveside Gorge ●</td>
<td>NA (&gt; CE)</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia laxa</em> ●</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia rupicola</em> ●</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia suberosa</em> ●</td>
<td>VU (&gt; NT)</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia verecunda</em> ●</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Boronia xanthastrum</em> ●</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Calytrix inopinata</em> ●</td>
<td>VU (&gt; NT)</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Cycas armstrongii</em> ●</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td><em>Dubouzetia australiensis</em> ●</td>
<td>EN (&gt; VU)</td>
<td>not listed</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td><em>Gleichenia dicarpa</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Helenium D21039 linifolia</em> ●</td>
<td>VU (&gt; NT)</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Helichrysum brevibracteatum</em> ●</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Lithomyrtus linariifolia</em> ●</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Malacis latifolia</em></td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td><em>Menodora hastata</em></td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td><em>Sauropsis filicinus</em> ●</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td><em>Utricularia subulata</em></td>
<td>EN</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

* n.b. Listed as *Gleichenia microphylla*, a name changed subsequently in light of recent taxonomic treatment (Short *et al.* 2003).
• Endemic to the Northern Territory
Table 1b. List of animal species recorded from Kakadu NP and currently (May 2004) considered as threatened under the Environment Protection and Biodiversity Conservation Act 1999 and/or the Territory Parks and Wildlife Conservation Act. Also indicated is the nationally threatened status as at 1995, at the time of the publication of the Endangered Species Program for Kakadu (Roeger and Russell-Smith 1995). Abbreviations as in Table 1a, plus LC=Least Concern.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common Name</th>
<th>NT Status</th>
<th>EPBCA STATUS</th>
<th>STATUS 1995</th>
<th>Kakadu significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taractrocera ilia ilia●</td>
<td>Northern Grassdart Butterfly</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cycoglossus heterolepis●</td>
<td>Freshwater Tongue Sole</td>
<td>EN</td>
<td>not listed</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Glyphis sp.A.</td>
<td>Speartooth Shark</td>
<td>EN</td>
<td>CE</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Glyphis sp. C.</td>
<td>Northern River Shark</td>
<td>EN</td>
<td>EN</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Pristis clavata</td>
<td>Dwarf Sawfish</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Pristis microdon</td>
<td>Freshwater Sawfish</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Caretta caretta</td>
<td>Loggerhead Turtle</td>
<td>EN</td>
<td>EN</td>
<td>EN</td>
<td>Low</td>
</tr>
<tr>
<td>Chelonia nydas</td>
<td>Green Turtle</td>
<td>LC</td>
<td>VU</td>
<td>VU</td>
<td>Low</td>
</tr>
<tr>
<td>Lepidocephalus olivaceus</td>
<td>Olive Ridley</td>
<td>DD</td>
<td>EN</td>
<td>VU</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Natator depressus</td>
<td>Flatback Turtle</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Carettochelys insculpta●</td>
<td>Pig-nosed Turtle</td>
<td>NT</td>
<td>(VU)**</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Diplodactylus acutus●</td>
<td>Yellow-snouted Gecko</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Egernia obiri●</td>
<td>Arnhemland Egernia</td>
<td>DD*</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Morelia oenpelliensis●</td>
<td>Oenpelli Python</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Dromaius novaehollandiae</td>
<td>Emu</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td>Erythrotriorchis radiatus</td>
<td>Red Goshawk</td>
<td>VU</td>
<td>VU</td>
<td>VU</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Ardeotis australis</td>
<td>Australian Bustard</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td>Geophaps smithii smithii●</td>
<td>Partridge Pigeon</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>Moderate</td>
</tr>
<tr>
<td>Tyto melanorrhinae kimberi</td>
<td>Masked Owl</td>
<td>NT</td>
<td>VU</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Amytornis woodwardii●</td>
<td>White-throated Grasswren</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Epthianura crocea tunneyi●</td>
<td>Yellow Chat</td>
<td>EN</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Tachycines (frontatus) whitei</td>
<td>Northern Shrike-tit</td>
<td>DD</td>
<td>VU</td>
<td>not listed</td>
<td>Low</td>
</tr>
<tr>
<td>Erythura gooldiae</td>
<td>Gouldian Finch</td>
<td>EN</td>
<td>EN</td>
<td>EN</td>
<td>Moderate</td>
</tr>
<tr>
<td>Dasyurus hallucatus</td>
<td>Northern Quoll</td>
<td>VU</td>
<td>(EN)***</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Phascogale (tapoatafa) pirata●</td>
<td>Northern Brush-tailed Phascogale</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Isoodon auratus auratus</td>
<td>Golden Bandicoot</td>
<td>EN</td>
<td>VU</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Saccolaimus saccolaimus macdoniatus</td>
<td>Bare-rumped Sheathtail Bat</td>
<td>DD</td>
<td>CE</td>
<td>not listed</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Macroderma gigas</td>
<td>Ghost Bat</td>
<td>DD</td>
<td>not listed</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Hipposideros diadema inornata●</td>
<td>Arnhem Leafnosed Bat</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
<tr>
<td>Conilurus penicillatus</td>
<td>Brush-tailed Rabbit-rat</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>Moderate-High</td>
</tr>
<tr>
<td>Mezembrinomys macrurus</td>
<td>Golden-backed Tree-rat</td>
<td>EN</td>
<td>VU</td>
<td>VU</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Xeromys nyoides</td>
<td>Water mouse (False water-rat)</td>
<td>DD</td>
<td>VU</td>
<td>VU</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Zyzomys maini●</td>
<td>Arnhem Rock-rat</td>
<td>VU</td>
<td>not listed</td>
<td>not listed</td>
<td>High</td>
</tr>
</tbody>
</table>

* This species is not currently listed, but is likely to be added in the forthcoming (2005) revision of the Northern Territory’s threatened species list.

** This species has been nominated as Vulnerable in 2004, and is now in the process of assessment.

*** This species was nominated in 2004, and is in the process of assessment.
Clearly, there are clearly major discrepancies between the current compilation of listed threatened species in Kakadu NP, and the list considered in the previous consideration of threatened species in Kakadu (Roeger and Russell-Smith 1995).

Considering only nationally listed species, the earlier listing included no plant species, whereas the current listing includes six plant species; the earlier listing included eight animal species whereas the current listing comprises 16 species. One of the previously listed species (the ghost bat) is no longer considered as threatened at national level, but nine additional species have been added. Of the seven species on both the 1995 and current lists, six have maintained the same status, but one (the olive ridley) has been upgraded from Vulnerable to Endangered.

There are pronounced disparities, for both plants and animals, between the national and Northern Territory lists. Of the 16 plant species listed as threatened on either the national or Northern Territory lists, only one species (Boronia suberosa) is included in both lists. The five other nationally listed plants are classified as either Data Deficient or Near Threatened in the Northern Territory lists. Nine Kakadu plant species listed as Vulnerable and one listed as Endangered on the Northern Territory list are not included in the national list.

Of a total of 31 listed threatened animals, only seven species are listed as threatened on both Northern Territory and national lists: of these seven, only four species (northern river shark, loggerhead turtle, red goshawk and gouldian finch) have the same threatened status on both lists; two species have higher threat status on the Northern Territory list (golden-backed tree-rat and golden bandicoot, which are both listed as Vulnerable nationally but Endangered on the Northern Territory list); and one species has a higher status on the national list (the speartooth shark, listed as Critically Endangered at national level, but Endangered on the Northern Territory list).

The nine species listed at national level, but not listed as threatened at the Northern Territory comprise the Freshwater Sawfish, Green Turtle, Olive Ridley, Flatback Turtle, Partridge Pigeon, Masked Owl, Northern Shrike-tit, Bare-rumped Sheathtail Bat and False Water-rat. For all of these except the Green Turtle, Partridge Pigeon and Masked Owl, the status in the Northern Territory regulations is Data Deficient, in recognition of the relatively limited information available from which to assess population size and trends.

Many more Kakadu animal species (21) are listed as threatened under Northern Territory regulations than under national regulations. The Kakadu taxa considered threatened under Northern Territory legislation but not national legislation are: Northern Grassdarter Butterfly, Freshwater Tongue Sole, Dwarf Sawfish, Yellow-snouted Gecko, Oenpelli Python, Emu, Australian Bustard, White-throated Grass-wren, Yellow Chat, Northern Quoll, Northern Brush-tailed Phascogale, Arnhem Leaf-nosed bat, Brush-tailed Rabbit-rat and Arnhem Rock-rat.

Recognising the confusion stemming from such pronounced disparity in listings, the agencies responsible for national and Northern Territory listings are now undergoing a process for improving the alignment of these lists, with highest priority addressed to those plant and animal species that are endemic to the Northern Territory. Such species are indicated in Table 1. There is no specific timeframe for achieving this improved alignment.
Table 2a. Criteria used for assessing threatened status under the *Environment Protection and Biodiversity Conservation Act*.

<table>
<thead>
<tr>
<th>Item</th>
<th>Criterion</th>
<th>Critically Endangered</th>
<th>Endangered</th>
<th>Vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It has undergone, is suspected to have undergone or is likely to undergo in the immediate future ....</td>
<td>a very severe reduction in numbers</td>
<td>a severe reduction in numbers</td>
<td>a substantial reduction in numbers</td>
</tr>
<tr>
<td>2</td>
<td>Its geographic distribution is precarious for the survival of the species and is ....</td>
<td>Very restricted</td>
<td>restricted</td>
<td>limited</td>
</tr>
<tr>
<td>3</td>
<td>The estimated total number of mature individuals is .... and</td>
<td>Very low</td>
<td>low</td>
<td>limited</td>
</tr>
<tr>
<td></td>
<td>(a) evidence suggests that the number will continue to decline at ....</td>
<td>a very high rate</td>
<td>a high rate</td>
<td>a substantial rate</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) the number is likely to continue to decline and its geographic distribution is ....</td>
<td>precarious for its survival</td>
<td>precarious for its survival</td>
<td>precarious for its survival</td>
</tr>
<tr>
<td>4</td>
<td>The estimated total number of mature individuals is ....</td>
<td>Extremely low</td>
<td>very low</td>
<td>low</td>
</tr>
<tr>
<td>5</td>
<td>The probability of its extinction in the wild is at least ....</td>
<td>50% in the immediate future</td>
<td>20% in the near future</td>
<td>10% in the medium-term future</td>
</tr>
</tbody>
</table>
Table 2b. Criteria used for assessing threatened status under the *Territory Parks and Wildlife Conservation Act*.

<table>
<thead>
<tr>
<th>Item</th>
<th>Criterion</th>
<th>Category</th>
<th>Critically Endangered</th>
<th>Endangered</th>
<th>Vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Reduction in population size based on any of the following</td>
<td>1. An observed, estimated, inferred or suspected population size reduction of ... over the last 10 years or 3 generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) and of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.</td>
<td>&gt;90%</td>
<td>&gt;70%</td>
<td>&gt;50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. An observed, estimated, inferred or suspected population size reduction of ... over the last 10 years or 3 generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) and of (a) to (e) under A1.</td>
<td>&gt;80%</td>
<td>&gt;50%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. A population size reduction of ..., projected or suspected to be met within the next 10 years or 3 generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) and of (a) to (c) under A1.</td>
<td>&gt;80%</td>
<td>&gt;50%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. An observed, estimated, inferred or suspected population size reduction of ... over any 10 year or 3 generation period, whichever is the longer (up to a maximum of 100 years), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) and of (a) to (c) under A1.</td>
<td>&gt;80%</td>
<td>&gt;50%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>B</td>
<td>Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:</td>
<td>1. Extent of occurrence estimated to be ..., and estimates including at least two of a-c: (a) Severely fragmented or known to exist at ... (b) Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals (c) Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals</td>
<td>&lt;100 km²</td>
<td>&lt;5000 km²</td>
<td>&lt;20,000 km²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>only a single location</td>
<td>no more than 5 locations</td>
<td>no more than 10 locations</td>
<td></td>
</tr>
</tbody>
</table>
|   | Area of occupancy estimated to be less than ..., and estimates indicating at least two of a-c:  
|   | (a) Severely fragmented or known to exist at ...  
|   | (b) Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals  
|   | (c) Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals  
|   |   |   |   |   |   |   |
|   | Population size estimated to number fewer than ... and either:  
|   |   | 250 mature individuals | 2500 mature individuals | 10,000 mature individuals |
|   | 1. An estimated continuing decline of at least ..., whichever is longer (up to a maximum of 100 years in the future) OR  
|   | 2. A continuing decline, observed, projected or inferred, ion numbers of mature individuals AND at least one of the following (a-b):  
|   | (a) Population structure in the form of one of the following: (i) no subpopulation estimated to contain more than ... OR (ii) at least ... of mature individuals in one subpopulation.  
|   | (b) Extreme fluctuations in number of mature individuals  
|   |   | 50 mature individuals | 250 mature individuals | 1000 mature individuals |
|   |   | 90% | 95% | all |
|   | Population size estimated to number fewer than ...  
|   | OR (for Vulnerable only) population with a very restricted area of occupancy (typically <20km²) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future  
|   |   | 50 mature individuals | 250 mature individuals | 1000 mature individuals |
|   | Quantitative analysis showing the probability of extinction in the wild is at least ..., whichever is the longer (up to a maximum of 100 years)  
|   |   | 50% within the next 10 years or 3 generations | 20% within the next 20 years or 5 generations | 10% within the next 100 years
List stability

Natural resource managers, and the public generally, appreciate some stability in lists of threatened species. There has been little stability in the lists for Kakadu National Park over the last decade. This instability reflects legislative change, increased knowledge (indeed, discoveries) of some taxa, altered impacts of threats and their management, and taxonomic advances. These factors will continue to cause changes in listings of Kakadu’s threatened species. Indeed, stability of lists will not occur until the ideal and unlikely situation that Kakadu’s biota is perfectly known and all threatening factors are controlled.

The recent (re-)discovery of *Acacia* D19063 Graveside Gorge (Kerrigan 2004) is an example of list instability. Until 2004, this taxon was not recognised (because the location details on the only previous collection were vague and thought to be erroneous). As a result of its re-location in 2004 and sampling then, it is now likely to be recognised as the most endangered plant in Kakadu NP. It is a truism that the rarest species are typically those most likely not to be found in broad-ranging surveys, so it is to be expected that there may be many other comparable cases of new discoveries of highly restricted threatened plant species.

Invertebrates are poorly represented in the current listing. The Kakadu invertebrate fauna remains relatively poorly known, but is certain to contain many currently undescribed but narrowly endemic species. The current listing of Kakadu’s threatened biota is probably most inadequate for at least some invertebrate groups.

Lists of threatened species change not only in the complement of species included, but also in the status code assigned to particular species. In Tables 1 and 3, I note for a number of species likely changes to the conservation status under Northern Territory legislation. Such changes are easier to predict for the Northern Territory list than for the national list, because of frequent (typically annual) review of the Northern Territory list, and a more streamlined process of incorporating recently collected information to the assessment. While these changes are foreshadowed here as likely, and are justified from detailed information provided mostly in Kerrigan (2003, 2004), these proposals still require due consideration. Where such proposed changes are approved, these are unlikely to be enacted until 2005.

Nearby threatened species

We present in this report some information on a set of four threatened plant species known from near, but not yet within, Kakadu National Park. Given their proximity, it is possible that further survey work will locate populations of these species within the Park. These species are listed in Table 3.

Table 3. List of threatened plant species known from near, but not within, Kakadu NP. Status codes and conventions as for Table 1.

<table>
<thead>
<tr>
<th>species</th>
<th>NT status</th>
<th>EPBCA status</th>
<th>distribution (nearest known population)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Boronia quadriata</em></td>
<td>CE (-&gt;VU)</td>
<td>VU</td>
<td>in stone country about 12km East of Park boundary (upper Magela Ck)</td>
</tr>
<tr>
<td><em>Cephalomanes obscurum</em></td>
<td>EN</td>
<td>not listed</td>
<td>in stone country about 12km East of Park boundary (upper Magela Ck)</td>
</tr>
<tr>
<td><em>Dichapetalum timoriense</em></td>
<td>VU</td>
<td>not listed</td>
<td>in stone country about 20km East of Park boundary</td>
</tr>
<tr>
<td><em>Ochroperma sulcatum</em></td>
<td>CE (-&gt; NT)</td>
<td>CE</td>
<td>in stone country about 5km East of Park boundary (17km ENE of Jabiru)</td>
</tr>
</tbody>
</table>
Recent advances in knowledge

There have been substantial advances in the knowledge of threatened species in Kakadu NP since, and indeed partly because of, the Roeger and Russell-Smith (1995) report. Some of the most notable of these advances include:

- commissioned surveys of the population size and distribution of a set of most of Kakadu’s listed threatened plants (Kerrigan 2003, 2004);
- broad-scale surveys across northern Australia (including the Alligator Rivers) for threatened freshwater and estuarine sharks and rays (Larson 2000; Thorburn et al. 2003);
- ongoing surveys and monitoring of nesting marine turtles by Parks Australia North staff on Field Island (Winderlich 1998);
- the establishment of a substantial monitoring program for terrestrial vertebrates generally in Kakadu NP (Woinarski et al. 2002; Watson and Woinarski 2003, 2004), partly prompted by some long-term studies indicating decline in some mammal species (Woinarski et al. 2001);
- a long-term study of the ecology and management requirements of the threatened Partridge Pigeon (Fraser 2000; Fraser et al. 2003), largely undertaken within Kakadu NP;
- a long-term specific study of the response of the northern quoll to the invasion of cane toads, undertaken entirely within Kakadu NP (Oakwood 2004).

In addition to these studies and projects, the period since the Roeger and Russell-Smith (1995) report has also encompassed the Second Atlas of Australian Birds (1998-2002) (Barrett et al. 2003), that saw a substantial observation effort on birds across Australia, and provided an assessment of national and regional changes in abundance and distribution since the original Atlas (1977-81).

The period has also seen the production of information dossiers on every plant and animal species listed as threatened under the Territory Parks and Wildlife Conservation Act: These dossiers (Anon 2002) summarise current knowledge of the status of all Northern Territory threatened species.

Other recent sources of information concerning threatened species in Kakadu NP include:

- The Action Plan for Australian Birds 2000 (Garnett and Crowley 2000);
- The Action Plan for Australian Butterflies (Sands and New 2002);
- The Action Plan for Australian Bats (Duncan et al. 1999); and the

In each of these Action Plans, listing of species as threatened hasn’t necessarily resulted (yet) in formal consideration and listing under the Environment Protection and Biodiversity Conservation Act 1999.

Some Kakadu threatened species have been considered within more detailed national recovery plans produced in the recent past. These plans indicate management actions appropriate for the conservation of these species. Such plans include for:

- marine turtles (Environment Australia 2003);
- three nationally-listed Boronia species (B. quadrilata, B. tolerans and B. viridiflora) [draft currently released for public comment: Gibbons and Liddle 2003];
- the **Golden Bandicoot** and **Golden-backed Tree-rat** [draft currently released for public comment: Palmer *et al.* 2003];
- the **Partridge Pigeon**, **Masked Owl** and **Northern (crested) shrike-tit** [draft currently released for public comment: Woinarski 2004].

Other recovery plans that concern species occurring in Kakadu NP are currently in preparation. These include plans for the gouldian finch (replacing a previous plan); Red Goshawk (replacing a previous plan); Freshwater Sawfish; and a combined plan for Speartooth Shark and Northern River Shark.

For further information, the addresses of relevant websites are listed in Table 4.

### Table 4. Sources of more information on threatened species within Kakadu NP.

<table>
<thead>
<tr>
<th>subject</th>
<th>web address</th>
</tr>
</thead>
</table>

### Monitoring

More recently, the delivery of natural resource management across Australia, specifically through the Natural Heritage Trust, has been directed through a regional planning process that stipulates that natural resource management must address explicit environmental “matters for target”, and that these matters will be monitored in prescribed ways that can chart progress towards agreed environmental outcomes. The major defined biodiversity matter for target is “significant native species and ecological communities”. “Significant” species are taken to include those species listed as threatened under relevant State or national legislation, species listed as migratory under the *Environment Protection and Biodiversity Conservation Act 1999*, narrowly restricted or endemic species, species likely to become listed as threatened, and/or species whose long-term survival is likely to be jeopardised by the dominant land use or some other process within a specified region (Anon 2004).

Trends in the condition of these significant native species will be monitored through explicitly recommended indicators (“range area and location of each species”; “area, location and condition
of key habitat of each species”, and “relative abundance of each species”), with this monitoring occurring in a consistent and stipulated manner. Further information on the matters for targets, recommended indicators and monitoring procedures is available at http://www.nrm.gov.au/monitoring/index.html

It is likely that the protocols and targets defined at the regional level will place an increasing emphasis on monitoring, particularly of the status and trend of threatened species and/or the factors that affect them; and that strategic choices will need to be taken in defining which species should be explicitly identified as indicators of progress in environmental management or restoration.

**Threatened communities**

The *Environment Protection and Biodiversity Conservation Act 1999* contains provisions for the nomination of threatened ecological communities, a provision not included in its precursor, the *Endangered Species Protection Act 1992*, nor the *Territory Parks and Wildlife Conservation Act*. To date, no ecological community occurring in Kakadu NP (nor for that matter anywhere else in the Northern Territory) has been nominated or listed as threatened. There is a reasonable argument that sandstone heathlands may meet the criteria for listing under the relevant provisions.

**Other listed species**

The *Environment Protection and Biodiversity Conservation Act 1999* includes consideration not only of threatened species, but also of migratory species. The former set comprise those species listed under bilateral and other international treaties - notably the Japan-Australia Migratory Bird Agreement, the China-Australia Migratory Bird Agreement and the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention). This report does not include explicit consideration of the status of such species, but Appendix C provides a tabulation of the 65 listed migratory species in Kakadu National Park.
2. INFORMATION DIGEST FOR INDIVIDUAL
THREATENED SPECIES OCCURRING IN KAKADU
NATIONAL PARK

In this section, information dossiers are presented for every plant and animal species known to
occur in Kakadu National Park and currently listed as threatened under Australian or Northern
Territory legislation.

For most species, these dossiers are adapted from those presented in Anon (2002), for threatened
species in the Northern Territory as a whole. In such cases, the original compiler of the
information sheet is listed. In all cases, I have revised the dossier as published in Anon (2002)
and added more recent information (where available) and information specific to Kakadu
National Park. Where no previous compiler is listed, the information sheet was prepared
specifically for this report.

Plant species are listed first, in alphabetical order. Animal species are listed in taxonomic order.
References are included at the end of each species’ account, rather than within the reference
section for this report as a whole.

For each species, the following information is presented:

Name: common and scientific name
Conservation status: both at Australian and Northern Territory level
Description: brief general description
Distribution: total known range, along with map of this (generally for the Northern Territory only)
and map of known occurrences within Kakadu. Where possible, records are
differentiated as either historic or recent: α = pre 1970; ● = post 1970.
Conservation reserves: list of all conservation reserves from which the species is known (note – in the
Northern Territory only)
Ecology: brief description of relevant ecological information
Conservation assessment: assessment against current IUCN criteria, on which its conservation status is based.
In most cases, this assessment relates to NT range only.
Threatening processes: assessment of known or presumed threats
Conservation objectives: broad priorities for research and/or management
Kakadu status: information on abundance and distribution within Kakadu NP
Kakadu monitoring: information on monitoring in Kakadu NP
Importance of Kakadu: relative to total range and status
Compiler: where applicable, compiler of the original (Anon 2002) information dossier on which
this account is based
References: key relevant references only

Note that this set of information sheets includes six plant species known from near (< ca. 20 km)
but not within Kakadu. Information is presented for these species because there is a reasonable
likelihood of them being present within Kakadu NP. In each case, the text for such species is
explicit about the lack of current records from Kakadu. Information is also presented on three
species not currently listed, but which have either been recently nominated for listing under the
EPBC Act (pig-nosed turtle) or will be listed in the next revision of the Northern Territory
threatened species list (Arnhemland Egernia and Acacia D19063 Graveside Gorge).
**Acacia D19063 Graveside Gorge**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:
Not Listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:
Not Assessed.

This plant was not recognised prior to the survey of Kerrigan (2004). That report recommends a coding of Critically Endangered, and this coding is likely to be approved in the next round of revisions of conservation status of NT plants and animals (due in 2005).

**Description**

A distinctive small shrub, with narrow needle-like leaves arranged in whorls around the stem. It is grey-green and distinctly hairy. The flower is globular and the seedpods short (Kerrigan 2004).

**Distribution**

Only known from a single locality near Graveside Gorge, Kakadu NP.

**Conservation reserves where reported:**
Kakadu NP.

**Ecology**

The only known population occurs on a rocky slope near the top of a cliff line.

**Conservation assessment**

Kerrigan (2004) considered that it qualified as critically endangered because of its very small known total population size (single adult plant and 20 seedlings), single location,
and evidence of high sensitivity to fire
(about 30 dead stems, killed by fire, near the
single live adult)

**Threatening processes**
The limited evidence suggests that it is fire-
sensitive and adults are killed by fire. It is
likely to require fire-free intervals of at least
3-5 years to maintain population viability.

**Conservation objectives and
management**
The main management objective is to
impose a fire regime that is suitable to this
species. Such a regime is likely to be
characterised by low frequency and long
intervals (>3 years) between fires. More
precise information on life history
parameters (time to maturity and lifespan) is
required to tune fire management
prescriptions.

Given the vulnerability of the single known
population, it would be prudent to consider
some *ex-situ* management, at least including
seed collection. Further searches in
appropriate habitat should be conducted.
Monitoring should comprise at least annual
scrutiny of fire occurrence, and counts of
plants in at least every second year.

**Information on abundance and/or
status within Kakadu NP**
The total known population comprises one
adult plant and about 20 small seedlings, all
at one site in Kakadu NP.

There is currently no information on trends
in abundance in Kakadu NP.

**Information on monitoring in
Kakadu NP**
One baseline monitoring sample undertaken
by Kerrigan (2004) encompassing the single
known population.

**Importance of Kakadu NP relative to
total range**
The only known population is within
Kakadu NP.

**References**
Report. Volume 2. Results of a threatened flora
survey 2004*. (NT Department of Infrastructure Planning and Environment, Darwin.)
**Boronia laxa**

**Conservation status**
*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):
Vulnerable

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):
Near Threatened.

**Description**
A semi-prostrate branching shrub to 1.5m long. Flowers white to mauve. Flowering and fruiting material has been collected between February and June. Note that the taxonomic status of this species is still incompletely resolved, and the taxon as currently recognised may comprise two species (Duretto 1999).

**Distribution**
Restricted to Mt Brockman area and the main Arnhem Land Plateau.

**Conservation reserves where reported**
Kakadu NP.

**Ecology**
*Boronia laxa* occurs in woodland communities and sandstone heathlands, where it grows on sand and loam between sandstone rubble (Kerrigan 2003, 2004). The species is an obligate re-seeder, unable to resprout from rootstock, and hence susceptible to frequent fire (Kerrigan 2003).

**Conservation assessment**
Kerrigan (2003, 2004) considered that, although the species was uncommon and restricted, it did not meet any IUCN criteria for threatened status. The extent of occurrence is about 1140 km$^2$ and the total mature population is about 1300 individuals (Kerrigan 2003).

**Threatening processes**
As with other obligate re-seeder plants, it requires a fire free interval of at least 3-5 years for plants to mature sufficiently to set...
Conservation objectives and management
Fire management is the single most important conservation action, with the objective being to ensure that fires occur no more frequently than at least 3-5 years apart. More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

Information on abundance and/or status within Kakadu NP
All known populations of this species are on the western Arnhem Land plateau. Kerrigan (2003, 2004) noted that a total of 17 disjunct populations were known, of which 9 were within Kakadu NP.

There is currently no information on trends in abundance in Kakadu NP.

Information on monitoring in Kakadu NP
Kerrigan (2003, 2004) established a baseline for ongoing monitoring for this species.

Importance of Kakadu NP relative to total range
High. Kakadu NP is the only conservation reserve, and only intensively managed area, containing this species. At least half of the total known population occurs within Kakadu NP.

References
Boronia quadrilata

Conservation status


Description
Erect slender shrub to 1.5 m; stems 4-angled. Boronia quadrilata differs from B. viridiflora by being erect, having elliptical leaves with acute tips and cuneate bases and having larger flowers and fruit.

Distribution
Endemic to the NT. Known only from the type locality at Magela Creek on the Arnhem Land plateau to the east of Kakadu National Park. At present this species is known only from a single population of about 1000 individuals (Kerrigan 2003).

Conservation reserves where reported
None.

Ecology
Very little is known about the ecology of this species. Kerrigan (2003) reports it growing on the upper slopes of a rocky sandstone ridge, with individuals growing on sand between boulders, and in rock crevices.

Conservation assessment
This species is known only from one locality (where it was first collected in 1991). The most recent assessment of its status relative to IUCN criteria was that of Kerrigan (2003), who assessed it as Vulnerable, with an area of occupancy of 9 ha and an extent of occurrence of 39 ha.

Threatening processes
As with most other Boronias, its major threat is high frequency of fire.
**Conservation objectives and management**

A draft national recovery plan (Gibbons and Liddle 2003) includes this species. The main action recommended is for fire management, to ensure reasonably long (3+ years) fire-free intervals. The draft plan also recommends monitoring plots and considers the issue of ex situ propagation.

More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

**Information on abundance and/or status within Kakadu NP**

No populations are known from Kakadu NP. The sole known location of the species is 12 km east of the Kakadu NP border.

**Information on monitoring in Kakadu NP**

Nil, but Kerrigan (2003) provided a baseline for ongoing monitoring.

**Importance of Kakadu NP relative to total range**

Currently unrecorded from the Park.

**Compiled by**

Raelee Kerrigan, Ian Cowie, Bryan Baker
[January 2002]

**References**


**Boronia rupicola**

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*): Vulnerable


**Description**

A pendulous sub-shrub to 40 cm long, with yellow-green flowers. Leaves inconsistently compound.

Flowering and fruiting material collected from March to July.

**Distribution**

Known only from eight populations around Mt Brockman and near Nabalerk.

**Conservation reserves where reported:**

Kakadu NP.

**Ecology**

Restricted to vertical sandstone surfaces, presumably sites offering some refuge from frequent fire.

**Conservation assessment**

Kerrigan (2003) provides the most recent assessment of conservation status, with estimates of extent of occurrence of 178 km², area of occupancy of 6 ha, and at least 2000 mature individuals. On this basis, she considered that the national listing of Vulnerable was inappropriate.

**Threatening processes**

The species is probably sensitive to frequent fire, and now occurs only in sites offering topographic protection from fire.
Conservation objectives and management
The habitat where the species now occurs may provide adequate protection from fire. It is possible that it can expand from this range with reduction in fire frequency and intensity. The populations and fire regimes affecting them should be regularly monitored. More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

Information on abundance and/or status within Kakadu NP
Kerrigan (2003) counted individuals in defined area around Mt Brockman, recording around 2000 mature individuals.

There is currently no information on trends in abundance in Kakadu NP.

Information on monitoring in Kakadu NP
Kerrigan (2003) established a baseline for ongoing monitoring for this species, around Mt Brockman, with a permanent plot and marked transect route.

Importance of Kakadu NP relative to total range
High: Kakadu has about half of the known populations, and is the only area in which the species is reserved.

References
**Boronia suberosa**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*: Vulnerable.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*: Vulnerable.

**Description**

Sprawling or pendulous, much branched sub-shrub to 50 cm. Leaves simple lanceolate, 7-20 mm long, 3-11 wide. Flowers green/white; foliage aromatic. Older stems characteristically develop massively corky bark. Flowering: Feb, Apr, May. Fruiting: Apr.

**Distribution**

Endemic to the NT, this species is known only from the Ja Ja massif, near Jabiru, and a recently discovered population in nearby Arnhem Land (Kerrigan 2003).

**Conservation reserves where reported**

Kakadu National Park.

**Ecology**

Found on sandstone pavements and cliff faces.

**Conservation assessment**

Kerrigan (2003) reported a population of at least 2000 mature individuals at the Ja Ja site, an extent of occurrence of about 8 km², and area of occupancy of about 10 ha. Given these data, she considered that the species no longer met the criteria for Vulnerable status, and its status should be downgraded.

**Threatening processes**

The habitat of this species suggests an intolerance to fire and expansion of the population into areas exposed to frequent
fire is unlikely. Recruitment success appears to be low (no juveniles have been observed at the known populations), given the limited availability of suitable cliff face sites and the low probability of successful dispersal to these sites.

**Conservation objectives and management**
A monitoring program for the species has been established recently (Kerrigan 2003) and should be maintained. The species will be favoured by a regime of less frequent fires. More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

**Information on abundance and/or status within Kakadu NP**
Kerrigan (2003) provides detailed data on the distribution and population in Kakadu. At least 2000 mature individuals are known from the Ja Ja site.

There is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**
Kerrigan (2003) established the baseline for an ongoing monitoring program for this species in Kakadu.

**Importance of Kakadu NP relative to total range**
High: most of the known population lies within Kakadu NP, and this is the only conservation reserve from which the species is known.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker [February 2002]

**References**

Boronia verecunda

Conservation status
Australia (Environment Protection and Biodiversity Conservation Act 1999): Vulnerable


Description
Boronia verecunda is a small (to 40 cm tall) erect sub-shrub, with red-edged leaves and sepals, and with new growth with dense covering of pinkish hairs. Flowers are white or pink, becoming green with fruit. This species is similar in appearance to B. xanthastrum, but distinguished by weak white hairs, narrower leaves and larger flowers. Flowering material has been collected from January to April, and fruiting material in April.

Ecology
Like other boronias, this is an obligate seeder, requiring fire-free intervals of at least 3 years to persist. It has been recorded growing on scree slopes of broken sandstone cobbles.

Conservation assessment
The most recent assessment of status was that of Kerrigan (2003, 2004), who estimated the total population probably

Distribution
Restricted to the sandstone plateau of western Arnhem Land. Nine populations are known, all in the south of Kakadu NP (Kerrigan 2003, 2004).

Conservation reserves where reported
Kakadu NP.
exceeded 1000 mature individuals and extent of occurrence of about 630 km².

Kerrigan (2003) considered that the population was sufficiently secure to be downlisted from Vulnerable.

Typical habitat of Boronia verecunda (Photo R. Kerrigan)

**Threatening processes**
Along with many other sandstone heathland species, this boronia is fire-sensitive, and will decline where fires recur at intervals of less than 3-5 years.

**Conservation objectives and management**
A monitoring program has recently been established (Kerrigan 2003, 2004) and should be maintained. The species is dependent upon the maintenance of favourable fire regimes (infrequent fire). More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

**Information on abundance and/or status within Kakadu NP**
Kerrigan (2003, 2004) provided information on the distribution and abundance of this species in Kakadu NP. The species occurs in Fire Plot 133, with a population of 116 mature individuals there in 2004.

There is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**

Kerrigan (2003, 2004) established a baseline for an monitoring program for this species in Kakadu NP.

**Importance of Kakadu NP relative to total range**
High: all of the known population occurs in Kakadu.

**References**


**Boronia xanthastrum**

**Conservation status**


**Description**

*Boronia xanthastrum* is an erect much-branched sub-shrub, to 40cm tall. It is densely covered with yellowish stellate hairs throughout. The flowers are yellow-green. Flowering and fruiting material has been collected between February and June.

**Distribution**

Restricted to the sandstone plateau of western Arnhem Land. The most recent assessment (Kerrigan 2004) considered that there were six extant populations, mostly within Kakadu NP.

**Ecology**

Grows in both sandstone and schist geology, and in heath and woodland vegetation communities.

**Conservation assessment**

The most recent assessment of status was that of Kerrigan (2004), who noted six sub-populations, over an extent of occurrence of about 600 km², with a total population that...
probably exceeded 1000 mature individuals. Although two previously known sub-populations may have disappeared, Kerrigan (2004) considered that the population was sufficiently secure to be downlisted from vulnerable.

**Threatening processes**
Along with many other sandstone heathland species, this boronia is fire-sensitive, and will decline where fires recur at intervals of less than 3-5 years.

**Conservation objectives and management**
A monitoring program has recently been established (Kerrigan 2003, 2004) and should be maintained. The species is dependent upon the maintenance of favourable fire regimes (infrequent fire). More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

**Information on abundance and/or status within Kakadu NP**
Kerrigan (2004) provided counts at a series of marked sits, including Graveside Gorge (9 mature individuals and 675 seedlings in a 0.05 h area), fire plot 76 (Mt Basedow: 100 mature individuals in a 1800 m² area), and fire plot 140 (a population recorded in 1999 was no longer present in 2004).

Beyond information from these two fire plots, there is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**
Kerrigan (2003, 2004) established a baseline for an ongoing monitoring program for this species in Kakadu NP, and trend data are currently available from two fire monitoring plots.

**Importance of Kakadu NP relative to total range**
High: most of the known population lies within Kakadu NP, and this is the only conservation reserve from which the species is known.

**References**
**Calytrix inopinata**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*: Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*: Vulnerable.

**Description**

*Calytrix inopinata* is a slender shrub to 3 m tall, stipules to 0.75 mm. Inflorescences are few to many, often clustered. Petals are white to pale pink. Flowering and Fruiting has been reported in April.

**Distribution**

*Calytrix inopinata* is endemic to the NT. It is known only from two populations near El Sherana, Kakadu National Park. The populations are located north and south of the South Alligator River Valley.

**Conservation reserves where reported**

Kakadu National Park.

**Ecology**

This species has been recorded in very open shrubland with spinifex and shrubs growing in cracks on a gently sloping sandstone pavement, and in cracks on an exposed sandstone knoll.

**Conservation assessment**

The species is known from only two localities, with an extent of occurrence of 25 km². Based on recent counts, the total population size is estimated at > 7000 mature individuals (Kerrigan 2003). On this basis, Kerrigan (2003) proposed to de-list the species.

**Threatening processes**

With a very restricted distribution and small population size this species is susceptible to stochastic events. It is known from sandstone plateaux on a dissected sandstone...
pavement in sparse shrubland with spinifex. The effect of fire is unknown but unfavourable fire regimes may be a threat. In the recent survey of Kerrigan (2003), no seedlings or juveniles were observed; and fire-affected individuals re-sprout.

Conservation objectives and management
A monitoring program has recently been established (Kerrigan 2003) and should be maintained. More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

Information on abundance and/or status within Kakadu
Kerrigan (2003) provided detailed counts of the two known populations, both occurring in Kakadu.

There is currently no information on trends in abundance in Kakadu NP.

Information on monitoring in Kakadu NP
Kerrigan (2003) provided baseline monitoring.

Importance of Kakadu NP relative to total range
High: all of the known population occurs in Kakadu.

Compiled by
Raelee Kerrigan, Ian Cowie, Bryan Baker
[February 2002]

References
**Cephalomanes obscurum**

**Conservation status**

**Australia** (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.


**Description**

*Cephalomanes obscurum* is a terrestrial fern, erect to 20 cm tall. The leaf blade is 3-pinnate to 3-pinnate-pinnatifid, 5-15 cm long, 2-9 cm wide. Clusters of spores (sori) erect, borne on short lobes in the axils of tertiary segments.

**Distribution**

This species occurs from north-eastern Qld to north-eastern NSW; also in Sri Lanka, southern India to Taiwan, Malesia, Solomon Island and possibly Vanuatu. In the NT, it has been collected from three localities: Tarracumbie Falls and a nearby location on Melville Island, and Magela Creek in Arnhem Land.

**Conservation reserves where reported**

None.

**Ecology**

It has been recorded as growing in damp gullies along creek banks or under rock ledges, in tropical and subtropical rain forest. Short et al. (2003) described its primary habitat as “splash zones of permanent waterfalls”. It has been described as a common coloniser, growing in dense patches, with young plants (sporelings) appearing in disturbed sites.

**Conservation assessment**

This taxon qualifies for **Endangered** (under criteria D) based on the number of mature individuals in the total population estimated to be <250.

The Magela Creek population, collected in 1984, consisted of four individuals. The Tarracumbie population first collected in
1975 and last collected in 2000 consists of approximately 100 individuals. Additional populations have not been collected nor has the second population on Melville Island been located since 1994. This is despite substantial survey effort on the Tiwi Islands in the last 3-4 years.

It is possible that more populations exist. However, using the precautionary principle, the status of Endangered is given based on estimates of population size.

**Threatening processes**
With a small population size this species is susceptible to stochastic events. Changes to hydrology and infestation from exotic weeds have the potential to threaten known populations but at present they are not imminent threats.

**Conservation objectives and management**
Further survey is required to monitor the known populations and to search for others.

**Information on abundance and/or status within Kakadu NP**
Not yet reported from Kakadu.

**Information on monitoring in Kakadu NP**
Nil. No baseline monitoring from the nearby population.

**Importance of Kakadu NP relative to total range**
Nil: not yet reported from Kakadu.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker
[February 2001]

**References**


**Cycas armstrongii**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:
Vulnerable.

**Description**
This species is a medium cycad up to 6 m tall with a slender trunk 6-12 cm in diameter. Branching occurs along with occasional offsets and basal suckers. Leaves form an obliquely erect to spreading crown. Each has 160-300 leaflets attached to the rachis at about 70° with a prominent midrib above.

**Distribution**
Endemic to the NT. Known from Gunn Point to Hayes Creek, west to Bradshaw and east to the Mary River catchment, with a few records from the Wildman River catchment. It also occurs on the Tiwi Islands and Cobourg Peninsula.

**Conservation reserves where reported**

**Ecology**
This cycad occurs mainly in open grassy woodland on yellow and red earths, limited in the area by drainage.

**Conservation assessment**
This species is locally abundant with less than 1% of the population included in conservation reserves. Applying the precautionary principle within the range, this species qualifies as **Vulnerable** (under criteria A4ce) based on a predicted >30%
reduction in population size over a 100 year period commencing a decade ago (Liddle 2003).

Available habitat in and around Darwin and the Litchfield Shire has been reduced due to land clearing for urban, rural residential and horticultural purposes. Such land clearing is expected to continue as Darwin expands. In particular prime cycad habitat with deep loamy soil has been identified as land suitable for horticulture. It is anticipated that substantial areas of prime habitat on the Tiwi Islands will be cleared for forestry. In areas not subject to clearing there is a major threat from the combined impact of introduced grasses and fire whereby increased fuel loads lead to increased mortality of adult stems.

**Threatening processes**

Land clearing due to the expansion of Darwin, rural residential living, horticulture, agriculture and forestry are the major threats to the species. Prime habitat for *C. armstrongii* includes deep loamy soils suitable for horticulture, agriculture and forestry. Mortality in excess of 20% of adult stems per fire event has been recorded when subject to fuel loads of 20 tonnes per hectare (Liddle 2003). The exotic pasture species, Gamba Grass *Andropogon gayanus*, supports fuel loads up to 20 tonnes per hectare (Barrow 1995) and the exotic Perennial Mission Grass *Pennisetum polystachyon*, supports fuel loads up to 27 tonnes per hectare (Panton 1993). Both of these exotic species are spreading rapidly and have the potential to extend over the full range of *C. armstrongii*. Fire also reduces seed viability in *C. armstrongii* (Liddle 2003).

**Conservation objectives and management**

Reservation of high quality habitat, control of exotic grasses and fire management are priority management requirements. Promotion of the value of cycad habitat through the economic returns gained by the sustainable use of this species may assist conservation of the species.

**Information on abundance and/or status within Kakadu NP**

Reported in Kakadu only from the far northwest edge (Wildman River system).

**Information on monitoring in Kakadu NP**

Nil; some monitoring established in populations at Litchfield and Charles Darwin NPs.

**Importance of Kakadu NP relative to total range**

Low: Kakadu is geographically marginal to the main distribution and population.

**Compiled by**

Raelee Kerrigan, Ian Cowie, Bryan Baker [May 2002]

**References**


**Dichapetalum timoriense**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:
Vulnerable.

**Description**

Climbing or creeping shrub, rarely a small tree up to 10 m. Leaves ovate to obovate 7-18 cm x 3-10 cm, pubescent. Fruit globular to ovoid, pear shaped or cordate, velvety pubescent, golden brown when fresh. Fruiting: Apr – May.

**Distribution**

Recorded from Malesia, dubious from Melanesia. In Australia, known from the NT and Queensland. In the Northern Territory the species is known from three localities (Magela Creek Valley, Lightning Dreaming and upper East Alligator) in a restricted area of Arnhem Land.

**Conservation reserves where reported**

None.

**Ecology**

Very little is known of the ecology of this species. In the NT it is found on rocky scree slopes and protected gorges of sandstone escarpments in *Allosyncarpia* forest.

**Conservation assessment**

It has been recorded growing in only three nearby localities in *Allosyncarpia* forests. However the potential habitat for this species is extensive and further populations may exist. Given that there has been some targeted search effort of this habitat in Arnhem Land, it was felt it was inappropriate to code this species as Data Deficient. Hence the status is considered Vulnerable (under criteria D1+2) based on:
• its restricted distribution (estimated to be <20 km\(^2\), with an extent of occurrence of about 160 km\(^2\)) and
• its low abundance (estimated to be <1000 mature individuals) (Kerrigan 2003).

**Threatening processes**
With a restricted distribution and small population this species is susceptible to stochastic events.

It is difficult, however, to identify likely stochastic events which would threaten this species as the deep sandstone gorges and valleys where *Allosyncarpia* forests grow are reasonably well protected from cyclonic events and fire.

As with other components of the *Allosyncarpia* forests, high fire frequency has probably forced it to retreat to fire-protected sites (Russell-Smith *et al.* 1993).

**Conservation objectives and management**
Research and further survey is required to establish the status of this population and the extent of its distribution. It is difficult to prescribe recovery actions without knowledge on the dynamics of the population or the associated threats.

**Information on abundance and/or status within Kakadu NP**
Not yet recorded from Kakadu NP, but reasonably likely to be present.

**Information on monitoring in Kakadu NP**

**Importance of Kakadu NP relative to total range**
Not yet recorded from Kakadu NP.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker [February 2002]

**References**


**Dubouzetia australiensis**

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):
Not listed.

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):
Endangered.

**Description**

Sub-shrub growing horizontally or pendulously from sandstone gorge cliffs. The twigs are slender, short and velvety. The flowers are faintly sweet smelling, creamy in colour.

Flowering: Jan, May, Sep, Oct.
Fruiting: May, Oct, Dec.

**Distribution**

Endemic to the NT. Known from a very restricted distribution of approximately six localities around the upper Magela Creek area, Arnhem Land.

**Conservation reserves where reported**

Kakadu NP.

**Ecology**

Very little is known of the ecology of this species. It is found on the walls of a sandstone gorge, not far above the floodwater level of a permanent creek at low altitude. It was noted as being moribund in one collection.

**Conservation assessment**

Kerrigan (2004) provided the most recent assessment of conservation status. She considered the most appropriate coding to be Vulnerable.

**Threatening processes**

The small population size of this taxon makes it susceptible to stochastic events such as rock falls, raised water levels or cyclonic events. The habitat suggests it is intolerant of fire and is unlikely to colonise areas exposed to fire. Recruitment potential...
must be low given the limited availability of suitable sites and low probability of successful dispersal to these sites.

**Conservation objectives and management**

Research is required to establish the status of this population and the extent of its distribution. It is difficult to prescribe recovery actions without knowledge of the dynamics of the population or the associated threats. Propagation of material and translocation to a botanic gardens may be required in the future.

**Information on abundance and/or status within Kakadu NP**

Only one population is known within Kakadu (Kerrigan 2004), but the population size at this site is unknown.

There is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**

Nil. Kerrigan (2004) established a baseline for monitoring this species, at one site 500m east of the Kakadu border.

**Importance of Kakadu NP relative to total range**

Low-moderate: of six known broad locations, one is just within Kakadu NP (Kerrigan 2004).

**Compiled by**

Raelee Kerrigan, Ian Cowie, Bryan Baker
[February 2002]

**References**


**SCRAMBLING CORAL FERN**  
*Gleichenia dicarpa*

**Conservation status**  
**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:  
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:  
Vulnerable.  
(Note: listed there as *Gleichenia microphylla*).

**Description**  
Pendulous or erect fern to 50 cm. Leaves (fronds) of 1-3 tiers of branches, 9-200 cm long. Leaf stalk (stipe) 10-55 cm long. Pinnules oblong to triangular 1-2.5 mm long, 1-2 mm wide. Spores in clusters (sori) of 2-4 sporangia.  
Fertile plant: Jan, Sep.

*Gleichenia dicarpa* (Photo K. Brennan)

**Taxonomic Note**  
Note that the taxonomy of this fern remains unresolved. In the recent major Australian treatment of the ferns, Chinnock and Bell (1998) did not list this genus from the Northern Territory. More recently, Short *et al.* (2003) labelled the fern from Twin Falls as *Gleichenia dicarpa* (rather than *G. microphylla* as previously labelled), and considered the Twin Falls site as the only known location of this species in the Northern Territory. Short *et al.* (2003) considered that records from the Victoria River Gorge previously referred to the same taxon should now be treated as a distinct taxonomic entity.

**Distribution**  
In the Northern Territory, it is known only from a gorge near Twin Falls (Short *et al.* 2003). Beyond the Northern Territory, *G. dicarpa* is known from SE Australia, with a disjunct population at Thornton Peak (NE
Queensland), and it occurs also in New Zealand, New Caledonia and Malaysia.

**Ecology**
In the NT it is found growing in seepage areas at the base of sandstone scarps or rock overhangs. Recorded in one collection as regrowing after fire damage.

**Conservation assessment**
Although there has been a substantial survey effort in Kakadu NP, extensive areas of potential habitat remain unsurveyed. It is likely therefore that this taxon may be more common than collections reflect.

The initial assessment of the conservation status of this species referred to *G. microphylla*, in which the Kakadu taxon and another taxon from the Victoria River District were combined. For that assessment, the taxon was scored as **Vulnerable** (under criteria D1+2) based on:
- a population size estimated to be <1000 individuals and
- a restricted area of occupancy estimated to be <20 km².

Subsequent to taxonomic reconsideration, the status of *G. dicarpa* is better considered to be Data Deficient (R. Kerrigan pers. comm.), reflecting the lack of targeted survey work for this species. This category is likely to be assigned at the next revision of the the NT list, due in 2005.

**Threatening processes**
This species is susceptible to stochastic events. Rock slides and changes to hydrology are a potential threat.

**Conservation objectives and management**
Research, further survey and monitoring is required to establish the status of this population and the extent of its distribution.

**Information on abundance and/or status within Kakadu NP**
No detailed information.

**Information on monitoring in Kakadu NP**
Nil.

**Importance of Kakadu NP relative to total range**
Medium: in the Northern Territory, the species is known only from Kakadu; however it has an extensive range beyond the Northern Territory.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker [February 2002]

**References**
**Helicteres D21039 linifolia**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:
Vulnerable.

**Description**
This species is a many stemmed perennial sub-shrub with annual above ground parts and woody rootstock. Flowers are mauve/red.  Floweरing: Nov – Jan.  Fruiting: Dec – Jan, Mar.

**Distribution**
This species is endemic to the NT and known from a relatively restricted distribution of two broad localities between the Mary River and the South Alligator River.

**Conservation reserves where reported**
Kakadu National Park, Mary River National Park (proposed).

**Ecology**
Very little is known of the ecology of this taxon. It grows in sandy soil in Woollybutt *Eucalyptus miniata* open forest. It has been recorded re-sprouting readily after fire *(Kerrigan 2003).*

**Conservation assessment**
The most recent assessment *(Kerrigan 2003)* recommended de-listing *(to Near Threatened).* She considered the species is known from two localities, with extent of occurrence of 24 km², area of occupancy at
least 0.1 km² and up to 8 km²; and a total population of at least 4000 mature individuals.

**Threatening processes**
A small population size makes this species vulnerable to stochastic events such as unfavourable fire regimes and/or infestation from exotic weeds. The proximity of some populations to the roadside makes them vulnerable to further road development in the future. All known populations are located in conservation reserves.

**Conservation objectives and management**
Research into the population dynamics of this species is required to establish trends and potential impact of fire and weeds.

**Information on abundance and/or status within Kakadu NP**
Kerrigan (2003) counted 975 individuals along a 0.1 km² belt transect near the South Alligator ranger station, and estimated this population to be at least 4000 mature individuals. There is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**
Kerrigan (2003) provided a baseline for monitoring of the single Kakadu population.

**Importance of Kakadu NP relative to total range**
High: of the only two known populations, one is in Kakadu NP. The other population is also in a reserved area.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker [February 2002]

**References**
Hibiscus brennanii

Conservation status

Description
Hibiscus brennanii is an erect perennial shrub with woody base, to 1.8 m tall. The outer stems are prickly; the leaves are velvety green grey; the sepals pale brown; and the corolla pink. Flowering: Mar – May.

Distribution
Endemic to the NT. Restricted to the Baroalba Creek, Mt Brockman area.

Conservation reserves where reported
Kakadu National Park

Ecology
This species occurs on sandstone cliffs, in gullies and on broken sandstone pavements.

Conservation assessment
The entire known population is located in Kakadu National Park. Craven and Fryxell (1993) recorded several hundred plants from Baroalba Creek when collected in 1990.

Kerrigan (2003, 2004) provided the most recent assessment of status, based on more explicit counts and targeted surveys. She estimated that the extent of occurrence is 1.5 km² and the total population size is 441 mature individuals.
Threatening processes
At present no imminent threats are identified. *Hibiscus* species are often considered ‘fire weeds’, regenerating strongly after wildfire. As such, unfavourable changes to fire regimes may adversely affect the population. With a small population and limited distribution the species is vulnerable to stochastic events.

Conservation objectives and management
A monitoring program has recently been established (Kerrigan 2003, 2004) and should be maintained.

Research into the status of the population and the role of fire in its distribution is required. More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

Information on abundance and/or status within Kakadu NP
Kerrigan (2003, 2004) visited all known locations and estimated the total population to comprise 441 mature individuals. There is currently no information on trends in abundance in Kakadu NP.

Information on monitoring in Kakadu NP
Kerrigan (2003, 2004) established a baseline monitoring program for this species in Kakadu NP.

Importance of Kakadu NP relative to total range
High: the entire population is within Kakadu.

Compiled by
Raelee Kerrigan, Ian Cowie, Bryan Baker
[February 2002]

References
**Lithomyrtus linariifolia**

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:
Vulnerable.

**Description**

*Lithomyrtus linariifolia* is a low spreading plant 0.1-0.2 (up to 1.0) m tall. Leaves opposite, linear 10-51 mm long, 1-3 mm wide. Bark brown to orangey. Flowers are pink, and fruit yellow-green or olive-green. Flowering: Feb – Apr. Fruiting: Apr – May.

**Distribution**

This species is an NT endemic, known from 14 locations in and around the western Arnhem Land plateau and escarpment.

**Conservation reserves where reported**

Kakadu NP; Nitmiluk NP

**Ecology**

Found in heaths or eucalypt woodlands on sandstone, in sandy or skeletal soils.

**Conservation assessment**

This taxon was classified by Snow and Guymer (1999) as **Vulnerable** (under criteria D1) based on a small population size estimated at <1000 mature individuals.

Kerrigan (2003, 2004) provided the most recent assessment of status, based on explicit counts and targeted surveys. She
estimated that the extent of occurrence is 3400 km$^2$ and the total population size is at least 200 mature individuals; and on this basis considered that it should be classified as Vulnerable.

**Threatening processes**
Unfavourable fire regimes seem the most likely threat to this taxon.

**Conservation objectives and management**
A monitoring program has recently been established (Kerrigan 2003, 2004) and should be maintained.

More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

**Information on abundance and/or status within Kakadu NP**
Kerrigan (2003, 2004) counted individuals at most of the known populations. The Kakadu population was estimated as <200 individuals. There is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**
Kerrigan (2003, 2004) established a baseline for an ongoing monitoring program for this species in Kakadu NP.

**Importance of Kakadu NP relative to total range**
High: 11 of the 14 known populations are within Kakadu.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker
[February 2002]

**References**


**Malaxis latifolia**

**Conservation status**

Australia (Environment Protection and Biodiversity Conservation Act 1999):
Not listed.

Northern Territory (Territory Parks and Wildlife Conservation Act 2000):
Vulnerable.

**Description**

Deciduous terrestrial orchid. Leaves to 30 cm x 9 cm, ovate, thin textured, bright green, sheathing at base, margins wavy. Flower stem to 30 cm tall, green-brown or purplish flowers. Lower lip of flower with three blunt apical teeth, the central one being longest and upturned. Plants conspicuous when in flower but are very difficult to detect when dormant. Flowering: Feb, May.

**Distribution**

Known from Qld, New Guinea, Indonesia, Malaysia and India to Japan. In the NT it is recorded from one population (at Bellyungardy Springs) in Kakadu National Park.

**Conservation reserves where reported**

Kakadu National Park

**Ecology**

Across its broader range, Jones (1988) noted that the species is widespread and common in rainforests, along protected stream banks in open forest and sometimes close to low-lying swampy areas.

**Conservation assessment**

Despite broad-ranging surveys of more than 1000 rainforest patches in the Northern Territory (Russell-Smith 1991; Liddle et al. 1994), this species has been recorded from only one locality (27 plants) in the NT and was last recorded in 1993. Although these
data support a category of Critically Endangered, the ephemeral nature of the above ground parts has lead us to downgrade the species. It has been classified as **Vulnerable** (under criteria D1+2) based on:
- a restricted distribution estimated to be $<20$ km² and
- a small population.

The species was not relocated at this site in a detailed search in 2003 (Kerrigan 2003).

**Threatening processes**
With a small population this species is vulnerable to stochastic events. Feral pigs could detrimentally affect this population. Pressure from collectors is unlikely due to the remote locality.

**Conservation objectives and management**
Further research into the status of the population and the extent of the species is required. Additional searches at the single known locality (and nearby wet rainforests), at appropriate times, should be conducted. *Ex-situ* conservation may provide some conservation security. Experimental trials of exclosures should be conducted to assess the threat posed by feral pigs.

**Information on abundance and/or status within Kakadu NP**
The single known locality in Kakadu had a population of 27 plants in 1993; but no individuals were recorded in a thorough search of that location in 2003 (Kerrigan 2003).

**Information on monitoring in Kakadu NP**
The species has been censused in at least 1993 and 2003 at the single known location.

**Importance of Kakadu NP relative to total range**
Moderate to high: the single known population in the Northern Territory is in Kakadu NP; but the species is widespread beyond the Northern Territory.

**Compiled by**
Raelee Kerrigan, Ian Cowie, Bryan Baker

[February 2002]

**References**
**Monochoria hastata**

*Conservation status*

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:
Vulnerable.

*Description*

Emergent aquatic herb with stems approximately 0.7-1.2 m long. Basal leaves arrow shaped. Inflorescence of 25-60 flowers in a dense spike 6-9 cm long. Flowers 13-16 mm long, purple or whitish. Capsule 7 mm long, 5-6 mm diameter. Flowering: Mar – June. Fruiting: Apr – Jun.

*Distribution*

Native to India, Sri Lanka and SE Asia and extending to New Guinea and Australia. In Australia the only records are from the NT, on floodplains of the Finniss, Reynolds and Wildman Rivers.

*Conservation reserves where reported*
Kakadu National Park.

*Ecology*

Recorded as a component of floating mats in both the Finniss and Reynolds Rivers but also occurs on back-swamps. Overseas, recorded as being fed to cattle and used as a vegetable.

*Conservation assessment*

In the Northern Territory, this species has been recorded only from four localities, all from floodplains, either on floating mats or on back-swamps where it is considered to be locally abundant. It may be more
common than the few NT records suggest, as there has been relatively little systematic plant survey across wetland areas.

This species has been classified as **Vulnerable** (under criteria B1ab(iii,iv)+2ab(iii,iv); D2) based on:

- an inferred decline in quality of habitat and population numbers as a result of invasion by the weeds Para grass, Hymenachne and Mimosa
- a population estimated to be in the 1000s (I. Cowie) and
- an area of occupancy of known populations estimated to be <20 km².

**Threatening processes**

Invasion by introduced plant species such as Para grass (*Urochloa mutica*), *Hymenachne amplexicaulis* and *Mimosa pigra* appear to be the most imminent threats to this species. Saltwater intrusion of wetlands resulting from rising sea levels triggered by global warming or other factors would have an adverse impact on this species. As a floodplain species, changes to hydrology will affect populations, although no such changes are likely in the near future.

**Conservation objectives and management**

A monitoring program has recently been established (Kerrigan 2003) and should be maintained. The wetland habitat should be protected from invasion by para grass and/or other exotic plant.

**Information on abundance and/or status within Kakadu NP**

In Kakadu, *Monochoria hastata* is known only from Ben Bunga floodplain, Wildman catchment. At this site, Kerrigan (2003) estimated the population to be about 5000 individuals, having increased and expanded since reduction in buffalo populations.

**Information on monitoring in Kakadu NP**

Kerrigan (2003) established a baseline for monitoring at the single Kakadu location.

**Importance of Kakadu NP relative to total range**

Low to moderate: In the Northern Territory, Kakadu includes one of the four known populations, and the only site in which conservation is a priority management aim. The species also occurs widely beyond Australia.

**Compiled by**

Raelee Kerrigan, Ian Cowie, Bryan Baker
[February 2002]

**References**


**Ochrosperma sulcatum**

**Conservation status**

- **Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*: Not listed.

**Description**

*Ochrosperma sulcatum* is a hanging or erect shrub to 0.5 m. The leaves are very small and narrow, and arranged in a succession of alternating pairs of opposite leaves. Fruiting: Nov.

**Distribution**

Endemic to the NT. This species is known only from the type locality ENE of Jabiru (just outside the eastern boundary of Kakadu National Park).

**Ecology**

The species grows in fissures of a sandstone cliff-face in association with *Mitrasaene geniculosa*.

**Conservation assessment**

The most recent assessment of conservation status was Kerrigan (2003). She considered it should be de-listed (to Near Threatened); and estimated the area of occupancy as 10
ha, and the population size of >3000 mature individuals.

Chalson and Keith (1995) assessed the risk category for this species as critical.

**Threatening processes**
With a cliff face habitat this species is susceptible to rock falls. Its habitat suggests an intolerance of fire. Recruitment is expected to be low given the limited availability of suitable sites and a low probability of successful dispersal to these sites.

**Conservation objectives and management**
More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.

A monitoring program has recently been established (Kerrigan 2003) and should be maintained.

**Information on abundance and/or status within Kakadu NP**
Not yet recorded from Kakadu NP.

**Information on monitoring in Kakadu NP**
Nil: Kerrigan (2003) established a baseline for ongoing monitoring in nearby Arnhem Land.

**Importance of Kakadu NP relative to total range**
Not yet recorded from Kakadu NP, but reasonably likely to be present.

**Compiled by**

**References**


Sauropus filicinus

Conservation status

Northern Territory (Territory Parks and Wildlife Conservation Act 2000): Data Deficient (note that the most substantial recent survey of this species (Kerrigan 2004) proposes that this categorisation remains the most appropriate).

Description
Sauropus filicinus is a dwarf somewhat fern-like dioecious subshrub. Male flowers are clustered (3-15 per cluster) green to pink; female flowers solitary and red to pink.

Flowering known from April to August; fruiting known only from April.

Distribution
The few known specimens are from the western Arnhem Land plateau.

Conservation reserves where reported
Kakadu NP.

Ecology
Restricted to crevices in sandstone cliffs.

Conservation assessment
The most recent assessment of status was that of Kerrigan (2004). She reported that this species was now known from 7 localities, with an extent of occurrence of 230 km².

Known locations of Sauropus filicinus

Threatening processes
There has been no rigorous assessment of threats. It is restricted to fire-protected sites, so is probably disadvantaged by frequent fire.

Conservation objectives and management
More precise information on life history parameters (time to maturity and lifespan) is required to tune fire management prescriptions.
A monitoring program has recently been established (Kerrigan 2003) and should be maintained.

**Information on abundance and/or status within Kakadu NP**
Kerrigan (2004) counted two populations around the northern outliers (north of Jabiru) and reported a total of 66 mature plants in a total transect length of 3.5 km. There is currently no information on trends in abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**
Kerrigan (2003, 2004) established a baseline monitoring program for this species in Kakadu NP. However, she noted that this baseline may be unreliable due to confusion between the two similar taxa *S. filicinus* and *S. rimophilus*, and recommended that the baseline be revisited to provide greater certainty in counts.

**Importance of Kakadu NP relative to total range**
High: six of the seven known populations are within Kakadu NP; and this is the only part of the range in which conservation management is a primary objective.

**References**
**Utricularia subulata**

**Conservation status**


**Description**
Small to very small annual, terrestrial bladderwort. Inflorescence erect, solitary, simple or sometimes branched. Flower cleistogamous or chasmogamous 0.5-1 cm long, yellow or white or reddish. Upper lip broadly ovate, lower lip deeply 3-lobed. Flowering: Mar, May.

**Distribution**
Pan-tropical. This is the most widespread of all *Utricularia* species.

In the NT it is known from three localities, in Kakadu, on Bathurst Island and at McMinns Lagoon. The latter population was not relocated during a survey in 2001.

Not recorded from Kakadu NP until the survey of Kerrigan (2003).

**Conservation reserves where reported**
Kakadu NP.

**Ecology**
The species occurs in wet open grassland on the margins of drainage depressions.

**Conservation assessment**
This species is known from three localities and additional populations were not located in a recent *Utricularia* survey in the Darwin rural area. The McMinns Lagoon population may no longer be extant due to substantial changes in land use in the area.
Using a precautionary approach this species qualifies in the NT for **Endangered** (under criteria B1ab(iii)+2ab(iii)) based on:

- an extent of occurrence <5000 km²
- an area of occupancy <500 km² and
- a projected decline as a result of sandmining and subdivision activity in the Howard Springs area.

**Threatening processes**
Sandmining, changes to hydrology and subdivision activity in the Howard Springs area.

**Conservation objectives and management**
Protection of habitat at known localities is required to maintain the status of the species. Further survey may yield additional localities.

**Information on abundance and/or status within Kakadu NP**
Known only from a single recent record (1.2 km S of the Arnhem Highway, on the west branch of the West Alligator River). Only three individual plants were recorded over a 20 min search of the wet sandsheet habitat (I. Cowie pers. comm.).

**Information on monitoring in Kakadu NP**
There is currently no information on trends in abundance in Kakadu NP. The site of

the single Kakadu record could serve as a baseline for ongoing monitoring.

**Importance of Kakadu NP relative to total range**
Medium: in the Northern Territory, this species is known from only three locations – of these, only Kakadu is managed with a priority for conservation. However, this species occurs widely beyond the Northern Territory.

**Compiled by**
Raelee Kerrigan, Ian Cowie
[February 2002]

**References**


Northern grassdart butterfly

Conservation status
Australia (Environment Protection and Biodiversity Conservation Act 1999):
Not listed.

Northern Territory (Territory Parks and Wildlife Conservation Act 2000):
Vulnerable.

Description
The northern grassdart is a small orange butterfly about 20 mm across the outspread wings. It is similar to many other typical skippers, darters and swifts. The adult has a short, stocky body and the triangular forewings are usually held in a swept-back position like a jet fighter, but vertically over the body. The wings are dark brown with prominent orange markings. When in sunshine or feeding they frequently hold just their hind wings horizontally. The clubs at the end of the antennae are shaped like flattened spoons.

Conservation reserves where reported:
Kakadu NP

Ecology
Almost nothing is known of the ecology of this species. Its eggs and larvae are unknown, and adults have only rarely been collected. The larvae of related species are thought to feed almost exclusively on particular grasses (Poaceae). The adults congregate in areas near sandstone escarpments and during the heat of the day may shelter in caves (Sands and New 2002).
**Conservation assessment**
This butterfly is rarely recorded. Conservation categorisation is difficult as there is a lack of information on population trends. There is some evidence that other northern Australian butterflies whose larvae feed on grasses have declined in recent years due to an increase in the frequency and intensity of fires (T.L. Fenner *pers. comm.*), and it is reasonable to assume that the northern grassdart will be exposed to the same pressures.

In 2002, for the assessment of species under NT legislation, this butterfly was coded as **vulnerable** (under criterion B1ab(i,ii,iii,iv)) based on:
- extent of occurrence <20,000 km²
- known to exist at <10 locations and
- continuing decline observed, inferred or projected.

In contrast, a subsequent assessment (Sands and New 2002) evaluated this taxon as of “no conservation significance”. This inconsistency reflects a relatively sparse information base, disagreement about abundance and decline and lack of clear measure of putative threatening processes.

**Threatening processes**
Larvae of this butterfly probably feed almost exclusively on particular species of grass. They are thus likely to be particularly vulnerable to the increased frequency and intensity of fires brought about by a greater density of settlement across their known range, and the extensive spread of gamba grass, mission grass and other exotic invasive pasture species.

**Conservation objectives and management**
There is no existing management program for the northern grassdart butterfly in the Northern Territory. As its host plants and life cycle are unknown, it is difficult to design a management program that will ensure its survival.

Research priorities are:
(i) to investigate the ecology of the species so that larval food plants and breeding sites can be identified and protected.

Management priorities are:
(ii) to better safeguard potential breeding sites through encouraging burning practices that create a mosaic of grassland patches burnt at different frequencies and seasons; and

(iii) to better safeguard larval foodplants through controlling the spread of exotic perennial pasture grasses.

Sands and New (2002) also considered that “the impact of regular fires on populations of *T. ilia* needs evaluation”, and that “surveys ... should be encouraged ... to ascertain its distribution”.

**Information on abundance and/or status within Kakadu NP**
Little documented information.

**Information on monitoring in Kakadu NP**
No existing monitoring program.

**Importance of Kakadu NP relative to total range**
Medium: although occurring reasonably widely, Kakadu is the only site within that range that is managed with conservation as a priority. Sands and New (2002) considered that “no recovery actions are necessary for *T. ilia* because a major population is secure in Kakadu National Park”.

**Compiled by**
Colin Wilson
[February 2002]

**References**


FRESHWATER TONGUE SOLE
*Cynoglossus heterolepis*

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):
Not listed.

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):
Endangered.
[but likely to be de-listed in the forthcoming revision]

**Description**

The freshwater tongue sole grows to around 25 cm in length. The body is uniformly brownish on the dorsal surface sometimes with narrow brown bars or blotches. The ventral surface is white. Tongue soles are distinguished from true soles by having eyes on the left side of the head and a more elongate body (Allen *et al.* 2002).

**Distribution**

The freshwater tongue sole is known from few records in the Northern Territory; these include six specimens collected in the East Alligator River, at Cahill’s Crossing, in the 1940s (Allen *et al.* 2002), and more recent records from the Adelaide, West Alligator and Wildman Rivers.

**Conservation reserves where reported**: Kakadu National Park.

**Ecology**

The species is poorly known. However, tongue soles occur in tropical and temperate seas and estuaries where they favour mud or sand bottoms. The species in the genus *Cynoglossus* occur in freshwater habitats. Tongue soles are well camouflaged benthic predators that partially bury themselves in mud or sand substrate and ambush passing prey. They feed on fish and invertebrates (Allen *et al.* 2002).

**Conservation assessment**

Conservation assessment is hampered by the lack of any information on trends or threatening processes.

The species was classified by PWCNT as **Endangered** (under criteria B2ab(v)) due to:
- populations known to exist at no more than 5 locations and
- inferred decline in the number of mature individuals.
The inferred decline was based on the fact that it has not been recorded since the 1940s.

More recent opinion (H. Larson, Museum & Art Gallery of the Northern Territory *pers. comm.*, Aug 2004), based on consideration of substantially more records than those from which the original listing was proposed, is that this categorisation is not justified, and the species should be de-listed.

**Threatening processes**
No information. Rather than declining, the species may simply be rare and/or not readily collected.

**Conservation objectives and management priorities**
The managing authority for this species is the Fisheries Section of the Department of Business Industries and Resource Development.

The main research priority is to better define the distribution and status of this species.

**Information on abundance and/or status within Kakadu NP**
The species has now been recorded in Kakadu from the East Alligator, West Alligator and Wildman River systems. There is no substantial information on population size or trends in abundance.

**Information on monitoring in Kakadu NP**
The few specimens collected, and the relatively sparse survey effort, are inadequate baseline for a monitoring program.

**Importance of Kakadu NP relative to total range**
Unknown: there has been no systematic assessment of its range, or variation in abundance across that range. It is known from beyond Kakadu (in the Adelaide River system).

**Compiled by**
Simon Stirrat
[October 2002]

**References**
SPEAROTH SHARK
*Glyphis* sp. A

**Conservation status**

*Australia* *(Environment Protection and Biodiversity Conservation Act 1999):*
Critically Endangered.

*Northern Territory* *(Territory Parks and Wildlife Conservation Act 2000):*
Endangered.

**Description**

The speartooth shark is a medium sized whaler shark that grows to 2 to 3 m in length. Australian specimens range from 0.7 m to 1.3 m in length. The dorsal surface is grey and the ventral surface paler, with an inconspicuous pale stripe on the flanks. It has a short, broadly rounded snout and small eyes. The dorsal fins are similar in size and the anal fin is about the same size as the second dorsal fin. There are no distinctive fin markings *(Last and Stevens 1994).* An illustration of the species can be found in Plate 29 of Last and Stevens *(1994).*

**Distribution**

The taxonomy of the genus *Glyphis* is incompletely resolved. In Australia the speartooth shark is known only from two specimens collected in the Bizant River in Queensland and several specimens collected from the Adelaide River and the Alligator rivers region in Kakadu National Park *(Thorburn et al. 2003).* A *Glyphis* shark was also collected from Murganella Creek *(Thorburn et al. 2003).* The specimens from the Bizant River were collected in shallow, freshwater upper reaches of the river.

**Conservation reserves where reported:**
Kakadu NP.

**Ecology**

Virtually nothing is known of the biology of the speartooth shark. The small eyes and slender teeth suggest that it is primarily a fish feeder adapted to life in turbid waters *(Fowler 1997).* Species in this genus have low fecundity, small litters and breed every year or two years. This species can occur in the upper reaches of rivers, well inland from the coast *(Thorburn et al. 2003; Larson et al. 2004).*

Known locations of the speartooth shark.
a very limited distribution in the Northern Territory. A recent search for the species at the known locations failed to locate any further specimens. The species is very rare, occupies restricted habitat and is vulnerable to capture (Department of Environment and Heritage 2004).

There is no evidence for decline in the known range of the species but this may be due to lack of reporting (Department of Environment and Heritage 2004). However, it is possible that the species has declined due to fishing pressure and other anthropogenic factors such as habitat alteration. Thorburn et al. (2003) noted that this species has not been recorded again from the site of its original collection in Queensland, despite several surveys and ongoing commercial fishing occurring in the area.

Pogonoski et al. (2002) recommended that the Australian status of the speartooth shark be Endangered. In the Northern Territory, it qualifies as Endangered (under criteria B2ab(v)) due to:

- area of occupancy <500 km²;
- known to occur at no more than 5 locations; and
- projected continuing decline in the number of mature individuals.

Declines are inferred based on susceptibility to capture.

The species was listed as Critically Endangered in the IUCN regional Red List 2003 (Thorburn et al. 2003).

**Threatening processes**

Barramundi gillnetting and recreational fishing are threatening processes in the Northern Territory (Department of Environment and Heritage 2004).

**Conservation objectives and management**

Currently there is no management program for the speartooth shark in the Northern Territory.

The research priorities are:

(i) to obtain information on the distribution and status of the species (ii) to monitor and limit the impacts of commercial and recreational fishing operations in estuarine areas.

Commercial fishing (involving gill-nets) is not permitted within Kakadu NP, and there are no data to suggest that recreational fishing activities currently affect the species within the Kakadu area.

**Information on abundance and/or status within Kakadu NP**

Based on very limited information, Department of Environment and Heritage (2004) estimated the population in the Alligator River estuaries as no more than a few hundred individuals. Larson (2000) captured 7 specimens of *Glyphis* shark (including both *G. sp.A* and *G. sp.C*) from the West, South and East Alligator Rivers.

**Information on monitoring in Kakadu NP**

Larson (2000) undertook monitoring of this and other estuarine fish in Kakadu NP, but the few specimens of this species collected provide a relatively meagre baseline.

**Importance of Kakadu NP relative to total range**

Moderate to high: Department of Environment and Heritage (2004) considered that its current distribution may be relictual, with recreational and commercial fishing, and habitat degradation, eliminating the species elsewhere. As such, the relative lack of disturbance in the Alligator Rivers systems render this population extremely significant. Although the data are extremely limited, Environment Australia (2004) infer that the Kakadu population may comprise half of the national population.

**Compiled by**

Simon Stirrat and Helen Larson  
[June 2002]

**References**


**NORTHERN RIVER SHARK**  
*Glyphis sp. C.*

**Conservation status**  
_Australia_ (Environment Protection and Biodiversity Conservation Act 1999):  
Endangered.

_Northern Territory_ (Territory Parks and Wildlife Conservation Act 2000):  
Endangered

**Description**  
The northern river shark is similar to the more common bull shark that occurs in the same habitat and range. However, this species is a steely-grey colour and may achieve a length of over 2 m. The northern river shark also has a triangular shaped first dorsal fin, and a second dorsal fin that is two thirds the height of the first dorsal fin. Its small eye is located in the grey shaded part of the head (Last and Stevens 1994).

**Distribution**  
In Australia the northern river shark is so far known only from the Adelaide and Alligator River systems in the Northern Territory, and the Fitzroy system (Doctors Creek) in the west Kimberley (Thorburn et al. 2003).

**Conservation reserves where reported:**  
Kakadu NP.

**Ecology**  
Little is known of the ecology of the northern river shark but it is probably restricted to the shallow, freshwater to brackish reaches of the Adelaide and Alligator River systems. This conclusion is based on the fact that it has not yet been caught in the coastal marine areas despite considerable fishing and collecting activity in these habitats. This species can occur in the upper reaches of rivers, well inland from the coast: one specimen was collected 60km up the South Alligator River (Thorburn et al. 2003; Larson et al. 2004).

**Conservation assessment**  
In a recent review, Larson _et al._ (2004) noted “*Glyphis* are particularly problematic large sharks as both species appear to be undescribed and their true distribution and basic ecology is unknown”. The northern river shark has a limited distribution in the Northern Territory, similar to the speartooth shark (*Glyphis* sp. A). It was only recently that these two species were recognised as both occurring in the
Northern Territory. The northern river shark probably has a small population size and may be subject to threatening processes of barramundi gill-netting and recreational fishing.

Pogonoski et al (2002) recommended that the Australian status of the northern river shark be Endangered. As it only occurs in the Northern Territory its status here should be equivalent to its Australian status. It qualifies as Endangered (under criteria B1ab(v)+2ab(v)) due to:
- extent of occurrence <5,000 km²;
- area of occupancy <500 km²;
- known to occur at no more than 10 locations; and
- continuing decline, observed inferred or projected in number of mature individuals).

The species was listed as Critically Endangered in the IUCN regional Red List 2003 (Thorburn et al. 2003).

**Threatening processes**
Potential threatening processes in Northern Territory waters include recreational fishing and barramundi gill-netting.

**Conservation objectives and management**
The managing authority for this species is the Fisheries Section of the Department of Business Industries and Development. Currently there is no management program for the northern river shark in the Northern Territory.

The research priorities are:
(i) to establish the distribution and status of the species across the Northern Territory.
(ii) to assess the potential impacts of fishing operations on populations.

**Information on abundance and/or status within Kakadu NP**

**Kakadu NP**
Larson (2000) undertook monitoring of this and other estuarine fish in Kakadu NP, but the few specimens of this species collected provide a relatively meagre baseline.

**Importance of Kakadu NP relative to total range**
Uncertain (moderate?): Other than a set of specimens collected on the Adelaide River in 1989, the Kakadu records comprise the only Northern Territory records of this species (Department of Environment and Heritage 2004). However, Thorburn et al. (2003) noted that it also occurred in the Fitzroy River, WA.

**Compiled by**
Simon Stirrat and Helen Larson [June 2002]

**References**
Department of Environment and Heritage (2004). *Glyphis* sp. C (Northern River Shark).
**DWARF SAWFISH**  
*Pristis clavata*

**Conservation status**  


**Description**  
A small, robust shark-like sawfish that grows to at least 1.4 m long. The rostrum (snout) is broad and bears 18 to 22 pairs of lateral teeth starting from the base. Nostrils behind the eyes are broad with large nasal flaps. The body is usually greenish-brown and white ventrally. The pectoral fins are broadly triangular with broad bases and the dorsal fins are tall and pointed with the first dorsal fin positioned over or just forward of the pelvic fin origin. The lower lobe of the caudal fin is small and the posterior margin of the caudal fin almost straight (Last and Stevens 1994). An illustration of the species can be found in Plate 43 of Last and Stevens (1994).

**Distribution**  
The dwarf sawfish occurs in shallow waters (2-3 m) in coastal and estuarine areas of tropical Australia, from the west Kimberley to the Mission River in Queensland. In the Northern Territory it has been recorded in several catchments, including Keep River, Buffalo Creek and Rapid Creek (Darwin Harbour), Victoria River and the South Alligator River.

**Conservation reserves where reported**  
Kakadu NP, Casuarina Coastal Reserve

**Ecology**  
There is little known of the biology of this species (Peverell *et al.* 2004). Like other sawfishes it may feed on slow-moving shoaling fish, which are stunned by sideswipes of the snout, and molluscs and crustaceans that are swept out of the mud by the saw (Allen 1982). Most frequently recorded from saltwater at lower estuarine sites, but one specimen has been recorded over 100 km from the sea in the Victoria River (Thorburn *et al.* 2003).

**Conservation assessment**  
The species is on the 2000 IUCN Red List of Threatened Species and its recommended status in Australia is Endangered (Pogonoski *et al.* 2002). The IUCN shark specialist group categorised all Australian sawfishes as endangered on the basis of...
their rapid decline in range (Cavanagh et al. 2003).

In the Northern Territory, the species is classified as Vulnerable (under criterion A2d) due to:

- an inferred population size reduction of \(>30\%\) over the last 10 years or three generations where the reduction may have not ceased (based on potential levels of exploitation).

Declines are inferred based on the susceptibility of the species to various fishing practices in coastal and estuarine habitats.

Note that it was considered for listing as Vulnerable under the *Endangered Species Protection Act 1992*, but not listed then, on the grounds of insufficient information (Pogonoski et al. 2002).

**Threatening processes**

Populations have been significantly reduced as a result of bycatch in commercial gillnet and trawl fisheries (Pogonoski et al. 2002). Recreational fishing may also affect the species.

**Conservation objectives and management**

In the Northern Territory, the managing authority for this species is the Fisheries Section of the Department of Business Industries and Development. Currently, there is no specific management program for the dwarf sawfish in the Northern Territory. Recently, a draft national plan of action has been developed for this and related species (Anon 2002).

The research priorities are to: (i) clarify the distribution and status of the species, and (ii) assess the impacts of fishing operations in estuarine areas in known locations.

**Information on abundance and/or status within Kakadu NP**

There is little information on the abundance or status of this species in the Kakadu area. The only confirmed record is of a single specimen from Brooks Creek, in the South Alligator system.

**Kakadu NP**

Larson (2000) undertook monitoring of this and other estuarine fish in Kakadu NP, but the few specimens of this species collected provide a relatively meagre baseline.

**Importance of Kakadu NP relative to total range**

Low to moderate: the species has a wide geographic range. However, it has been reported from few other conservation reserves, and most other sites where it occurs are subject to commercial or recreational fishing, so the Kakadu occurrences are probably unusually secure.

**Compiled by**

Simon Stirrat and Helen Larson

[June 2002]

**References**


Anon (2002). *Australian National Plan of Action for the conservation and management of sharks. Consultation Draft*. (Department of Agriculture Fisheries and Forestry – Australia Shark Advisory Group, Canberra.)


**FRESHWATER SAWFISH**

*Pristis microdon*

*Conservation status*

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999):*

Vulnerable.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000):*

Data Deficient.

*Description*

The freshwater sawfish is a medium sized sawfish with a body length up to 3 m although reputed to reach up to 7 m. The body is slender and shark-like with a blade-like rostrum (snout) bearing mostly 20-22 pairs of lateral teeth. The teeth start near the rostrum base. The body is yellowish to greyish with a white ventral surface. Pectoral fins are broadly triangular with broad bases and dorsal fins tall and pointed with the first dorsal fin positioned well forward of the pelvic fin origin. The lower lobe of the caudal fin is small and the posterior margin of the caudal fin concave *(Last and Stevens 1994).*

*Conservation reserves where reported:*

Kakadu NP.

*Ecology*

There is little known of the biology of this species *(Peverell *et al.* 2004). Freshwater sawfishes prefer mud bottoms of freshwater areas and upper reaches of estuaries. They usually occur in water greater than 1 m depth but may move into shallow water to feed *(Wilson 1999).* They have been recorded from main river channels, larger tributaries and backwaters, in river mouths.*
and up to 400km inland (Thorburn et al. 2003).

Sawfishes feed on slow-moving shoaling fish, which are stunned by sideswipes of the snout, and molluscs and crustaceans that are swept out of the mud by the saw (Allen 1982). Freshwater sawfishes are viviparous and produce from 1 to 12 young. In Queensland spawning occurs at the beginning of the wet season.

**Conservation assessment**

There is little information to determine changes in population sizes or ranges but the species is extremely vulnerable to gillnet fishing (Pogonoski et al. 2002). Serious declines are evident in overseas populations (Pogonoski et al. 2002) because of habitat loss and fishing impacts.

The IUCN shark specialist group categorised all Australian sawfishes as endangered on the basis of their rapid decline in range (Cavanagh et al. 2003).

The species has been classified as **Data Deficient** in the Northern Territory. Although fishing is a potential threatening process it is not clear to what extent this may be affecting the species detrimentally. Although the freshwater sawfish is probably susceptible to gillnet fishing, there is no gillnet fishing allowed in freshwater in the NT. A few rivers are open to gillnet fishing a few kilometres upstream but not in freshwater reaches. There are no reports of by-catch of freshwater sawfish from any commercial fishery, but they are occasionally caught by recreational fishers.

**Threatening processes**

The impact of fishing practices on freshwater sawfish is unknown. Increasing development in the Northern Territory, resulting in water pollution and loss of riverine habitat may also threaten the species.

**Conservation objectives and management**

The managing authority for this species is the Fisheries Section of the Department of Business Industries and Development. Currently there is no specific management program for the freshwater sawfish in the Northern Territory. Recently, a draft national plan of action has been developed for this and related species (Anon 2002).

The research priorities are:
(i) to establish the status of the species in the Northern Territory; and
(ii) to assess impacts of commercial and recreational fishing operations in both estuarine and freshwater sections of rivers where they are known to occur.

**Information on abundance and/or status within Kakadu NP**

There is very little information on its distribution or status in Kakadu. A skull collected recently on the bank of the South Alligator River opposite El Sherana suggests that the species may be distributed well into the upper reaches of the main river systems.

**Information on monitoring in Kakadu NP**

Larson (2000) undertook monitoring of this and other estuarine fish in Kakadu NP, but the few specimens of this species collected provide a relatively meagre baseline.

**Importance of Kakadu NP relative to total range**

Low to moderate: the species has a wide geographic range. However, it has been reported from few other conservation reserves, and most other sites where it occurs are subject to commercial or recreational fishing, so the Kakadu occurrences are probably unusually secure.

**Compiled by**
Simon Stirrat and Helen Larson
[June 2002]

**References**


Anon (2002). *Australian National Plan of Action for the conservation and management of sharks*. Consultation Draft. (Department of Agriculture Fisheries and Forestry – Australia Shark Advisory Group, Canberra.)

Specialist Group Australia and Oceania Regional Red List workshop. (University of Queensland Biomedical Sciences, Brisbane.)


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**LOGGERHEAD TURTLE**  
*Caretta caretta*

**Conservation status**

**Australia** (*Environment Protection and Biodiversity Conservation Act 1999*):  
Endangered.

**Northern Territory** (*Territory Parks and Wildlife Conservation Act 2000*):  
Endangered.

**Description**

The loggerhead is a marine turtle with a red-brown to brown shell of ~1 m length and a relatively large head. It usually has five pairs of large scales down each side of the shell (costal scales). When ashore it moves with an alternating gait. Eggs are intermediate in size (mean diameter = 4.1 cm) compared with other species. Hatchlings are dark brown dorsally and light brown ventrally.

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Subtidal and intertidal coral and rocky reefs and seagrass meadows, as well as deeper, soft bottomed habitats. Feeding loggerheads are known to occur in Northern Territory waters but are infrequently encountered.

**Conservation reserves where reported:**  
Kakadu, Garig Gunak Barlu, Barranyi.

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**Distribution**

The species has a global distribution. In Australia, breeding is centred in the southern Great Barrier Reef and adjacent mainland, on Dirk Hartog Island (Shark Bay) and Muiron Island (North West Cape) in Western Australia. The eastern and western populations are genetically distinct. No breeding is known to occur in the Northern Territory, or elsewhere in northern Australia (*Limpus and Chatto 2004*). Loggerheads from Australia migrate to the Pacific Islands and southern Asia. The animals that feed in Northern Territory waters appear to come from both the eastern and western breeding populations. When feeding in inshore areas they inhabit subtidal and intertidal coral and rocky reefs and seagrass meadows, as well as deeper, soft bottomed habitats. Feeding loggerheads are known to occur in Northern Territory waters but are infrequently encountered.

**Conservation reserves where reported:**  
Kakadu, Garig Gunak Barlu, Barranyi.

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**Ecology**

Loggerheads eat shellfish, crabs, sea urchins and jellyfish. Females migrate up to 2600 km from feeding areas to traditional nesting beaches. Females lay up to six clutches of around 125 eggs each season with 3-4 years between breeding. After hatching young turtles take up a drifting existence in surface waters and feed on macro zooplankton. As partially grown immature turtles (shell length of ~75 cm) they move to inshore areas. They settle in one area and do not appear to move large distances, except to breed.

**Conservation assessment**

The population trends in the western stock are not known but between 1985 and 1992 the population in the southern Great Barrier Reef declined by 20% and between 1985 and 1998 a decline of 65% occurred in the number of loggerheads nesting on Heron...
Island (Chaloupka and Limpus 2001). No data are available on trends in numbers feeding in Northern Territory waters but as the threatening processes are operating here (see below) it is concluded that a decline is likely.

If it is assumed the same decline is occurring in Northern Territory waters as is occurring in Queensland then the species qualifies as Endangered (under criteria A2b) due to:

- population reduction of ≥50% over the last 10 years or three generations.

**Threatening processes**

Simulation models suggest that increased fox predation on eggs and mortality of pelagic juveniles from incidental capture in coastal otter trawl fisheries and oceanic longline fisheries have led to the observed declines (Chaloupka and Limpus 2001). The main anthropomorphic mortality factor operating within Territory waters is probably capture of turtles by prawn trawlers (Poiner and Harris 1996). Loggerhead turtles have a greater propensity than other sea turtles to consume baited longline hooks (Witzell 1998)

**Conservation objectives and management**

This species is included within a current Recovery Plan (Environment Australia 2003). The main components of that plan are a series of measures to reduce mortality (particularly from by-catch, customary harvest and entanglement in marine debris), to establish and integrate monitoring programs, and to enhance habitat suitability around nesting areas and at feeding sites.

**Information on abundance and/or status within Kakadu NP**

There is little information on the status of the species in Kakadu NP. Roeger and Russell-Smith (1995) reported that it was rare in Kakadu’s coastal waters. Given the preference of this species for deeper water, it probably only occurs rarely in Kakadu waters (where the boundary is to the low water mark).

**Information on monitoring in Kakadu NP**

No current monitoring program.

**Importance of Kakadu NP relative to total range**

Low. Major Australian breeding sites are on the east and west coast (Limpus 1993), and there are few reliable sightings of this species in Kakadu waters.

**Compiled by**

Robert Taylor and Ray Chatto

[March 2002]

**References**


GREEN TURTLE
*Chelonia mydas*

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*): Vulnerable

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*): Not threatened (Least Concern)

**Description**
The green turtle has a high domed carapace, olive-green above, usually patterned with reddish-brown. The shields on the side of the face are conspicuously pale edged. There are four costal shields on each side of the upper shell. Total length to 1m. On sand, flipper drag marks are opposite rather than alternate.

![Green turtle. (Copyright: State of Queensland)](image)

**Distribution**
Pantropical distribution across the world. Many nesting sites occur in the Northern Territory. Nationally significant nesting beaches occur along the eastern coastline of Arnhem Land and the eastern coast of Groote Eylandt but nesting generally occurs from the western end of Melville Island to near the border with Queensland (Chatto 1998).

**Conservation reserves where reported:**
Kakadu, Garig Gunak Barlu, Barranyi, Casuarina Coastal Reserve.

**Ecology**
Adult green turtles are herbivorous; but young are carnivores. Green turtles breed across much of their Australian range, with females producing about 100 round, smallish parchment-shelled eggs per clutch.

**Conservation assessment**
There are no population trend data for the Northern Territory (Limpus and Chatto 2004); however Aboriginal landowners have expressed some concerns about decline in north-eastern Arnhem Land (Kennett *et al.* 1998).

A recent assessment of trends for this species in the southern Great Barrier Reef has shown that the overall population increased by 11% per annum over 8 years (1985-1992) and the female nesting population increased by 3% per annum between 1974 and 1998 (Chaloupka and Limpus 2001).
**Threatening processes**
As with other sea turtles, the populations are threatened by a wide range of factors, including fishing by-catch, entanglement in marine debris ("ghost nets"), harvesting, marine pollution, coastal development, and predation of eggs and young by feral dogs and pigs.

**Conservation objectives and management**
This species is included within a current Recovery Plan (Environment Australia 2003). The main components of that plan are a series of measures to reduce mortality (particularly from by-catch, customary harvest and entanglement in marine debris), to establish and integrate monitoring programs, and to enhance habitat suitability around nesting areas and at feeding sites.

**Information on abundance and/or status within Kakadu NP**
Winderlich (1998) noted that green turtles were common around reefs adjacent to Field Island, counting 20 individuals over a 2 hr search period. In contrast, Roeger and Russell-Smith (1995) noted that they are rare in the waters off Field Island and West Alligator Head. There are no records of nesting in Kakadu.

**Information on monitoring in Kakadu NP**
A study of green turtles foraging adjacent to Green Island has been established since 2002. Tissue samples from individuals captured in this study have been forwarded to a national study of the population genetics of this species (R. Kennett pers. comm.).

**Importance of Kakadu NP relative to total range**
Low. Main breeding sites for this species in the Northern Territory are along the east coast (north-western Gulf of Carpentaria) (Chatto 1998). There are many other major breeding sites along the Queensland coast, northern Western Australia, and islands of the Pacific and SE Asia (Limpus 1993).

**References**

**Compiled by**
Robert Taylor and Ray Chatto
[April 2002]
OLIVE RIDLEY
*Lepidochelys olivacea*

**Conservation status**
*Australia* (Environment Protection and Biodiversity Conservation Act 1999): Endangered


**Description**
The olive ridley (also known as pacific ridley) is a small sea turtle. It is grey or olive-grey above, typically without conspicuous blotchings or other markings. The head is large. The shell is broadly heart-shaped. There are 6 or more pairs of costal scutes. Total length to 1.5 m.

**Distribution**
The vast majority of the nesting population in Australian waters occurs in the Northern Territory (Limpus 1993; Environment Australia 2003). Nesting has been recorded from Melville Island to Groote Eylandt with the highest nesting occurring on Melville Island, islands to the east of Croker Island and some islands off northeast Arnhem Land (Chatto 1998 and unpublished data).

**Conservation reserves where reported**
Kakadu, Garig Gunak Barlu, Barranyi, Casuarina Coastal Reserve.

**Ecology**
Olive ridleys live in shallow protected waters and feed on benthic molluscs, crabs, echinoderms and gastropods. Clutches comprise about 100 large round parchment-shelled eggs.

**Conservation assessment**
There are no accurate population estimates. The female breeding population in the Northern Territory is very roughly
estimated to be between 1,000 to 5,000. Mortality of animals does occur due to capture in fishing nets. The worst recorded occurrence was in Fog Bay in 1991 when an estimated 300 turtles were killed in one incident. Of 100 turtles examined from this kill, 85% were olive ridleys. This level of mortality is, however, exceptional and annual bycatch is likely to be normally much lower.

Given the lack of information on population size and trends in the Northern Territory, the species is best classified as Data Deficient.

**Threatening processes**

As with other sea turtles, the populations are threatened by a wide range of factors, including fishing by-catch, entanglement in marine debris ("ghost nets"), harvesting, marine pollution, coastal development, and predation of eggs and young by feral dogs and pigs.

**Conservation objectives and management**

This species is included within a current Recovery Plan (Environment Australia 2003). The main components of that plan are a series of measures to reduce mortality (particularly from by-catch, customary harvest and entanglement in marine debris), to establish and integrate monitoring programs, and to enhance habitat suitability around nesting areas and at feeding sites.

**Information on abundance and/or status within Kakadu NP**

Roeger and Russell-Smith (1995) noted that Olive Ridleys have been observed nesting on beaches of Field Island and West Alligator Head. However, no nesting of this species has been observed on Field Island over the last 10 years of the monitoring program for flatback turtles.

**Information on monitoring in Kakadu NP**

A breeding marine turtle monitoring program was commenced at West Alligator Head in 1987, with ranger staff involved from 1989-90 (Roeger and Russell-Smith 1995). Numbers of olive ridleys nesting on the Kakadu mainland are very low (<10 per year), and hence the monitoring program for this species was discontinued around 1990.

**Importance of Kakadu NP relative to total range**

Low to moderate. The Kakadu breeding sites are minor relative to other nesting areas across Arnhem Land (Chatto 1998; Limpus and Chatto 2004).

**Compiled by**

Robert Taylor and Ray Chatto [April 2002]

**References**


FLATBACK TURTLE

**Natator depressus**

*Conservation status*
**Australia** (*Environment Protection and Biodiversity Conservation Act 1999*)
Vulnerable

**Northern Territory** (*Territory Parks and Wildlife Conservation Act 2000*)
Data Deficient

*Description*
The flatback turtle is a moderately large, marine turtle. It is grey to olive above, with the plates of the carapace covered by a thin fleshy skin. It is creamy-yellow below, extending to the sides of the neck and face. The shell is broadly oval, with upturned edges. There are four costal shields on each side. Total length to 1.2 m. On sand, flipper drag marks are opposite rather than alternate.

*Distribution*
Flatbacks largely occur in Australian continental waters but can be found in low numbers in Indonesia and Papua New Guinea.

Flatback turtles only breed in Australia and breed all around the coastline and offshore Islands of the Northern Territory. Flatbacks probably constitute the highest breeding numbers of any sea turtle in the Northern Territory (Chatto 1998).

*Ecology*
Flatback turtles inhabit shallow, soft bottomed sea beds. They are carnivores, feeding mainly on soft corals and soft bodied animals such as jellyfish and sea cucumbers. Eggs are the largest of all
Australian marine turtles, other than the rare leatherback turtle.

**Conservation assessment**
Mortality due to bycatch in nets and predation of eggs does occur. However, there are no quantitative data on the impacts of this mortality or trends in population size. In the Northern Territory, the species is best classified as **Data Deficient** as threatening processes are operating but no data are available to assess their impacts on the species.

**Threatening processes**
As with other sea turtles, the populations are threatened by a wide range of factors, including fishing by-catch, entanglement in marine debris (“ghost nets”), harvesting, marine pollution, coastal development, and predation of eggs and young by feral dogs and pigs (Limpus and Chatto 2004).

At the Kakadu mainland nesting sites, Vanderlely (1995) reported unsustainable rates of predation on eggs by goannas; however, subsequent observations (Winderlich 1998) reported far lower predation rates.

**Conservation objectives and management**
This species is included within a current Recovery Plan (Environment Australia 2003). The main components of that plan are a series of measures to reduce mortality (particularly from by-catch, customary harvest and entanglement in marine debris), to establish and integrate monitoring programs, and to enhance habitat suitability around nesting areas and at feeding sites.

**Information on abundance and/or status within Kakadu NP**
There are no published estimates of the abundance of flatback turtles in Kakadu, but Winderlich (1998) and Schuable, Kennett and Winderlich (unpubl) provide some information on the number of turtles tagged on Field Island and nearby mainland beaches.

**Information on monitoring in Kakadu NP**
Winderlich (1998) provided some background information and preliminary monitoring data for nesting populations at Field Island and nearby mainland beaches. This monitoring program commenced at West Alligator Head in 1987, with ranger staff involved from 1989-90. The Field Island population has been monitored since 1990 (Roeger and Russell-Smith 1995; Schuable, Kennett and Winderlich unpubl).

**Importance of Kakadu NP relative to total range**
Moderate. In a review of breeding sites around the entire NT coastline, Chatto (1998) mapped part of Field Island and beaches near West Alligator Head as of “medium density” for marine turtle nesting, and all other Kakadu coastal areas as of “low density”. Neither of the two main Kakadu sites was rated among the set of 16 “major” nesting areas for this species in the Northern Territory.

 Nonetheless, Field Island and the nearby mainland beaches have some significance, as few other breeding sites are reserved, and these sites also have value because there has been some longer-term (10+ years) monitoring there (Winderlich 1998; Schuable, Kennett and Winderlich unpubl).

The national recovery plan for marine turtles (Environment Australia 2003) listed Field Island as one of Australia’s 12 “key monitoring sites” for flatback turtles.

**Compiled by**
Robert Taylor and Ray Chatto
[April 2002]

**References**

PIG-NOSED TURTLE
*Carettochelys insculpta*

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):
Not listed; but currently nominated as Vulnerable (assessment in progress)

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):
Near Threatened.

**Description**
The pig-nosed turtle is a highly distinctive species, the sole surviving member of the once widespread family Carettochelyidae. It is large freshwater turtle, with distinctive unusual snout, a pitted shell (lacking the protective bony scutes that are typical of other freshwater turtles), and clawed paddle-like flippers.

**Distribution**
The pig-nosed turtle occurs in southern New Guinea (the Fly River drainage) and in the Northern Territory (the Daly, South Alligator, East Alligator, Victoria, Goomadeer and PeterJohn systems). Within these systems it occurs in lowlands, generally above estuarine influences.

**Conservation reserves where reported**
Kakadu NP, Daly Esplanade, Gregory, Flora River

**Ecology**
The pig-nosed turtle is a long-lived herbivorous freshwater turtle. It leaves water only to breed, in adjacent (typically clean and unvegetated) sand deposits. It is long-lived, with minimum age at female maturity of at least 25 years (Heaphy 1990). Nesting occurs in the mid to late dry season, in order to allow the hatchlings to emerge before wet season floods. As with marine
turtles, the sex ratio of young is dependent upon nest temperatures.

**Conservation assessment**

Anon (2004) provides a detailed assessment of its conservation status in Australia, and its fit to Vulnerable status under IUCN criteria. This estimates the total extent of occurrence and area of occupancy at <50 km²; mature population at about 2900 individuals, with this likely to decline because of increasing water extraction for horticultural development (Daly system).

**Threatening processes**

Intensification of horticultural production in the Daly River (involving increased offtake of water, increased runoff from cleared areas, and chemical pollution) was seen as the greatest acute pressure on this species (Anon 2004). However, across its entire range, reproductive success may be reduced by predation of eggs by feral pigs; there is some hunting of adults; and weeds of riparian areas may reduce access to the bare sandy beaches required for nesting. It is possible that rapid climate change may affect the species through altered sex ratios of hatchlings and/or altered flooding regimes affecting nest site availability and reproductive success.

**Conservation objectives and management**

Within Kakadu NP, control of feral pigs, at least in the vicinity of important nesting sites, may be the most important management consideration. There is relatively little data on extent of take by hunting, or what sustainable levels may be (Roeger and Russell-Smith 1995). In catchments beyond Kakadu, the major threats are changes to water quality and flow regimes, due to horticultural production. Erskine et al. (2003) have assessed water flow requirements for management of this species, and how these requirements may be affected by varying levels and regimes of water use.

**Information on abundance and/or status within Kakadu NP**

Anon (2004) estimates the total adult population in the South Alligator River catchment as 980, and that in the East Alligator at 158. Relatively high densities of pig-nosed turtles are found in the upper South Alligator, notably at Pul Pul Billabong (Georges and Kennett 1989).

**Information on monitoring in Kakadu NP**

There is no formal monitoring program for this species in Kakadu NP, but estimates of abundance (27 turtles +/-9) and population size distribution were provided for Pul Pul Billabong in September-October 1987 by Georges and Kennett (1989).

**Importance of Kakadu NP relative to total range**

High. The South Alligator population is estimated to comprise 33% of the total Australian population, and that in the East Alligator 5% (Anon 2004). These populations may be critical for the conservation of the species, because they are the only ones occurring in large catchments without current or proposed horticultural development.

**References**


**YELLOW-SNOUTED GECKO**
*Diplodactylus occultus*

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):
Not listed

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):
Vulnerable.

**Description**
A small ground gecko (snout-vent length 40mm); dark brown above with a reddish head, four large, squarish pale brown blotches along the back, and whitish spots scattered on the flanks and limbs.

**Distribution**
The yellow-snouted gecko is endemic to the Northern Territory and is known from only a few locations. Until the recent discovery of this species on Wildman Reserve (*Armstrong et al. 2002*), previous records were limited to only three specimens, all from the northwest of Kakadu National Park (*King et al. 1982*). One individual was also recorded recently (2003) from the military training area of Mt Bundey (*L. Corbett pers. comm.*).

**Conservation reserves where reported**
Kakadu National Park, Wildman Reserve

**Ecology**
Very little is known of the ecology of this species. All individuals captured to date have occurred in conjunction with well-developed leaf litter and grasses (*King et al. 1982; K. Egges unpubl.*) in open forests dominated by *Eucalyptus miniata* and *E. tetrodonta*. Records from Wildman Reserve include sites with sparse to moderate...
occurrences of introduced gamba grass \( (Andropogon gayanus) \).

Habitat on Wildman Reserve – open *Eucalyptus miniata* – *E. tetrodonta* forest.

**Conservation assessment**

Conservation categorisation for the yellow-snouted gecko is problematic because of lack of information on its distribution and population trends at the known sites. However, it can be reasonably inferred that this species has a relatively small total population within its limited and fragmented range. Since its description, there has been only one further record from Kakadu National Park (L. Corbett unpubl.), eight records from four locations on Wildman Reserve (K. Beggs unpubl.) and one recent record from Mt Bundey. The species qualifies as *Vulnerable* (under criteria B1ab(ii,iii,iv,v)) due to:

- extent of occurrence <20,000km²;
- known to exist at <10 locations;
- continuing decline, observed, inferred or projected;

**Threatening processes**

Based on meagre data, the likely threats to the yellow-snouted gecko are related to inappropriate fire regimes and spread of introduced pasture species. There have been no further records from Kakadu National Park since the capture of one individual near Kapalga in 1988, where part of its habitat was subjected to frequent, intense fire regimes. It is therefore likely that this species requires conservative fire management (small areas burnt early in the dry season, and no extensive late dry season fires). It is also likely this species will be disadvantaged by the spread of exotic pasture grasses (namely gamba grass) which form a denser understorey and promote more intense and extensive fires.

**Conservation objectives and management**

There is no existing management program for the yellow-snouted gecko in the Northern Territory.

Since August 2000, two individuals from Wildman Reserve have been maintained in captivity in the Territory Wildlife Park, and in March 2001, produced two hatchlings.

Research priorities are:

(i) to undertake further survey work and baseline ecological research aimed at establishing the distribution, abundance and ecological requirements of the yellow-snouted gecko; and

(ii) to identify the impact upon this species of increased cover of exotic pasture grasses, the fire regimes associated with such grasses, and the measures used to control them.

Until more is known about the ecological requirements of this species, its population size, and the threatening processes operating, management priorities cannot be described with any confidence.

**Information on abundance and/or status within Kakadu NP**

Despite substantial pitfall trapping surveys in the area occupied by this species, few individuals have been encountered. The only records from Kakadu are the three individuals considered in the species’ description, and one subsequent individual, all from Kapalga.

**Information on monitoring in Kakadu NP**

There is no current monitoring of this species in Kakadu, and the few individuals captured to date are inadequate to form a reasonable baseline. In 2004, a monitoring program was established in Wildman Reserve.
Importance of Kakadu NP relative to total range
Moderate. Kakadu probably comprises about half of the range area and total population of this apparently highly localised species.

Compiled by
Kerry Beggs and Martin Armstrong
[November 2001]

References
**Conservation status**  
**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:  
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:  
Data Deficient.  
(Likely to be listed as Vulnerable in the forthcoming revision of the list).

**Description**  
*Egernia obiri* is a large (to at least 20cm snout-vent length) thickset ground-dwelling skink (resembling a blue-tongue lizard in shape). It is grey to light brown above, with a brown longitudinal streak. Legs are short and chunky.

Until recently, the species was more widely known as *Egernia arnhemensis* (Sadlier 1990).

**Distribution**  
Restricted to the western Arnhem Land plateau and outliers (e.g. Jabiluka). Within this range, it has been recorded at relatively few locations, including Nawurlandja (Little Nourlangie Rock), Jabiluka, near Oenpelli, near El Sherana and Koolpin Gorge.

**Conservation reserves where reported**  
Kakadu National Park.

**Ecology**  
This species is largely restricted to sandstone outcrops, typically with extensive fissures and cave systems. It is probably at least partly nocturnal or crepuscular (Sadlier 1990).

**Conservation assessment**  
There is little information on its population, distribution or trends in abundance. As with other endemics of the western Arnhem
Land massif, its total range spans about 34,000 km². However, the limited data suggest that it is very patchily distributed, with the population comprising a set of (semi-) isolated subpopulations. The best baseline information on status is that of many individuals caught as “by-catch” in mammal surveys at Nawurlandja in the late 1970s (Begg et al. 1981). No Arnhemland egernias have been caught there in more recent surveys that used identical procedures (Watson and Woinarski 2003). On the basis of its presumed decline, limited extent of occupancy and probable total population of <10,000 mature individuals, the species qualifies as Vulnerable.

**Threatening processes**
The ecology of this species is very poorly known. It may be affected by predation by cats or changes in food resources caused by altered fire regimes.

**Conservation objectives and management priorities**
Current knowledge is insufficient to provide much guide to management. Research is required to more precisely delineate distribution, habitat preferences, ecology, and to identify threatening factors. This research should also provide a baseline for ongoing monitoring.

**Information on abundance and/or status within Kakadu NP**
There is little information on its abundance or status in Kakadu NP, or across the rest of its limited range. The most substantial data are that of the late 1970s mammal study at Little Nourlangie Rock, in Kakadu, however the data collected there on this lizard were imprecise. A current (2004) research program (by M. Armstrong and A. Dudley) aims to collate all previous records, search all of these sites that are accessible and provide an estimate of population status.

**Information on monitoring in Kakadu NP**
As described above, there is no firm baseline for monitoring. A current (2004) research project aims to provide such a baseline and to establish a longer-term monitoring program.

**Importance of Kakadu NP relative to total range**
High. As with other species endemic to the western Arnhem Land massif, Kakadu NP is important for this species, because it includes about one quarter of the range and population, and is the only area in which management for biodiversity conservation is a primary priority.

**References**
**OENPELLI PYTHON**  
**Morelia oenpelliensis**

*Conservation status*

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*:  
Not listed.

**Northern Territory** *(Territory Parks and Wildlife Conservation Act 2000)*:  
Vulnerable.

*Description*

A very large (to 4 m length) dark olive-brown python, patterned with darker blotches. Underside is cream to dull yellow.

*Distribution*

The Oenpelli python is restricted to the sandstone massif of western Arnhem Land. Within this area, it has been reported from the upper catchments of the Cadell, South Alligator and East Alligator River systems.

*Conservation reserves where reported:*

Kakadu National Park.

*Ecology*

There have been no detailed studies of this species. It shelters in cracks, caves and crevices of rugged broken sandstone escarpments and gorges. Within this environment, it has been reported from monsoon rainforest patches, riparian areas, woodlands, open heathlands and bare rock pavements. Its diet comprises mostly large mammals, particularly possums and macropods.

*Conservation assessment*

There has been no assessments of total population size or trends in abundance. Hence, it is difficult to provide a detailed assessment of status.

The total area of the western Arnhem Land massif is about 34,000 km². Within this area, much of the habitat is probably unsuitable (insufficiently rocky or topographically complex). As a large solitary predator feeding on prey at
relatively low abundance, its population density is probably generally low. On this basis, the total population size is probably under 10,000 mature individuals.

There is some anecdotal indication of at least local decreases, possibly associated with illegal collecting in the most accessible sites. There is also some possibility of decline associated with changing fire regimes.

Accordingly, the Oenpelli python may be classified as **Vulnerable** (under criteria C2a(i)) due to:

- population size estimated at <10,000 mature individuals;
- continuing decline, observed, projected or inferred, in numbers of mature individuals; and
- no subpopulation estimated to contain more than 1000 mature individuals.

This case is weak, in that evidence for decline is scant, circumstantial or conjectural, and there is no information available on population substructure.

**Threatening processes**

This species is sought by some illicit herpetological collectors. This impact is probably minor and localised, as much of the range is almost inaccessible.

More pervasively, fire regimes across its range have changed over the last 50 or so years, to now include a far higher incidence of extensive hot, late dry season fires (Russell-Smith *et al.* 1998). It is possible that this may increase direct mortality, but, more likely, the resulting vegetation change may reduce habitat suitability either directly for this species or indirectly to its prey species.

**Conservation objectives and management**

Research priorities are to:

(i) examine the impacts of fire regimes upon the Oenpelli python directly, or its preferred prey species; and

(ii) attempt to establish some quantitative sampling technique, to derive some estimate of relative abundance, habitat associations and total population size.

Management priorities are to:

(i) establish a monitoring program for this species, particularly with reference to its response to fire management;

(ii) continue to deter illicit reptile collectors.

**Information on abundance and/or status within Kakadu NP**

There have been no quantitative estimates of abundance in Kakadu NP.

**Information on monitoring in Kakadu NP**

Nil.

**Importance of Kakadu NP relative to total range**

High. Kakadu probably comprises about one quarter of the range and total population of this species, and is the only conservation reserve from which the species is known.

**Compiled by**

John Woinarski

[February 2002]

**References**

EMU
*Dromaius novaehollandiae*

**Conservation status**

*Australia (Environment Protection and Biodiversity Conservation Act 1999):*
Not listed.

*Northern Territory (Territory Parks and Wildlife Conservation Act 2000):*
Vulnerable.

**Description**

The emu is an unmistakeable huge flightless bird (height 150-190 cm) with long legs and neck. The plumage is shaggy and varying colouration, from pale greyish brown or warmer brown to greyish buff with black spots or mainly blackish. The skin of the face, throat and upper neck is almost bare and conspicuously bluish. The wings are rudimentary, hanging limply below the breast. The young are striped with dark brown/black-brown over a buff down.

**Distribution**

The emu is distributed throughout most of the Northern Territory but is scarce in the dry desert regions and densities are low in most of the Top End woodlands (Marchant and Higgins 1990).

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*Rafflesia arnoldii*

From Morgan (1986) and personal observations.

**Conservation reserves where reported:**

Alice Springs Desert Park; Chamber’s Pillar Historical Reserve; Connells Lagoon Conservation Reserve; Dulcie Ranges National Park; Garig Gunak Barlu National Park; Illamurta Springs Conservation Reserve; Kakadu National Park; Litchfield National Park; Longreach Waterhole Protected Area; Mary River National Park; Nitmiluk National Park; Purta Co-
management Area; Uluru-Kata Tjuta National Park; Watarrka National Park; and West MacDonnell National Park.

Ecology
Emus can move large distances in response to changes in food or water resources. They are probably more sedentary in the north than the south of the Territory. Emus are omnivorous taking seeds, fruits, insects and the growing tips of plants. They often occur in loose flocks. The male incubates the eggs in a ground nest and broods the chicks.

Conservation assessment
Barrett et al. (2003) reported a significant national decline in the reporting rate for the emu between the first (1997-81) and second (1998-2001) Australian bird atlases. The Northern Territory showed an 80% decrease (the highest of all states/territories). However, it is difficult to compare the results of the two surveys as different methods were used and the second atlas covered a period with a substantially different climate to that of the first atlas. Ian Morris (pers. comm.) reports that Aboriginal landowners in the Kimberley and Arnhem Land believe emus are becoming rarer. We have taken a precautionary approach and listed the species as Vulnerable (under criteria A2b) due to an inferred reduction in population size of >30% over the last 10 years.

Threatening processes
In the Top End declining numbers could possibly be associated with the occurrence of too frequent extensive fires. Such fires lead to a reduction in food supplies, particularly in the size and abundance of plants that produce fleshy-fruit, and in the crop of fruit produced. Fires at the wrong time of year can also lead to destruction of eggs. In Central Australia declines may be also be related to altered fire regimes or to vegetation change associated with pastoralism.

There is a generally held view in the Kimberley that the disappearance of emus coincided with the heavy use of 1080 dingo poison in the pastoral industry (I. Morris pers. comm.). However this would not explain a decline in Arnhem Land where 1080 is not used.

Conservation objectives and management
Research priorities are to determine the causes of the decline in numbers. Management priorities cannot be determined until factors threatening the species are understood. However, a reduction in the extent and frequency of fires is likely to benefit the species.

Information on abundance and/or status within Kakadu NP
Although this is a large and culturally significant species, there is little information on the abundance and distribution of emus in Kakadu, or the Top End as a whole. The relatively small quadrat size used as standard in wildlife survey in Kakadu is generally unsuitable for sampling of such large, wary and thinly dispersed species. There has been no systematic attempt to assess population size in Kakadu. Feasibly, this could be done as part of other general aerial survey, and/or through recording of traditional knowledge.

Information on monitoring in Kakadu NP
Nil.

Importance of Kakadu NP relative to total range
Probably low: the population in Kakadu is likely to be small compared with its total range. However, compared with the rest of the sparse Top End population, Kakadu may offer some security from hunting and unfavourable fire regimes.

Compiled by
Rob Taylor
[August 2003]

References
**RED GOSHAWK**
*Erythrotriorchis radiatus*

*Conservation status*


*Description*

A large reddish-brown goshawk, with conspicuous dark streaks from chin to belly, conspicuously barred on the underwing and tail. The head is whitish with dark streaks. The legs and feet are strong and yellowish, with prominent red feathering ("trousers"). Compared with the common Brown Goshawk, the wings are longer and more pointed and the tail is shorter.

*Distribution*

The red goshawk occurs across much of northern Australia, from near Broome in the south-west Kimberley to south-eastern Queensland. Within this range it generally occurs in taller forests characteristic of higher rainfall areas, but there are some isolated recent records from central Australia. It appears to be unusually common on the Tiwi Islands (Bathurst and Melville).

Known locations of the red goshawk. ○ = pre 1970; ● = post 1970.

Conservation reserves where reported:
Kakadu, Litchfield, Nitmiluk and Garig Gunak Barlu National Parks.
Ecology
The red goshawk hunts mainly for medium-sized birds (up to the size of kookaburras and black cockatoos). Territory size is typically very large (up to 200 km$^2$) (Debus and Czechura 1988; Czechura and Hobson 2000). The preferred habitat is tall open eucalypt forest and riparian areas (including paperbark forest and gallery forests). The conspicuous basket-shaped stick nest is typically placed in large trees near watercourses (Aumann and Baker-Gabb 1991).

Conservation assessment
Based on a series of surveys across northern Australia (Debus and Czechura 1988; Aumann and Baker-Gabb 1991; Czechura and Hobson 2000), there is now reasonably reliable information available on distribution and total population. Garnett and Crowley (2000) collated these surveys to estimate the population size as 1000 breeding birds, and considered it to be vulnerable at the national level, on the IUCN 1994 criterion of D1 (<1000 mature individuals).

Based on the proportion of the known distribution, the Northern Territory population probably accounts for about one-third of the total population (that is, about 330 mature individuals). Of this tally, about 120 live on Melville Island (Woinarski et al. 2000). Proposed forestry operations are likely to reduce this Melville Island population by about 10%. Given these figures, the red goshawk qualifies as Endangered in the Northern Territory (under criteria C2a(i)) due to:

- population size estimated to number <2500 mature individuals;
- a continuing decline (observed, projected or inferred); and
- population structure with no subpopulation containing more than 250 mature individuals.

Threatening processes
Nationally, the red goshawk has been threatened chiefly by clearance of preferred habitat for agriculture, with some localised problems related to illegal egg-collection, shooting, and fire (Garnett and Crowley 2000). In the Northern Territory, the most immediate threat is clearing of prime habitat on Melville Island for short rotation plantations of exotic pulpwood.

Conservation objectives and management
The management priorities are:
(i) to minimise the impact of the proposed Melville Island forestry development, through retention of adequate habitat especially around known nest sites, and
(ii) the establishment of an appropriate monitoring program.

Information on abundance and/or status within Kakadu NP
Roeger and Russell-Smith (1995) noted that there were three known breeding pairs in Kakadu, in paperbark forest fringing the South Alligator upstream from El Sherana, and Naramu at Kapalga.

Information on monitoring in Kakadu NP
Studies reported in Aumann and Baker-Gabb (1991) provide a baseline of known nesting sites in Kakadu; that could be used as the basis for ongoing monitoring.

Importance of Kakadu NP relative to total range
Low-medium. Red goshawks have a wide distribution across northern Australia, albeit typically at low densities. Kakadu comprises only a small proportion of this range and total population.

Compiled by
John Woinarski
[May 2002]

References


AUSTRALIAN BUSTARD
Ardeotis australis

Conservation status
Australia (Environment Protection and
Biodiversity Conservation Act 1999):
Not listed

Northern Territory (Territory Parks and
Wildlife Conservation Act 2000):
Vulnerable

Description
The Australian Bustard is a large, stately
bird that exhibits significant sexual size
dimorphism between males and females,
with males (5-10 kg) up to three times
heavier than females (2-3 kg). The crown is
brown-black, and the neck and breast grey-
white with a distinct black breast band. The
bend of wing is patterned black and white.
Back, wings and tail are brown with fine
buff markings. Females have a narrower
brown crown, less distinct or absent breast
band and greyer neck and breast.

Distribution
The Australian Bustard is widespread
though generally relatively scarce in the
Northern Territory. It is more locally
common away from settled parts when
prevailing conditions are favourable. Its
strongholds in the Northern Territory
include the Barkly Tableland, Daly River
region, the Victoria River District and the
Tanami Desert.

Conservation reserves where reported:
It has been recorded from numerous
reserves including Alice Springs Telegraph

Although the species has been recorded from a range of reserves its highly mobile nature means that very few reserves host permanent, let alone viable, populations of bustards year round and many records are of single individuals. They have most commonly been recorded from Uluru-Kata Tjuta National Park, Watarrka National Park, West MacDonnell National Park.

Ecology
The Australian Bustard is a bird of open country preferring grasslands, low shrublands, grassy woodlands and other structurally similar but artificial habitats such as croplands, golf courses and airfields (Downes and Speedie 1982). However, they respond readily to fire and are often found on recently burnt country, even in more wooded areas.

Bustards have a broad, omnivorous diet largely comprising seeds, fruit, vegetation, invertebrates and small vertebrates. They apparently move readily, tracking rainfall, fires and food resources (e.g. grasshopper outbreaks) across the landscape opportunistically. Their movements are not well defined. However, they are believed to be nomadic or irruptive in the arid and semi-arid regions and migratory with more regular north-south movements in relation to wet/dry seasons in the north. Some populations in the Top End may also be sedentary.

The species’ reproductive biology is unique in that it exhibits an “exploded” lek mating system. In lek systems males aggregate in display arenas that are visited by females for the purpose of mating. The lek system of the bustard is referred to as “exploded” as the display arenas of the males are well spaced apart and aggregation may not be detectable until they are mapped over a larger area. Following mating males play no further role in the breeding process and females care for young until independence.

Conservation assessment
Although still widespread in the Northern Territory the species is relatively scarce. Localised fluctuations in numbers occur in response to rainfall and fire events and they are locally common and possibly sedentary in several horticultural regions (e.g. Douglas-Daly Rivers region). Populations in the north are generally more robust than those in the south.

Outside the Northern Territory the species’ overall population size is still substantial. However, there has been a very large historical decline in abundance in southern Australia and parts of the north such that Garnett and Crowley (2000) categorised the Australian Bustard as Near Threatened in the Action Plan for Australian Birds 2000.

The widespread declines in the Northern Territory are evident from Bird Atlas reporting rates for bustards that have dropped by 70% between the first and second atlases (highest for any state/territory) (Barrett et al. 2003). These declines have been largest in the southern regions. These trends are consistent with anecdotal evidence from mail surveys of pastoral properties and private submissions that suggest that bustards are now completely absent from some areas where they were previously commonly recorded. Although populations in the north are more robust, similar declining trends are evident with consistent reports of lower overall
numbers (e.g. flocks of 50+ in the past to present flocks of <20 at a time).

Assessing numbers of highly mobile birds such as bustards is inherently difficult because of their readiness to move across the landscape in response to variable climatic conditions and patchily distributed resources and naturally large population fluctuations. However, given the evidence consistently suggests an overall decline, a precautionary approach has been adopted. In the Northern Territory, the species qualifies as Vulnerable (under criteria A2b) based on an estimated population reduction of >30% over the last 10 years.

In addition to conservation significance, this species is of cultural significance and an important item of bush tucker in many areas of the Northern Territory.

**Threatening processes**
The widespread decline in bustard numbers has been variously attributed to a combination of factors including predation, altered fire regimes, hunting, disturbance, habitat alteration (e.g. woody weed infestation), pesticides and grazing (Marchant and Higgins 1993; Garnett and Crowley 2000), yet there exists little information regarding the relative effects of these threats.

Another potential threatening process is traditional hunting. Breakdown of controls on traditional hunting compounded by access to modern weapons and vehicles may potentially be one of the most serious threats to bustards in the N.T., possibly explaining the patchy declines in numbers in northern Australia. The conspicuousness and size of males during the breeding period may make them particularly susceptible to hunting resulting in significant male-biased harvesting rates. Such a bias may have serious implications for the specialized lek mating system of the species.

**Conservation objectives and management**
Research priorities are to:
(i) determine population size, distribution and habitat relationships (especially in relation to fire, land use and grazing).
(ii) assess patterns of movements
(iii) establish an effective monitoring program and model numbers in relation to landscape factors including rainfall and fire.
(iv) identify key areas used for breeding and refuge sites in times of drought.
(v) assess factors affecting breeding success.
(vi) quantify the relative impact of hunting of the species, including assessment of the implications of significant male-biased harvesting.

Management priorities are to:
(i) develop fire management programs, with the collaboration of Aboriginal land owners, that are not detrimental to this taxon.
(ii) develop harvesting protocols to minimize impacts.
(iii) control feral predators in key breeding habitats.

**Information on abundance and/or status within Kakadu NP**
There is little information on the abundance and distribution of bustards in Kakadu, or the Top End as a whole. The relatively small quadrat size used as standard in wildlife survey in Kakadu is generally unsuitable for sampling of such large, wary and thinly dispersed species. There has been no systematic attempt to assess population size in Kakadu. Feasibly, this could be done as part of other general aerial survey, and/or through recording of traditional knowledge. As bustards are highly mobile, populations in Kakadu probably vary substantially between seasons and years.

**Information on monitoring in Kakadu NP**
Nil.

**Importance of Kakadu NP relative to total range**
Probably low: the population in Kakadu is likely to be small compared with its total range. However, compared with the rest of the sparse Top End population, Kakadu may offer some security from hunting and unfavourable fire regimes.
Compiled by
Mark Ziembicki
[August 2003]

References


**PARTRIDGE PIGEON**  
(eastern subspecies)  
*Geophaps smithii smithii*

**Conservation status**  
**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*: Vulnerable.  

**Description**  
The partridge pigeon is an unmistakable ground-dwelling pigeon. It is medium-sized (slightly smaller than the feral pigeon *Columbia livia*; weights about 220g cf. 300g respectively), grey-brown bird with conspicuous white leading edge to the wing and red bare skin on the face. It forages entirely on the ground, and, except when flushed in alarm, rarely flies. The subspecies occurring in the Northern Territory *G. smithii smithii* differs from the other subspecies *G. s. blauwii* (of the Kimberley) in colour of the bare skin around the face.

**Distribution**  
The partridge pigeon occurs across the Top End of the Northern Territory and Kimberley. However it has declined or disappeared from much of the lower rainfall parts of this range over the last century.

**Conservation reserves where reported**  
Kakadu, Litchfield, Nitmiluk and Garig Gunak Barlu National Parks.

**Ecology**  
The diet of the partridge pigeon comprises seeds, mostly of grasses but also from *Acacia* and other woody plants (Higgins and Davies 1996). It is largely sedentary, although may make local-scale movements (up to 5-10km) in response to seasonal variations in water and food availability (Fraser 2001). It typically occurs singly or in small family
groups, but larger aggregations may occur, especially in the late dry season, around water sources. It nests on the ground, mostly in the early dry season (Fraser 2001), with “nest” location preferentially in sites with relatively dense grass cover. Such sites contrast to the relatively open (typically burnt) areas preferred for feeding, and suggest that the species may be much affected by fire regimes. Small, patchy fires have been recommended for the management of this species (Fraser 2001).

Partridge pigeons occur principally in lowland eucalypt open forests and woodlands, with grassy understoreys; but also occur in some other vegetation types including paperbark woodlands and around plantation edges.

Conservation assessment
The partridge pigeon has declined substantially in the Northern Territory, and probably also in the Kimberley (Johnstone 1981; Garnett and Crowley 2000; Fraser 2001; Woinarski 2004), although is still abundant in some locations (e.g. parts of Kakadu NP, Litchfield NP and Tiwi Islands: Woinarski et al. 2000). The timing and currency of this decline is poorly resolved, but may have occurred gradually over the last century (Franklin 1999). Neither the extent nor the recency of this decline quite meets the IUCN criteria for vulnerable status. However, it is likely that declines will continue and possibly escalate, given the recent rapid spread of exotic grasses and their consequential impact of increasing the intensity, extent and severity of fires.

Threatening processes
Partridge pigeons face a number of threats, whose relative impacts have not been well established. As they forage, nest and roost on the ground, partridge pigeons are highly susceptible to predation by feral cats. Partridge pigeons are also dependent upon daily access to water for drinking, so are likely to do poorly in relatively dry years, and will be affected by any manipulation of water sources.

But probably the most importantly threats are the inter-related changes in grass composition and fire regimes. Across much of the Top End (and including parts of the Tiwi Islands), exotic grasses (including mission grass *Pennisetum polystachion*, gamba grass *Andropogon gayanus* and/or other African and South American grasses) have spread rapidly over recent decades (e.g. Kean and Price 2003), and, where now present, have greatly reduced the diversity of native grasses. This will change the diversity, timing and abundance of seeds available as food to the partridge pigeon. Fire regimes have also changed appreciably over the Top End (and Tiwi islands) over the last century, and continue to change. Traditional Aboriginal fire regimes were probably far more patchy and fine-scale than the regimes now prevailing. The partridge pigeon was probably greatly advantaged by a regime of frequent, patchy but localised fire, and is probably disadvantaged by the current regime of fewer but more extensive fires (Fraser et al. 2003). That current regime is now being made even more disadvantageous by the high fuel loads associated with exotic grasses, that make for hotter and more extensive fire.

Partridge pigeons may also be affected by the change in vegetation composition and structure caused by livestock and feral animals, although the direction and magnitude of this impact is uncertain. In some cases, grazing by stock may create the more open and patchy ground layer preferred by partridge pigeons (Fraser 2001).

Partridge pigeons occur principally in tall eucalypt open forest, and their population will be reduced wherever these areas are cleared. This habitat is that currently most subjected to conversion for horticulture or forest plantation.

Conservation objectives and management
The major conservation management objective is to maintain extensive areas of eucalypt open forest with intact native grass species composition, and exposed to a fine-scale relatively frequent fire regime.
The partridge pigeon is widespread and at least patchily common in the lowlands of Kakadu. There has been no broad-scale assessment of its total population, but indices of relative abundance can be drawn from the wildlife surveys of Stages I and II (Braithwaite 1985) and Stage III (Woinarski and Braithwaite 1991), and recent surveys of fire monitoring plots (Watson and Woinarski 2004). Unlike much of the rest of its range (Woinarski 2004), there is no evidence of decline in Kakadu.

**Information on monitoring in Kakadu NP**

The set of all fire plots provides some baseline for ongoing monitoring of this species. As at July 2004, 114 fire plots had been sampled for fauna, and partridge pigeons have been recorded in 11 of those plots (Watson and Woinarski 2004). The Kakadu Stages I and II survey sites (Braithwaite 1985) also provide some baseline for broad-scale monitoring.

Fraser et al. (2003) provided a protocol and initial results for monitoring the response of partridge pigeons to mosaic fire management.

**Importance of Kakadu NP relative to total range**

Moderate; the partridge pigeon remains widespread across the Top End of the Northern Territory, including the Tiwi Islands, but it has declined across much of this range. Kakadu may represent a major stronghold, probably because of the relative lack of grazing by livestock and because of the imposition of fine-scale landscape burning.

**Compiled by**

John Woinarski

(May 2003)

**References**


**MASKED OWL (north Australian mainland subspecies)**  
*Tyto novaehollandiae kimberli*

**Conservation status**  
Australia (*Environment Protection and Biodiversity Conservation Act 1999*):  
Vulnerable.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*):  
Near Threatened.

**Description**  
The masked owl is a large dark owl, most likely to be confused with the barn owl *Tyto alba*, which is noticeably smaller and paler, with far weaker legs and feet and with far less feathering on the legs. It is most likely to be detected from its loud call, which comprises a highly varied set of shrieks and complex whistles.

The subspecies occurring on the north Australian mainland is only weakly differentiated from the subspecies *T. n. melvillensis* occurring on the Tiwi Islands. Both are appreciably smaller than the two other subspecies from south-eastern and south-western Australia.

**Distribution**  
The distribution of the mainland north Australian masked owl subspecies *T.n.kimberli* is very imperfectly known, with remarkably few records across its broad range. Based on compilation of records from 1998-2002, the New Atlas of Australian Birds (Barrett *et al*. 2003) reported it from only one 1/4° grid cell (from a total of about 130) in northern Western Australia, two (of a total of about 320) in the Top End of the Northern Territory, one on the Barkly Tableland, and five in northern Queensland. The circumscription of this distribution is confused by (i) a number of dubious or at least unconfirmed records away from its main range (Higgins 1999), such as on the south-west of Cape York Peninsula and in semi-arid Northern Territory; and (ii) whether or not the northeast Cape York Peninsula population is recognised as subspecifically distinct.
Recognising the shortcomings in survey information, the current range can be considered to include the north and north-west coastal Kimberley; the Top End of the Northern Territory, including Cobourg Peninsula, extending south to around Katherine (Storr 1977), with a handful of isolated records from further south, including Jasper Gorge (the Victoria River District), McArthur River station, and Avon Downs (Barkly Tablelands) (Storr 1977; Higgins 1999; Barrett et al. 2003); north-eastern Queensland, including a few early records from north-eastern Cape York Peninsula (Archer-Watson Rivers) (the putative subspecies *T.n. galei*), with a broader distribution centred on Townsville.

Conservation reserves where reported
In the Northern Territory, the masked owl is known from Kakadu, Gregory and Garg Gunak Barlu NP.

Ecology
The masked owl occurs mainly in eucalypt tall open forests (especially those dominated by Darwin woollybutt *Eucalyptus miniata* and Darwin stringybark *E. tetrodonta*), but also roosts in monsoon rainforests, and forages in more open vegetation types, including grasslands. Although it may roost in dense foliage, it more typically roosts, and nests, in tree hollows (Debus 1993). Mammals, up to the size of possums, constitute the bulk of its diet (Higgins 1999).

Although there is no detailed information for this subspecies, masked owls of other subspecies occupy large home ranges, estimated at 1-10 km² (Debus 1993; Kavanagh and Murray 1996).

Conservation assessment
Too little information is known about the distribution, population size and trends in population to ascribe conservation status with any confidence.

Threatening processes
There is no reliable information on what factors may affect the status of this subspecies. It is possible that food resources may be diminishing, through broad-scale decline of small and medium-sized native mammals, a decline itself possibly due to changed fire regimes (Woinarski et al. 2001; Pardon et al. 2003). The greatly increased cover and height of invasive exotic grasses (Rossiter et al. 2003) possibly cause a reduction in foraging efficiency for this owl.

The current regime of more intense, frequent and extensive fires may reduce the availability of large trees and hollows (Williams et al. 2003) required for nesting. Conversely, more extensive and less patchy fires may lead to greater foraging efficiency (Oakwood 2000).

Conservation objectives and management
A draft management plan has recently been compiled for the north Australian masked owl (Woinarski 2004). The main research priority is to:
(i) derive more precise information on population size, home range, habitat requirements, and response to putative threatening processes. Recent studies on the Tiwi Islands have demonstrated that playback of calls is likely to significantly increase probability of detection of this species (Woinarski et al. 2003).

Information on abundance and/or status within Kakadu NP
There is very little general information, and no quantitative data, on the status of masked owls in Kakadu.

Information on monitoring in Kakadu NP
Nil.

Importance of Kakadu NP relative to total range
Uncertain. The status of masked owls across their north Australian range generally remains very poorly known (Woinarski 2004).

Compiled by
John Woinarski
[June 2004]

References


**WHITE-THROATED GRASS-WREN**  
*Amytornis woodwardi*

**Conservation status**

*Australia (Environment Protection and Biodiversity Conservation Act 1999):*  
Not listed.

*Northern Territory (Territory Parks and Wildlife Conservation Act 2000):*  
Vulnerable.

White-throated grass-wren (Photo: Ian Morris)

**Description**

The white-throated grass-wren is a small shy ground-dwelling bird. It is secretive, and most observers get little more than a blurred impression of a mouse-like movement between clumps of spinifex, or darting rapidly behind rocks. This species is noticeably larger than the common red-backed fairy-wren. Its distinctive features include a long tail typically held upright or half-upright when stationary, but lowered when moving; a conspicuous white throat contrasting sharply with the head and upper parts that are black with white streaks, and a dark chestnut brown belly, rump and tail. Its presence is often revealed first by its distinctive call, a mixture of complex trills and chirps, and an alarm call characterised as a sharp “izzzzt”.

**Distribution**

The white-throated grass-wren is restricted to the rugged sandstone massif of western Arnhem Land, extending south-west as far as Nitmiluk National Park and northeast as far as the Mann River (Noske 1992a).

Known locations of the white-throated grass-wren.  

Conservation reserves where reported:

It occurs in two conservation reserves, Nitmiluk and Kakadu National Parks.

Within this range of about 14,000 km², it is patchily distributed.
Ecology
The white-throated grass-wren is confined to hummock grasslands ("spinifex"), sometimes with open shrubland or woodland overstorey, mixed among boulder fields and sandstone pavements (Schodde 1982; Noske 1992a). The diet comprises invertebrates, seeds and other vegetable matter (Noske 1992a). Like other grass-wrens and fairy-wrens, it often occurs in small family groups (typically of 3-6 birds), but also occurs singly or in pairs (Noske 1992a). Breeding occurs from December to June, and territory size is around 10 ha (Noske 1992a).

Conservation assessment
There has been some dispute about the status of this species. Based largely on an estimate of the area of potentially suitable habitat, and population density estimates at eight sites, Noske (1992a) estimated the total population at about 50,000 individuals (with a range of between 14,000 and 182,000), and considered that it was not threatened, although with the caveat that “it may be rash to assume that (it) is totally secure despite its apparent abundance”. Woinarski (1992) re-analysed these and additional data, and estimated that the total population size was about 5,000 to 10,000 individuals, and that the species was threatened by broad-scale habitat change associated with altered fire regimes. In response, Noske (1992b) provided a revised estimate of “in excess of 10,000” individuals. The most recent assessment is that of Garnett and Crowley (2000), who considered that the total population was 8,000 breeding birds, albeit with a low reliability for this estimate.

It can be regarded as Vulnerable (under criteria B1ab(ii,iii)+2ab(ii,iii); C2a(i)) due to:
- extent of occurrence <20,000 km²;
- area of occupancy <2000 km²;
- severely fragmented;
- continuing decline, observed, inferred or projected;
- population size <10,000 mature individuals, and
- no subpopulation estimate to contain more than 1000 mature individuals.
In all cases, the decline is presumed based on broad-scale change in habitat quality associated with altered fire regimes (Russell-Smith et al. 2002). The subpopulation structure of the species is not well known, and the fragmentation or continuity of populations across the Arnhem Land plateau is uncertain.

It was listed as Vulnerable in the recent Action Plan for Australian Birds 2000 (Garnett and Crowley 2000).

Threatening processes
Fire regimes in the sandstone environments of western Arnhem Land have changed dramatically over the last 10-50 years, as traditional Aboriginal management has been disrupted or broken down. There is now a markedly increased incidence of extensive late dry season fires, leading to substantial vegetation change. The extent to which this change reduces habitat suitability for grass-wrens is uncertain, but the meagre evidence suggests that a high frequency of fires is deleterious (Woinarski 1992).

Conservation objectives and management
The principal research objectives are to:
(i) investigate the relationship between grass-wrens, habitat suitability and fire regimes; and
(ii) improve the assessment of total population numbers, distribution and meta-population structure.

Subsequent to results from (i), the main management objective is to implement a fire management program that maintains or enhances habitat quality across the range of this species.

Information on abundance and/or status within Kakadu NP
The species is patchily distributed in Kakadu (and throughout its range across the western Arnhem Land plateau). This patchiness makes it hard to estimate its total population. The Kakadu population is probably somewhere between 3000 and 20,000 birds (Noske 1992a, 1992b; Woinarski 1992; Garnett and Crowley 2000).
Information on monitoring in Kakadu NP

There is no current monitoring program for this species. Noske (1992a) provides population estimates for some sites, and these may serve as a baseline for ongoing monitoring.

White-throated grass-wrens have been recorded too infrequently in the general quantitative wildlife surveys of Kakadu (Braithwaite 1985; Woinarski and Braithwaite 1991) to use such sources alone as a basis for reliable monitoring. However, as at July 2004, they had been recorded from 3 of the 114 fire plots that had been sampled for fauna (Watson and Woinarski 2004); and this set could contribute to a broader monitoring program.

Importance of Kakadu NP relative to total range

High: Kakadu includes about one quarter of the known range of this species, and is the only area in which it occurs that is managed with a priority for biodiversity conservation. Relatively accessible populations of this species (notably at Gunlom) regularly attract many bird-watchers to Kakadu.

Compiled by
John Woinarski
[May 2002]

References
**YELLOW CHAT**  
*(Alligator Rivers subspecies)*  
*Epthianura crocea tunneyi*

*Conservation status*

Australia *(Environment Protection and Biodiversity Conservation Act 1999)*:  
Not listed.

Northern Territory *(Territory Parks and Wildlife Conservation Act 2000)*:  
Endangered.

*Description*  
The yellow chat is a small bird that typically forages on the ground, in dense grass or low shrubs. The male is a bright golden-yellow, with a prominent black chest band. The female is pale lemon yellow, and has no chest band.

![Yellow chat](Photo: M. Armstrong)

*Distribution*  
Yellow chats occur patchily across northern Australia, most typically in chenopod shrublands and grasslands around water sources in semi-arid areas. However, the subspecies *Epthianura crocea tunneyi* is restricted to a small geographic area encompassing the floodplains from the Mary River to the East Alligator River *(Schodde and Mason 1999)*, and within this area it is known from only about 12 sites.

![Known locations of the yellow chat.](Photo: M. Armstrong)

**Conservation reserves where reported:**  
Kakadu National Park and the Mary River National Park.

*Ecology*  
In the floodplain area, yellow chats occur in tall grasslands and samphire shrublands (on coastal saltpans). The diet is mostly invertebrates *(Higgins et al. 2001)*.
chats typically occur in small groups of 2-10 individuals.

**Conservation assessment**

For this endemic Northern Territory subspecies, Garnett and Crowley (2000) estimated the extent of occurrence as 500 km$^2$, area of occupancy at 100 km$^2$, and the total number of breeding birds as 500. However, these estimates are of relatively low reliability. The subpopulation structure is unknown: Garnett and Crowley (2000) considered there was only one subpopulation, but it may be that there are small resident subpopulations in the floodplain system associated with each river system in the Mary to East Alligator area. It is probable that its status is being affected by expansion of exotic weeds in the floodplain habitats (notably by Mimosa pigra, para grass Brachiaria mutica and gamba grass Andropogon gayanus), and possibly by habitat change caused by grazing of cattle and buffalo and by altered fire regimes.

Based on these estimates, the floodplains subspecies of yellow chat qualifies as **Endangered** (under criteria C2a(i) or (ii)) due to:

- population size estimated at fewer than 2500 mature individuals;
- a continuing decline (observed, projected or inferred) in numbers of mature individuals and
- population structure either with no subpopulation containing more than 250 mature individuals or at least 95% of mature individuals in one subpopulation.

It was listed as **Endangered** in the recent *Action Plan for Australian Birds 2000* (Garnett and Crowley 2000).

**Threatening processes**

The preferred floodplain habitats are being altered by expansion of exotic plant species and vegetation change due to grazing by buffalo and cattle and by altered fire regimes. Saltwater intrusion and sea-level rise may further consume preferred habitat. Notwithstanding this array of threatening processes, there may have been some improvement in habitat suitability over the last 20-50 years as a consequence of drastic reduction in the number of buffalo (and their resulting environmental degradation) on the floodplains between the Adelaide and East Alligator Rivers (Letts *et al.* 1979).

**Conservation objectives and management**

The principal research priority is to provide more informed estimates of population size, distribution, patterns of movement, habitat preference and response to the putative threatening processes.

The management priority is to maintain extensive areas of suitable habitat, most likely through control of exotic plants and feral animals.

**Information on abundance and/or status within Kakadu NP**

There is no robust measure of total population in Kakadu, nor on trends in abundance. Yellow chats appear to be very patchily distributed, and may disperse seasonally over at least tens of kilometres, with both of these factors rendering population estimate difficult. If the total population of this taxon is indeed fewer than 2500 individuals, the Kakadu population is probably about 1000 birds.

**Information on monitoring in Kakadu NP**

Nil; however a targeted study of this species to occur in late 2004 will aim to establish a baseline for ongoing monitoring.

**Importance of Kakadu NP relative to total range**

High: Kakadu probably comprises about a half of the total range (floodplain habitat) of this species, and may represent the area in which habitat suitability is most likely to be maintained or enhanced by management intervention.

**Compiled by**

John Woinarski

[May 2002]

**References**


(Environment Australia: Canberra.)


Northern (crested) Shrike-tit
Falcunculus (frontatus) whitei

Conservation status
Australia (Environment Protection and Biodiversity Conservation Act 1999):
Vulnerable.

Northern Territory (Territory Parks and Wildlife Conservation Act 2000):
Data Deficient.

Description
The northern shrike-tit is a distinctive medium-sized bird. It has a dull green back and wings, yellow belly and boldly marked black and white head, with a small black crest. Its bill is unusually deep, strong and hooked.

Known locations of the northern shrike-tit.

Distribution
This taxon forms part of a superspecies of three geographically isolated populations, in eastern and south-eastern Australia, south-western Australia and northern Australia. These taxa are variously accorded subspecific (Christidis and Boles 1994) or full specific (Schodde and Mason 1999) status.

There are remarkably few records of the northern shrike-tit (Robinson and Woinarski 1992). However, these are scattered widely from the south-west Kimberley east to near Borroloola. Most recent records from the Northern Territory have been in the Sturt Plateau and Arnhem Land.

Conservation reserves where reported:
Within the Northern Territory, the northern shrike-tit is known from three reserves (Kakadu, Nitmiluk and Elsey).

Ecology
There have been no detailed studies on the northern shrike-tit. A recent review of all records (Robinson and Woinarski 1992) suggested that it occurred across a range of eucalypt forests and woodlands.

There is more information available on the two other shrike-tit taxa. Shrike-tits are insectivorous. They forage in tree canopies, generally quietly and slowly seeking invertebrates on foliage or under bark. In south-eastern Australia, a high proportion of foraging is from the peeling bark of manna gum *Eucalyptus viminalis* and similar species; however no Northern Territory trees have this feature. The massive bill is extremely strong, and is used for chiselling and tearing bark and branches to access invertebrates sheltering within.

Most of the few records of the northern shrike-tit refer to small parties of 2-5 birds.

Conservation assessment
Assessment of conservation status is hampered by the paucity of records, lack of information on any change in status, and lack of information on limiting factors or threatening processes. Robinson and Woinarski (1992) suggested a possible decline (based largely on absence of recent records from the original collecting site near Borroloola) and a possible impact from frequent fire, but the available evidence is limited.

Garnett and Crowley (2000) considered it to meet criteria C2a for listing as Endangered (total population <2,500 mature individuals, no sub-population with >250 mature individuals, and declining). However, they recognised that the reliability of these estimates was low. The northern shrike-tit appears to be present at low densities over an extensive area and across a broad range of habitats. On current information, a total population size of >10,000 may be as likely an estimate as one of <2,500. This level of uncertainty probably renders the category of Data Deficient more apt.

Threatening processes
The lack of information on the ecology of this species means that it is impossible to assess threatening processes with any degree of confidence. Most likely, habitat quality will be affected by fire regimes, as these may determine the density of large trees and the abundance of the principal food items. However, there is a need to determine the optimum fire regime.

Conservation objectives and management
Research priorities are to:
(i) provide a more precise estimate of total population size and trends;
(ii) investigate the ecology of the species, with particular attention to characteristics associated with habitat suitability; and
(iii) assess the impacts of a range of fire regimes.

Information on abundance and/or status within Kakadu NP
The sole known Kakadu record is from 1976, at Kapalga (Robinson and Woinarski 1992).

Information on monitoring in Kakadu NP
Nil.

Importance of Kakadu NP relative to total range
Uncertain but probably low. Although infrequently recorded throughout its range, the northern shrike-tit has a broad distribution from the Kimberley to Arnhem Land. Most records are from woodlands in lower rainfall areas than Kakadu (notably around Katherine-Larrimah).

Compiled by
John Woinarski
[April 2002]

References


**GOULDIAN FINCH**  
*Erythrura gouldiae*

**Conservation Status**  


**Description**  
An easily recognised finch with mature adults having purple chest, yellow breast and green back. Females are duller than males and juveniles are completely dull green. Three colour morphs exist in the wild: black face, red face and yellow face. No subspecies are recognised.

**Distribution**  
Formerly the gouldian finch was distributed throughout the tropical savannas of northern Australia. It is now restricted to isolated areas mostly within the Northern Territory and the Kimberley. Although the decline has occurred throughout the entire range there is a more noticeable reduction in population numbers in an east-west direction.

**Conservation reserves where reported**  
Kakadu, Nitmiluk, Limmen, Garig Gunak Barlu and Gregory National Parks.

**Ecology**  
Gouldian finches occupy two different regions of the landscape on an annual cycle. In the dry season and part of the late wet season, between February and October, they live within wooded hills that contain a group of *Eucalyptus* species commonly referred to as “snappy gum”. These species of trees provide nesting sites. During this period they feed upon native sorghum and find water at small rocky waterholes that remain within the hills until the next wet. In the wet season gouldians move from the...
hills into lowland drainages to feed upon perennial grasses that begin to seed in mid December. These grasses include soft spinifex, cockatoo grass and golden beard grass.

Clutch size averages 5.2 and fledging rate is 1.5 young per pair (Tidemann et al. 1999). Pairs may raise several clutches per year.

_Conservation assessment_

There is evidence of range contraction and anecdotal and quantitative evidence of population decline for the gouldian finch. Data from the returns of licensed finch trappers operating in the Kimberley region of Western Australia suggested a rapid decline throughout the 1970s. The gouldian finch is considered _Endangered_ (under criteria A2c; C2a(i)ib) due to:

- an observed population size reduction of ≥50% over the last 10 years;
- the population size estimated to number <2,500 mature individuals;
- continuing decline observed in the number of mature individuals;
- no subpopulation estimated to contain more than 250 mature individuals;
- extreme fluctuations in the number of mature individuals.

Current data suggest that the previously observed processes have increased in frequency because of a much broader change in the landscape. New evidence suggests that current practices of large-scale late dry season burning is reducing the seed crops of grass species essential to gouldian finch survival.

_Threatening processes_

A variety of factors has been proposed to explain the decline of gouldian finches. These include the parasitic mite _Sternostoma tracheacolum_ (Tidemann et al. 1992, Bell 1996), trapping (Dostine 1998), and pastoral grazing practices (Tidemann et al. 1990).

Conservation objectives and management

The management priority is to improve current burning practices through reduction of extent of late dry season burning with special focus on wet season feeding grounds.

For Kakadu, the most important research priority is to delineate the breeding sites and evaluate the relative significance of the population.

A management plan for this species will be published in late 2004, to supersede that of Dostine (1998).

_Information on abundance and/or status within Kakadu NP_

There is little information on the status of this species in Kakadu. It has been recorded only infrequently in general wildlife surveys, there has been no specific search, and most records are largely anecdotal and fleeting. There is probably a breeding population of between 50 and 500 in the southern part of the park, with local dispersal after the breeding season.

_Information on monitoring in Kakadu NP_

Nil. The few previous records are insufficient to serve as a monitoring baseline. A long-established monitoring program is in place in the Yinberrie Hills, about 60km SSW of Mary River ranger station, Kakadu: this program is based on counts of individuals drinking at a set of waterholes (O. Price in prep.).
**Importance of Kakadu NP relative to total range**

Uncertain, but possibly high. If the entire population of Gouldian Finches across their range is indeed <2,500 mature individuals, then it is possible that Kakadu may encompass 2-20% of that total. However, these figures remain little more than educated guesses.

Kakadu has importance because it is one of the few conservation reserves in which a substantial population is known, and one of the few components of the species’ range in which there is little grazing by stock and in which relatively benign burning regimes are imposed.

**Compiled by**
Milton Lewis
[October 2001]

**References**


**NORTHERN QUOLL**
*Dasyurus hallucatus*

**Conservation status**

**Australia** (*Environment Protection and Biodiversity Conservation Act 1999*):
Not Listed, but recent (late 2004) submission (in review) proposes Endangered.

**Northern Territory** (*Territory Parks and Wildlife Conservation Act 2000*):
Vulnerable.

**Description**
The northern quoll is a distinctive carnivorous marsupial. It is the size of a small cat (weight 300-1100 g), with prominent white spots on a generally dark body, with a long sparsely furred tail.

**Distribution**
The northern quoll occurs across much of northern Australia, from southeastern Queensland to the southwest Kimberley, with a disjunct population in the Pilbara. It has declined across much of this range (Braithwaite and Griffiths 1994).

In the Northern Territory, it is restricted to the Top End. A 1905 record from Alexandria (Thomas 1906) marks the southern limit of its known Northern Territory distribution, now far from any recent records.

It has been recorded from Groote Eylandt and the nearby North-east Island, Marchinbar Island (in the Wessel group), Inglis Island (in the English Company Islands group) and Vanderlin Island (Sir Edward Pellew group).

**Conservation reserves where reported**:
In the Northern Territory, it has been recorded from 15 conservation reserves (Kakadu, Litchfield, Garig Gunak Barlu, Mary River, Manton Dam, Nitmiluk, Umbrawara Gorge, Fogg Dam, Charles Darwin, Black Jungle, Tjuwaliyn (Douglas
Hot Springs), Berry Springs, Limmen, Leaning Tree Lagoon and Howard Springs).

Ecology
The northern quoll is a generalist predator, consuming a wide range of invertebrates and small vertebrate prey. It dens in hollow logs, rock crevices and caves, and in tree hollows. Most foraging is on the ground, but it is also an adept climber.

It occurs in a wide range of habitats, but the most suitable habitats appear to be rocky areas. It is also common in many eucalypt open forests.

Northern quolls typically have an annual life cycle, with almost all males living for only one year (Oakwood 2000; Oakwood et al. 2001). Young are born in the mid dry season (June), and attain independence in the early wet season (November). Mating is highly synchronised, occurring in late May/early June. Males then die. During the non-breeding season, home ranges are about 35 ha, but this increases to about 100 ha for males in the breeding season (Oakwood 2002).

Conservation assessment
Broad-scale decline of the northern quoll was described by Braithwaite and Griffiths (1994), but the extent and rate of this decline did not quite reach the relevant threshold values for IUCN threatened status.

Since that review, recent studies have suggested collapse of northern quoll populations in those parts of Kakadu National Park recently invaded by cane toads Bufo marinus (Watson and Woinarski 2003; Oakwood 2004). Given the likely occurrence of cane toads across all of the mainland Top End over the next few years, a similar pattern elsewhere suggests that the northern quoll fits the category Endangered, on the basis of criterion A3 (population size reduction of >50%, projected or suspected to be met within the next 10 years, based on direct observation, and the effects of introduced taxa).

Threatening processes
Quolls appear to have been declining in the Northern Territory for at least several decades (Braithwaite and Griffiths 1994; Woinarski et al. 2001), possibly because of impacts from feral cats, disease or changed fire regimes. However, the spread of cane toads adds a far more catastrophic threat (Van Dam et al. 2002). Quolls appear to be particularly susceptible to the poison of cane toads, and are killed when they attempt to kill or consume the toads. Major declines to regional extinction have been reported for quolls following cane toad invasion on Cape York Peninsula (Burnett 1997).

Conservation objectives and management
In the short to medium term, it is unlikely that any control mechanism can be imposed on cane toads, the primary threat to quolls. Given this outlook, the management priority is to secure the existing island populations from colonisation by cane toads, and to increase the probability of the species’ survival by translocation to establish new populations on additional islands.

Information on abundance and/or status within Kakadu NP
Prior to the arrival of cane toads, northern quolls were generally abundant and widespread in Kakadu, although there was some evidence of at least local declines (Woinarski et al. 2001). Quantitative estimates of local abundance can be derived from the autecological studies by Oakwood (2000, 2002) and Begg (1981), and from broader survey results (Braithwaite 1985; Woinarski and Braithwaite 1991).

Information on monitoring in Kakadu NP
Prior to the arrival of cane toads, there were a series of studies and sites that provided a good baseline for ongoing monitoring, and some such monitoring had been conducted. These sites were:

Kapalga
Substantial baseline mark-recapture and radio-telemetry studies by Oakwood (2000, 2002), and grid-based sampling by Braithwaite and Muller (1997), re-sampled
by Woinarski et al. (2001). Results from the latter summarised in the Table below.

Mean abundance of northern quolls (% trap success) at Kapalga, 1986-99 (October sampling).

<table>
<thead>
<tr>
<th>86</th>
<th>87</th>
<th>89</th>
<th>90</th>
<th>91</th>
<th>92</th>
<th>93</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>1.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Nawurlandja (Little Nourlangie Rock).
An intensive study of this species was undertaken in four habitats at Nawurlandja from 1977-1980 (Begg 1981; Begg et al. 1981) that serves as a good baseline for ongoing monitoring. The sampling regime was replicated in 2002 (Watson and Woinarski 2003). The results are summarised below.

Mean abundance of northern quolls (% trap success) in 4 habitats at Nawurlandja (March-May sampling).

<table>
<thead>
<tr>
<th>1977-79</th>
<th>1980</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>rocky crevices</td>
<td>1.00</td>
<td>0.93</td>
</tr>
<tr>
<td>closed forest</td>
<td>0.89</td>
<td>0.86</td>
</tr>
<tr>
<td>rocky slopes</td>
<td>1.11</td>
<td>1.72</td>
</tr>
<tr>
<td>scree slopes</td>
<td>0.30</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Jabiluka
Around Jabiluka, Kerle and Burgman (1984) sampled 40 sites over the period 1979-81; these sites were revisited in 2003 (Watson and Woinarski 2004).

Mean abundance (% trap success) of northern quolls across 40 sub-sites around Jabiluka.

<table>
<thead>
<tr>
<th>1979-81</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Stage III fauna survey sites
In Stage III (Mary River district) of the Park, 263 quadrats were sampled in 1988-90 and again in 2001 (Woinarski et al. 2002). The results are summarised below.

Mean abundance of northern quolls (% trap success) across 263 quadrats in Stage III.

<table>
<thead>
<tr>
<th>1988-90</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.42</td>
<td>0.34</td>
</tr>
</tbody>
</table>

As at July 2004, 114 fire plots had been sampled for fauna. Northern quolls have been recorded in 36 of those plots (Watson and Woinarski 2004). The set of all fire plots provides some baseline for ongoing monitoring of this species.

Subsequent to the arrival of cane toads, cane toads have been intensively monitored at two sites (Mary River and East Alligator) by Oakwood (2004); and more extensively across a set of Stage III sites by Watson and Woinarski (2003). The latter results are summarised in the Table below:

Mean abundance of northern quolls (% trap success) in 2001 and 2002, across sites with and without cane toad invasion in the period between the samples.

<table>
<thead>
<tr>
<th>control</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>1.05</td>
<td>1.30</td>
</tr>
<tr>
<td>toad invaded, 2001-02</td>
<td>0.55</td>
<td>0</td>
</tr>
</tbody>
</table>

**Importance of Kakadu NP relative to total range**
Uncertain. Quoll populations in Kakadu, as in most of the Top End of the Northern Territory, are in rapid decline because of the invasion of cane toads. At present rates, the population in Kakadu may decline to extinction in the near future. If some residual population survives the establishment of cane toads, such a population may have regional significance.

**Compiler**
John Woinarski
[February 2002]

**References**


Oakwood, M. (2004). The effect of cane toads on a marsupial carnivore, the northern quoll, *Dasyurus hallucatus*. Progress report to Parks Australia North. (Envirotek, Nana Glen, NSW.)


NORTHERN BRUSH-TAILED PHASCOGALE
*Phascogale* (tapoatafa) 
*pirata*

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):
Not listed.

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):
Vulnerable.

**Description**

The northern brush-tailed phascogale is a carnivorous marsupial about midway in size between the larger northern quoll and the small antechinuses and dunnarts. Its most notable feature is the long dark hairs on the tail, which form a distinctive brush. The hairs can be stiffened when alarmed, giving a bottle-brush appearance. The general body colour is dark grey, the snout is notably pointed and the eyes are large. Body weight is about 150-200 g.

**Distribution**

Recent taxonomic studies (Rhind *et al*. 2001, Spencer *et al*. 2001) have suggested that the northern population of brush-tailed phascogale is specifically distinct from that in south-western and south-eastern Australia. As redefined, the northern brush-tailed phascogale is known only from a few locations in Top End of the Northern Territory, and is probably specifically distinct from populations elsewhere in northern Australia.

In the Northern Territory, there are recent (post 1980) records from the Tiwi Islands, Cobourg Peninsula, Groote Eylandt, West Pellew Island, Kakadu National Park (notably around Jabiru and near Jim Jim ranger station), and Litchfield National Park. There are older records from the Gove and Katherine areas.
It is known to still exist in three Northern Territory reserves: Kakadu, Litchfield and Garig Gunak Barlu (formerly Gurig) National Parks.

**Ecology**
There have been no detailed studies of the northern brush-tailed phascogale, but its ecology is probably similar to that reported for its temperate relatives (Rhind 1998). The diet is predominantly invertebrates with some small vertebrates. It is a nocturnal mammal, feeding both in trees and on the ground. It shelters in tree hollows during the day. Most records are from tall open forests dominated by *Eucalyptus miniata* (Darwin woollybutt) and *E. tetrodonta* (Darwin stringybark).

**Conservation assessment**
Conservation assessment is hampered by the lack of precise information on range, population size and trends. Decline is evident from variation between historic statements about status and current assessments: most notably Dahl (1897) reported that “on the rivers Mary and Katherine it was frequently observed. In fact nearly everywhere inland it was very constant, and on a moonlight walk one would generally expect to see this little animal”. This is certainly no longer the case. Surveys by PWCNT across the Top End over the last decade have resulted in fewer than 10 captures of brush-tailed phascogales in more than 350,000 trap-nights. However this meagre tally may also partly reflect some degree of trap-shyness.

It best fits the status of **Vulnerable** (under criteria C2ai) based on:
- population size estimated to number fewer than 10,000 mature individuals;
- a continuing decline, observed, projected or inferred, in numbers of mature individuals; and
- no subpopulations estimated to contain more than 1000 mature individuals.

**Threatening processes**
There are no data available to evaluate threatening processes. The apparent decline to coastal areas and especially islands suggests either exotic predators (cats) or disease. Other factors potentially involved may include vegetation change due to altered fire regimes and/or pastoralism. As a predator of small vertebrates, this species may be affected by the arrival of cane toads, but there is no relevant information available to assess the likelihood of this potential threat.

**Conservation objectives and management**
The major priority is to firm up knowledge of the distribution, abundance, habitat requirements and trends for this species. This will require a detailed autecological study and a distributional survey.

**Information on abundance and/or status within Kakadu NP**
The northern brush-tailed phascogale has been recorded rarely in wildlife surveys in Kakadu (Thomas 1904; Calaby 1973; Braithwaite 1985; Braithwaite and Muller 1997; Woinarski and Braithwaite 1991; Woinarski et al. 2001; Watson and Woinarski 2004), providing too little data to provide any robust estimate of population size; other than a recognition that it is generally uncommon. However, there are some places in Kakadu where it appears to be relatively more numerous: these include the area around Jabiru and the main visitor centre, and the area around Cooinda, Mardugal campsite and Jim Jim ranger station.

**Information on monitoring in Kakadu NP**
There are probably too few records of this species across the general wildlife surveys to provide an adequate baseline for ongoing monitoring. For example, this species has been recorded by only two individuals in two quadrats of the 114 fire plots sampled (Watson and Woinarski 2004). An explicit targeted study may be required to provide sufficient data on population size to serve as a foundation for ongoing monitoring.

**Importance of Kakadu NP relative to total range**
Moderate to high. Notwithstanding its uncommon status in Kakadu, it is probably more abundant here than in any other sampled area in the Top End of the Northern Territory. Recent taxonomic
studies suggest that this species occurs only in the Top End.

Compiled by
John Woinarski
[March 2002]

References
GOLDEN BANDICOOOT  
*Isoodon auratus*

**Conservation status**

**Australia** *(Environment Protection and Biodiversity Conservation Act 1999)*: Vulnerable.


**Description**

A small bandicoot weighing up to 550 g. Superficially similar to the more common northern brown bandicoot *Isoodon macrourus*, from which it can be distinguished in the field by its smaller size, by its flatter and more elongate head shape, and by the shape and other characteristics of the hair.

The golden bandicoot formerly occurred across most of northern, central and western Australia, extending to south-western NSW, and across a very broad variety of habitats. However, it declined very similar genetic composition albeit some marked morphological differences. The conservation status of the taxon within the Northern Territory is unaffected by the resolution of this taxonomic issue.

**Distribution**

In the Northern Territory it is now known from only one location, Marchinbar Island on the Wessel chain, north-east Arnhem Land. Beyond the Territory, the same subspecies *I.a. auratus* also occurs on a small portion of the mainland of the north Kimberley (WA) and from a nearby island, Augustus Island. Another subspecies, *I.a. barrowensis* occurs on Barrow and nearby Middle Islands off the Pilbara coast.

The taxonomic position of these forms is currently under review. A recent study *(Pope et al. 2001)* has suggested that golden bandicoots may be conspecific with the southern brown bandicoot *I. obesulus*, with

Known locations of the golden bandicoot. 
○ = pre 1970; • = post 1970.

Golden bandicoot  (Photo: K. Brennan).
precipitously within decades of European settlement, and disappeared from the central deserts between the 1940s and 1960s. The last specimen from the mainland NT was from The Granites (northwest Tanami) in 1952. There have been very few specimen records from the Territory mainland north of the Tanami, but these have included the Roper River area (in 1911) and South Alligator River (around 1900). There are also more recent records (1950s to 1980s) from mainland north-eastern Arnhem Land that are probably referable to this species (Lyne and Mort 1981; I. Morris unpubl).

**Conservation reserves where reported**
The only post 1950 record from any conservation reserve is in Kakadu NP.

**Ecology**
Most information on the ecology of the golden bandicoot is from a single short-term study on Marchinbar Island (Southgate et al. 1996). There it occurs mainly in heathland and shrubland on sandstone or sandsheets, and avoids vegetation with greater tree cover. Individuals maintain overlapping home ranges of from 12-35 ha. Their diet comprises a broad range of invertebrates.

![Preferred habitat on Marchinbar Island - heathland on sandstone.](image)

**Conservation assessment**
In 1994-95, the total population at its single known NT site was roughly estimated at around 1400 individuals, occurring across most of the 210 km² extent of Marchinbar Island (Southgate et al. 1996). There is no information on trends in this population.

The decline in the mainland population and range generally occurred earlier than relevant to IUCN status assignment criteria (i.e. >10 years or 3 generations ago), although the status of the population, if any, on mainland northeast Arnhem Land remains unresolved.

Conservation categorisation is problematical because of lack of information on the population trends at the sole known site. However, it can be reasonably inferred that there is some likelihood that this population may be exposed in the future to the same factor(s) that have so effectively extirpated populations elsewhere. Given this premise, the species qualifies as **Endangered** (under criteria B1ab+2ab; C2) based on:

- extent of occurrence <5,000 km²
- known to exist at <5 locations
- continuing decline, observed, inferred or projected
- area of occupancy <500 km²
- population size <2,500 mature individuals; and
- >95% of mature individuals in one subpopulation.

**Threatening processes**
No single factor has been demonstrated to have caused the decline of golden bandicoots, but the extent of loss on the mainland and the maintenance of some island populations suggests that it is not due to land use factors but rather to either disease or exotic predators. The most likely causal factor is predation by feral cats.

Marchinbar Island has no feral cats, although feral dogs have been present for around 30-50 years, and these are known to take some bandicoots. Bandicoots on Marchinbar Island are hunted occasionally by Aboriginal landowners. Golden bandicoots may be affected by fire regimes, and appear to prefer areas which have been burnt relatively recently (2-5 years previously) and within a fine-scale mosaic. The maintenance of such a fire regime is dependent upon management by Aboriginal landowners.

The greatest threat to the Marchinbar population is the deliberate or inadvertent introduction of cats to the island, either by visiting Aboriginal landowners, by visiting fishermen or yachters, or by refugee boat-people.
Conservation objectives and management
There is no existing management program for the wild population of this species in the Northern Territory. However, a national draft recovery plan has been produced (Palmer et al. 2003) and is now being assessed. This plan includes actions that (1) develop and implement cooperative management arrangements on lands with important populations; (2) establish a multiple species recovery team; (3) monitor populations; (4) survey sites of historic and recent unconfirmed records; (5) and undertake targeted research to identify key threatening factors and viable methods to mitigate these.

Information on abundance and/or status within Kakadu NP
The only records of this species from the Kakadu area are of three specimens collected in 1902-03 at “South Alligator River” (Thomas 1904) and one specimen at Goodparla, collected in 1967. It has not been recorded from any of the extensive wildlife surveys of the Park conducted since then, suggesting that it is very uncommon and/or highly localised. However, it is possible that animals caught over that period were misidentified as juveniles of the morphologically similar but far more common northern brown bandicoot I. macrourus. The specific identity of the 1967 specimen should be confirmed by more detailed scrutiny of its hair and/or genetic analysis.

Information on monitoring in Kakadu NP
Consistent with the lack of recent records, there is currently no monitoring program for this species in Kakadu NP.

Importance of Kakadu NP relative to total range
Uncertain (either low or high). There are no known surviving populations of this species from the mainland of the Northern Territory (and indeed, the entire mainland range is now restricted to a small number of populations in the Kimberley). If the species persists in Kakadu, that population is clearly of major conservation significance.

Compiled by
John Woinarski.
[October 2001]

References
BARE-RUMPED SHEATHTAIL BAT
Saccoilamus sacc poilamus

**Conservation status**

*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*): Critically Endangered.


**Description**

The bare-rumped sheathtail bat is a large (50 g) insectivorous bat. As with other sheathtail bats, the tip of the tail is free of the tail membrane. The fur is dark reddish-brown to almost black, with white speckles, and this fur doesn’t extend to the rump.

**Distribution**

This species has a wide distribution from India through south-eastern Asia to the Solomon Islands, and including north-eastern Queensland and the Northern Territory. The north-eastern Australian populations are described as the subspecies *S. s. nudicluniatus*, although it is not clear whether this should be applied to the Northern Territory population (Duncan *et al*. 1999).

It was first recorded in the Northern Territory from two specimens collected in 1979 and 1980 at Kapalga (McKean *et al*. 1981), and there have been no records since (Thomson 1991: D. Milne unpubl).

**Conservation reserves where reported**

Kakadu NP.

**Ecology**

This is a high-flying insectivorous bat. The Kakadu specimens were collected from open *Pandanus* woodland fringing the sedgelands of the South Alligator River (Friend and Braithwaite 1986). In the Northern Territory, it has also been recorded from eucalypt tall open forests (Churchill 1998). In Queensland, it is known mainly from coastal lowlands, including eucalypt woodlands and rainforests (Duncan *et al*. 1999).

It roosts in tree hollows and caves (Duncan *et al*. 1999).

Known locations of the bare-rumped sheathtail bat.
Its status in the Northern Territory is very difficult to assign, given the remarkably few records. One problem is that there is no record of a diagnostic call assigned to this species that can be used for detection (Duncan et al. 1999).

In the Northern Territory, there is no information from which to consider trends in status, and no obvious threatening process. While the known range is currently very limited, this may largely reflect sampling problems. Given this lack of critical information, the taxon is best considered Data Deficient.

**Threatening processes**
There are no obvious threatening processes. Hollow availability may be reduced by increasing levels of clearing in the Darwin-Mary River area, but this will not affect populations within Kakadu National Park.

Vegetation change associated with saltwater intrusion and/or invasion by exotic species (such as *Mimosa pigra*) may affect habitat suitability.

**Conservation objectives and management**
Research priorities are to:
(i) undertake a targeted study to better define habitat, distribution, population size, and status, and to develop more effective detection techniques.
(ii) resolve the taxonomic status of the Northern Territory population relative to that in north-eastern Queensland.

**Information on abundance and/or status within Kakadu NP**
The only records of this bat from Kakadu (and indeed from the Northern Territory) are the two specimens collected at Kapalga in 1979-80. It has not been recorded since, despite considerable recent surveys in Kakadu and elsewhere in the Top End of the Northern Territory (e.g. Milne et al. 2004).

**Information on monitoring in Kakadu NP**
Nil.

**Importance of Kakadu NP relative to total range**
Uncertain. The Kapalga records represent a considerable disjunction from the rest of this taxon’s range (itself a relatively small portion of north-eastern Queensland).

**Compiled by**
John Woinarski and Damian Milne
[February 2002]

**References**
ARNHEM LEAF-NOSED BAT  
*Hipposideros diadema inornata*

**Conservation status**  
*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*):  
Not listed.  

*Northern Territory* (*Territory Parks and Wildlife Conservation Act 2000*):  
Vulnerable

**Description**  
The Arnhem leaf-nosed bat is a moderately large (30 g) insectivorous bat. It is pale brown above and slightly paler on the belly. It has large, acutely pointed ears and a very well-developed nose-leaf. There are no similar species in the Northern Territory.

This bat is currently considered to be a very distinctive subspecies of a polymorphic species that ranges from the Asian mainland through to the Solomon Islands, and includes a larger subspecies *H. d. reginae* from north-eastern Queensland.

**Distribution**  
The Arnhem leaf-nosed bat was first collected as recently as 1969 (*McKean 1970*) and has been recorded only from a few locations in the western Arnhem Land sandstone massif (Deaf Adder Gorge and upper South Alligator River area) and from one site (Tolmer Falls) in Litchfield National Park (*McKean and Hertog 1979*).

**Conservation reserves where reported:**  
This taxon is known from two conservation reserves, Litchfield and Kakadu National Parks. However, it has not been recorded from Litchfield since 1983 (*Churchill 1998*).

**Ecology**  
This bat roosts in caves or abandoned mine adits in cool draughty areas, close to water (*Churchill 1998; Corbett and Richards*).
Little is known of its foraging habitat or diet, but it has been reported foraging in riparian areas and in eucalypt tall open forests. Its main diet is large invertebrates.

**Conservation assessment**

This bat appears to have a very restricted distribution (although large areas of the rugged western Arnhem Land escarpment have not been sampled), fairly narrow habitat (roost-site) requirements, is probably highly sensitive to disturbance, and has probably disappeared from one of its few known sites over the last two decades.

The species fits **Vulnerable** (under criteria B2ab(i,ii,iii,iv,v)) based on:
- an area of occupancy estimated to be <2000 km²;
- severely fragmented or known to exist at no more than 10 locations; and
- a continuing decline, observed, inferred or projected.

[Note that it is considered **Data deficient** in the national Bat Action Plan (Duncan *et al.* 1999)].

**Threatening processes**

The disappearance of the population at Litchfield National Park may have been due to disturbance from humans visiting roosting caves (Corbett and Richards 2001). At this site, this threat has now been ameliorated. The known sites in western Arnhem Land are generally remote and very rarely visited.

**Conservation objectives and management**

The main research priorities are to:
(i) survey to determine whether this bat still occurs within Litchfield National Park.

Management priorities are to:
(i) maintain controls over visitation to sites known to be used for roosting and breeding. Such controls are currently in place in both National Parks from which it is known.
(ii) establish a non-intrusive monitoring program in at least one site.

There is no substantial quantitative assessment of abundance of Arnhem leaf-nosed bats in Kakadu. Recent advances in knowledge of its echolocation calls now enable more comprehensive objective sampling (Milne 2002).

**Information on monitoring in Kakadu NP**

As at July 2004, 114 fire plots had been sampled for fauna. With recent advances in recording and identification of bat calls, Arnhem leafnosed bats have now been recorded in 4 of those plots (Watson and Woinarski 2004). The set of all fire plots will provide some baseline for ongoing monitoring of this species; and especially so henceforth, as recording of bat calls becomes more routine and sophisticated.

**Importance of Kakadu NP relative to total range**

High: most of the known records of this taxon are from Kakadu. The only other known population within a conservation reserve may have become locally extinct.

Compiled by

John Woinarski and Damian Milne.

[February 2002]

**References**


Milne, D.J. (2002). *Key to the bat calls of the Top End of the Northern Territory.* Technical report no. 71. (Parks and Wildlife Commission of the Northern Territory, Darwin.)

BRUSH-TAILED RABBIT-RAT
*Conilurus penicillatus*

**Conservation status**

**Australia (Environment Protection and Biodiversity Conservation Act 1999):**
Not listed.

**Northern Territory (Territory Parks and Wildlife Conservation Act 2000):**
Vulnerable.

**Description**

A moderately large (about 150 g) partly arboreal rat, with long brush-tipped tail (with the distal third either black or white), long ears. Fur colour is relatively uniformly coloured brown above, and cream below. Also known as the brush-tailed tree-rat, it is distinctly smaller than the two other long-tailed tree-rats in the Northern Territory.

**Distribution**

In the Northern Territory, this species has been recorded from near-coastal areas from near the mouth of the Victoria River in the west to the Pellew Islands in the east, and including Bathurst, Melville, Inglis and Centre Islands and Groote Eylandt (Parker 1973; Kemper and Schmitt 1992; Woinarski 2000). There are no recent records from much of this historically recorded range, and it is currently known to persist in the Northern Territory only on Cobourg Peninsula, Bathurst, Melville, Inglis and Centre Islands, Groote Eylandt, and a small area within Kakadu National Park. Two weakly-defined subspecies are recognised from the Northern Territory: *C.p. melibius* from the Tiwi Islands, and *C.p. penicillatus* from all other Australian areas (Kemper and Schmitt 1992). Beyond the Northern Territory, the species also occurs from higher rainfall, near-coastal areas of the north Kimberley, Bentinck Island (Queensland) and a small area of southern New Guinea.

Known locations of the brush-tailed rabbit-rat. 

Conservation reserves where reported

In the Northern Territory, it is known from two conservation reserves, Kakadu and
Garig Gunak Barlu (formerly Gurig) National Park.

**Ecology**

Preferred habitat is eucalypt tall open forest, generally with a relatively dense tall shrubby understorey (Fig. 3). However, at least on Cobourg Peninsula, it also occurs on coastal grasslands (with scattered large *Casuarina equisetifolia* trees, beaches, and stunted eucalypt woodlands on stony slopes.

It shelters in tree hollows, hollow logs and, less frequently, in the crowns of pandanus or sand-palms. Most foraging is on the ground, but it is also partly arboreal. The diet comprises mainly seeds (especially of grasses), with some fruits, invertebrates and leaves and grass.

**Conservation assessment**

Conservation assessment is hampered by lack of knowledge concerning the timing, extent and currency of geographic decline, and the lack of a recent assessment of status on Groote Eylandt and Centre Island. Its range and population size in the Northern Territory has probably declined by well over 50% since European settlement, but this decline cannot be dated with any assurance. Certainly, its current status no longer matches that reported more than 100 years ago: “in Arnhem Land is everywhere common in the vicinity of water” (Dahl 1897), “numerous all over Arnhem Land, and in great numbers on the rivers of the lowlands” (Collett 1897). There is some suggestion of a decline within the last 20 years at Kakadu National Park, but this is based on very few records (Woinarski et al. 2001).

Current research will provide some assessment of the population size (or at least an index of abundance, whose assessment can be consistently repeated) on Bathurst and Melville Islands, Cobourg Peninsula and Kakadu. A recent study (PWCNT 2001) found very high population density (>6 individuals/ha) in at least two locations on Cobourg Peninsula.

Its status best fits **Vulnerable** (under the criteria B1ab(i,ii,iii,iv,v) based on:
- extent of occurrence estimated to be <20,000 km$^2$;
- severely fragmented or known to exist at no more than 10 locations; and
- continuing decline, observed, inferred or projected.

Within this set, the estimate of extent is most arguable, as the islands where it is present are widely scattered. The total area of the islands known to be occupied is 11813 km$^2$, and that of Cobourg Peninsula is 2207 km$^2$. Elsewhere on the Territory mainland it is known to persist only in a small area (<20 km$^2$) within Kakadu National Park.

The Tiwi Island subspecies *C.p. melibius* unequivocally meets this set of criteria (with total extent of occupancy of about 8300 km$^2$). The other subspecies *C.p. penicillatus* would meet the set of criteria B2ab(i,ii,iii,iv,v).

**Threatening processes**

No single factor has been demonstrated to have caused the decline of brush-tailed rabbit-rats, but the extent of loss on the mainland and the maintenance of some island populations suggests that it is probably not due to land use factors but rather to either disease or exotic predators. The most likely causal factor is predation by feral cats.

However, it is possible that broad-scale habitat change may have contributed to the apparent decline. Changed fire regimes, weeds and grazing by livestock and feral animals may have changed the availability of
preferred or vital food resources (e.g. seeds from particular grass species), and more frequent hot fires may have reduced the availability of hollow logs, tree hollows and the tall fruit-bearing understorey shrubs.

**Conservation objectives and management**

Management priorities are to:

(i) establish a monitoring program in at least two sites, which can also measure responses to management actions. The baseline for this monitoring has now been established, with current studies on Cobourg Peninsula and in Kakadu National Park.

(ii) maintain effective quarantine actions for island populations, most particularly relating to maintaining at least some of these islands cat-free. Note that all islands occupied are Aboriginal lands.

(iii) develop effective captive population breeding programs, and evaluate the possibility of establishing translocated populations (either to currently uninhabited islands or to appropriately managed conservation reserves).

**Information on abundance and/or status within Kakadu NP**

The species was at least locally common in Kakadu lowlands at the turn of the twentieth century (Dahl 1897; Thomas 1904). Its range appears to have contracted markedly since. The Alligator Rivers Fact-finding study of the early 1970s recorded it as “a reasonably common species in the region” (Calaby 1973). It was subsequently recorded, rarely, at only three of the 30 sites sampled over the period 1980-84 in the CSIRO fauna surveys of Stages I and II (Braithwaite 1985) and recorded by only a few individuals in the substantial set of ecological studies undertaken at Kapalga over the period 1986-1993 (Braithwaite and Muller 1997); then it was not recorded at all in the intensive and extensive fauna sampling of Stage III of the park (Mary River District) between 1988 and 1990 (Woinarski and Braithwaite 1991), nor in resampling of Kapalga sites in 1999 (Woinarski et al. 2001). It has also not been recorded in recent extensive fauna surveys to the immediate west of Kakadu, in the Mary River catchment (Armstrong et al. 2002) and Mt Bundey Training Area (L. Corbett pers. comm.). However, a population persists in woodlands in the area around Cooinda, Jim Jim Ranger Station and Mardugal campground, and this locally abundant population has been studied over the period 2000-2003 (R. Firth unpbl.)

**Information on monitoring in Kakadu NP**

The Mardugal population has been sampled in a consistent and repeatable manner (unpublished study by R. Firth, Charles Darwin University), and this sampling would provide a good baseline for ongoing monitoring of this single known population.

**Importance of Kakadu NP relative to total range**

Moderate to high: Other than Cobourg Peninsula, the Kakadu population is the only known mainland population surviving on the mainland of the Northern Territory. Beyond this, the species remains common on the Tiwi Islands, and is known from one site in Queensland, a few records in New Guinea, and as a rare species in the Kimberley.

**Compiled by**

John Woinarski.

[February 2002]

**References**


PWCNT (2001). *Studies of the brush-tailed rabbit-rat Conilurus penicillatus in Gurig National Park.* (PWCNT: Darwin.)


GOLDEN-BACKED TREE-RAT
Mesembriomys macrurus

Conservation status


Description
A large rodent (about 300 g), midway in size between the Territory’s other two large semi-arboreal species, the smaller brush-tailed tree-rat and the larger black-footed tree-rat. Distinctive features include a long slightly brush-tipped tail that is white for at least the distal half, white feet, and a broad chestnut-gold stripe along the back from the crown to the base of tail.

Distribution
In the Northern Territory, the golden-backed tree-rat is known from only three records (Parker 1973); at “Balanbrinni” (probably Balbarini) in the upper McArthur in 1901; from four specimens collected at Nellie Creek (in the upper Mary) in 1903 (Thomas 1904); and from Deaf Adder Gorge in 1969. It has not been confirmed elsewhere despite many substantial surveys across much of the Top End over the last 30 years. However, there are several unconfirmed records based on possible sightings and limited hair samples (Woinarski 2000).

Beyond the Territory, it occurs in coastal areas of the north Kimberley, and five offshore islands there (Carlia, Conilurus, Hidden, Uwins, and Wollaston) (Abbott and Burbidge 1995).

Its range has declined substantially in Western Australia. It appears to have become regionally extinct from the Pilbara, and in at least the more arid southern margins of the Kimberley (McKenzie 1981). For example, Dahl (1897) reported that “the houses of settlers (around Broome) are always..."
Conservation reserves where reported
Two of the three Northern Territory records of golden-backed tree-rat are from the edges of Kakadu National Park (imprecision in the location of historic records is such that it is not clear whether the records were from within or beyond the border of Kakadu NP). It is not known from any other conservation reserve in the Territory.

Ecology
There is very little known of the ecology of this species. The only information from the Northern Territory is that all three records were from riverine vegetation. In the Kimberley, it has been recorded from a broad range of vegetation types, including eucalypt open forests with tussock grass understorey, rainforest patches on a variety of landforms and soils, eucalypt woodlands with hummock grass understorey, rugged sandstone scree, beaches, and blacksoil plains with pandanus. It roosts in tree hollows or, less commonly, in loosely woven nests under the spiky crown of pandanus. Its diet includes seeds, fruits, invertebrates, grass and leaves, and it forages both on the ground and in trees.

Conservation assessment
The remarkably few records from the Northern Territory provide a poor base for assessing status. A decline can be inferred based on the lack of recent records despite substantial survey effort, but it is not possible to say when the decline occurred, or if it is ongoing. The scarcity of historic records suggests that it was already rare in the Northern Territory at the onset of European settlement, or that it declined extremely rapidly thereafter. Historic and ongoing decline in the Territory population and range can be reasonably inferred from the marked decline evident in the better record from north Western Australia.

The Northern Territory status can be considered to be Endangered (under criteria B1ab(i,ii,iii,ij,v); C2a(ii)) based on:
- population size estimated to number <2,500 mature individuals
- severely fragmented or known to exist at no more than five locations
- a continuing decline, observed, projected or inferred and
- no subpopulation estimated to contain more than 250 mature individuals.
There is a high level of uncertainty (about total population size and extent of occurrence), but the assessment is probably reasonable.

Threatening processes
No single factor has been demonstrated to have caused the decline of golden-backed tree-rats, but the extent of loss on the mainland and the maintenance of some island populations (in W.A) suggests that it is probably not due to land use factors but rather to either disease or exotic predators. The most likely causal factor is predation by feral cats (Palmer et al. 2003).

However, it is possible that broad-scale habitat change may have contributed to the apparent decline. Changed fire regimes, weeds and grazing by livestock and feral animals may have changed the availability of preferred or vital food resources (e.g. seeds from particular grass species), and more frequent hot fires may have reduced the availability of hollow logs, tree hollows and the tall fruit-bearing understorey shrubs.

Conservation objectives and management
There is no existing management program for the wild population of this species in the Northern Territory. However, a national draft recovery plan has been produced (Palmer et al. 2003) and is now being assessed. This plan includes actions that (1) develop and implement cooperative management arrangements on lands with important populations; (2) establish a multiple species recovery team; (3) monitor populations; (4) survey sites of historic and recent unconfirmed records; (5) and undertake targeted research to identify key threatening factors and viable methods to mitigate these.

Information on abundance and/or status in Kakadu NP
The status of this species in Kakadu NP, and the Northern Territory generally, is puzzling. It is clearly very uncommon and/or highly localised. It has not been recorded in any of the extensive fauna surveys undertaken over the last 30 years in Kakadu NP, despite sampling in apparently suitable habitat and use of suitable traps. The last confirmed record in the Kakadu area was the Deaf Adder Gorge specimen, in 1969. There has been only very limited subsequent sampling in this area (McKenzie and Kerle 1995). One unconfirmed record near Gerowie Creek in 1993 (Fisher et al. 1993) was further investigated, unsuccessfully, by trapping and searching of tree hollows.

Information on monitoring in Kakadu NP
Consistent with the lack of recent records, there is currently no monitoring program for this species in Kakadu NP. Should a population be relocated in either of both Nellie Creek or Deaf Adder Gorge area, that population, and its response to management, should be monitored at 2-3 year intervals.

Importance of Kakadu NP relative to total range
Uncertain: the Deaf Adder record is the most recent confirmed report from the Northern Territory, and hence may represent one of the few remaining pockets of its NT distribution. However, it is not certain that the Deaf Adder population (or any other in Kakadu) persists.

Beyond the Northern Territory, the Kimberley is the stronghold of this species (Palmer et al. 2003), although it is in decline in at least parts of its range there.

Compiled by
John Woinarski.
[February 2002]

References
**FALSE WATER-RAT**
*Xeromys myoides*

*Conservation status*
*Australia* (*Environment Protection and Biodiversity Conservation Act 1999*): Vulnerable.


*Description*
The false water-rat is a small (35-50g) rodent of unmistakeable appearance. The most distinctive external features are a broad relatively short face, and very short sleek fur. Fur colour is pale grey above and white below. Eyes and ears are relatively small.

*Distribution*
In the Northern Territory, it is known from only 10 records at 6 sites (South Alligator River in 1903, Daly River floodplain in 1972, two sites on the Tomkinson River in 1975, Melville Island in 1975 and Glyde River floodplain in 1998 and 1999) (Redhead and McKean 1975; Magnusson *et al.* 1976; Woinarski *et al.* 2000). Beyond the Northern Territory, it is also known from three sites in coastal south-eastern Queensland and one site in New Guinea.

*Conservation reserves where reported*
Kakadu National Park.

*Ecology*
The ecology of the species is reasonably well known from a detailed study on North Stradbroke Island, Queensland (Van Dyck 1996). The false water-rat is a nocturnal predator eating mainly marine and freshwater invertebrates, especially including crabs, pulmonates and molluscs. It forages entirely on the ground, and is an adept swimmer. It builds and shelters in either burrows or substantial earthen mounds.
Its habitats comprise mangrove forests, freshwater swamps and floodplain saline grasslands (Woinarski et al. 2000).

Conservation assessment
Conservation assessment is hampered by the lack of precise information on range, population size and trends, to such an extent that it may qualify best as data deficient. However, in the Northern Territory, it can be assigned the status of vulnerable on the set of criteria B2ab (area of occupancy estimated to be less than 2000km²; severely fragmented or known to exist at no more than 10 locations; and continuing decline, observed, inferred or projected in area of occupancy, area, extent and/or quality of habitat, and number of locations or subpopulations. This assignment rests on a presumption that only a small proportion of the Territory’s mangroves and floodplains is suitable for (and/or occupied by) the species, and that a range of factors (including saltwater intrusion, spread of weeds, especially Mimosa pigra, and grazing of the floodplains by domestic and feral water buffalo and cattle) are operating to reduce habitat quality.

Threatening processes
There is insufficient information available to assess the impacts of possible threatening processes. There may be some predation by feral cats. However, the most plausible threatening processes relate to broad-scale habitat changes, especially those due to saltwater intrusion, spread of weeds and impacts of grazing. However, it is not clear that these changes necessarily reduce habitat quality for this species, and they are unlikely to diminish the extent of mangrove communities.

Conservation objectives and management
The main priorities are to better define the distribution and status of this species and to assess the impacts of a range of putative threatening processes. Such information is needed before management prescriptions can be formulated appropriately.

Information on abundance and/or status within Kakadu NP
The only record from Kakadu was one specimen collected in 1903, considered to be from “the coastal plain and tidal section of the South Alligator” (Parker 1973).

Information on monitoring in Kakadu NP
No existing monitoring. The single specimen collected, and the relatively sparse survey effort, are inadequate baseline for a monitoring program.

Importance of Kakadu NP relative to total range
Uncertain. With no records from Kakadu for more than a century, the species may no longer be present. However, there has been relatively little recent survey work in its presumed habitat. If still present in Kakadu, this would be the only reserved population in the Northern Territory.

Compiler
John Woinarski
[March 2002]

References
**ARNHEM ROCK-RAT**
*Zyzomys maini*

**Conservation status**
*Australia (Environment Protection and Biodiversity Conservation Act 1999):* Not listed.


**Description**
The Arnhem rock-rat is a large (100-150 g) rat distinguished from most other Northern Territory rodents by its large whiskers, typically swollen tail (especially at the base), the long hairs towards the tip of the tail, and the characteristic roman nose. It shares these features with the much smaller (30-70 g) common rock-rat *Z. argurus*, from which it can be separated by size, colour (typically more grey than brown), and higher density of long hairs on the tail.

The rock-rats have fragile tails and fur, and many individuals may have no or greatly reduced tails, presumably as a consequence of predator attack.

**Distribution**
The Arnhem rock-rat is endemic to the sandstone massif of western Arnhem Land. This area encompasses about 34,000 km², but a high proportion of this area comprises habitat that is probably unsuitable for this species.

Until recently, it was considered conspecific with the Kimberley rock-rat *Z. woodwardi*, now regarded as restricted to the north Kimberley (Kitchener 1989).

**Ecology**
The ecology of the Arnhem rock-rat is relatively well known from a series of studies at Little Nourlangie Rock in Kakadu National Park (Begg and Dunlop 1980,
It is an entirely terrestrial, nocturnal species, restricted to areas with large sandstone boulders or escarpment with fissures and cracks. It occurs in these areas very patchily, being restricted mostly to monsoon rainforest patches, notably in gullies and along creeklines, or in fire-protected refugia. This is a much narrower habitat than that occupied by the common rock-rat. The Arnhem rock-rat’s diet comprises mainly seeds, fruit and some other vegetable matter. The seeds eaten include those from many species of rainforest tree. Large seeds may be cached, or at least moved to be eaten at relatively safe sites, resulting in distinctive piles of chewed hard seeds in rock fissures or under large overhangs. On the basis of its response to a single large fire, the Arnhem rock-rat appears to be unusually fire-sensitive, with substantial decline for at least 1-2 years post-fire (Begg et al. 1981). A high frequency of fire will result in diminution of its preferred sandstone monsoon rainforests (Russell-Smith et al. 1993, 1998).

**Conservation assessment**

Conservation assessment is hampered by the lack of precise information on range, population size and trends. Decline can be presumed on the basis of the current high frequency of fire across much of the western Arnhem Land plateau (Russell-Smith et al. 1998), and resultant decline in its preferred habitat, monsoon rainforests, there (Russell-Smith and Bowman 1992; Russell-Smith et al. 1993, 1998).

It best fits the status of **Vulnerable** (under criteria B1ab(i,ii,iv,v)+2ab(ii,ii,iv,v)) based on:

- extent of occurrence estimated to be <20,000km²;
- area of occupancy estimated to be <2,000km²;
- severely fragmented or known to exist at no more than 10 locations; and
- continuing decline, observed, inferred or projected.

**Threatening processes**

The major threatening process appears to be reduction in habitat suitability and/or extent due to increased frequency of extensive hot dry season fires. It is possible that this species will benefit from the invasion of cane toads, as these may reduce the abundance of the rock-rat’s predators.

**Conservation objectives and management**

Management priorities are:

(i) to reduce the incidence of extensive, hot dry season fires; and

(ii) to establish a program for monitoring the status of at least one subpopulation, but preferably more, and preferably in association with a range of fire management practices, in order to help refine best management practice.

**Information on abundance and/or status within Kakadu NP**

The Arnhem rock-rat is (or was) locally common in sandstone sites with massive boulders, escarpment and fissures, and especially so where these sites support monsoon rainforest plants that bear fleshy fruits. There are quantitative estimates of abundance at two main sites in Kakadu - Nawurlandja (Begg 1981) and Jabiluka (Kerle and Burgman 1984), and measures of abundance and distribution arising from a series of more broad-ranging wildlife surveys (Woinarsi et al. 2002). While these studies and samples provide local measures of abundance, the patchy nature of its distribution means that these estimates cannot be reliably extrapolated to an estimate of the total number in Kakadu.

**Information on monitoring in Kakadu NP**

There are four components that could contribute to a regular monitoring program for this species in Kakadu.

**Nawurlandja (Little Nourlangie Rock)**

An intensive study of this species was undertaken in four habitats at Nawurlandja from 1977-1980 (Begg 1981; Begg et al. 1981) that serves as a good baseline for ongoing monitoring. The sampling regime was replicated in 2002 (Watson and Woinarsi 2003). The results are summarised below.
Mean abundance of Arnhem rock-rat (% trap success) in 4 habitats at Nawurlandja (March-May sampling).

<table>
<thead>
<tr>
<th></th>
<th>1977-79</th>
<th>1980</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>rocky crevices</td>
<td>0.41</td>
<td>1.00</td>
<td>0</td>
</tr>
<tr>
<td>closed forest</td>
<td>0.81</td>
<td>1.00</td>
<td>0</td>
</tr>
<tr>
<td>rocky slopes</td>
<td>0</td>
<td>0.93</td>
<td>0</td>
</tr>
<tr>
<td>scree slopes</td>
<td>0.22</td>
<td>0.75</td>
<td>0</td>
</tr>
</tbody>
</table>

Jabiluka
Around Jabiluka, Kerle and Burgman (1984) sampled 40 sites over the period 1979-81; these sites were revisited in 2003 (Watson and Woinarski 2004).

Mean abundance (% trap success) of Arnhem rock-rat across 40 sub-sites around Jabiluka.

<table>
<thead>
<tr>
<th>1979-81</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.48</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Stage III fauna survey sites
In Stage III (Mary River district) of the Park, 263 quadrats were sampled in 1988-90 and again in 2001 (Woinarski et al. 2002). The results are summarised below.

Mean abundance of Arnhem rock-rat (% trap success) across 263 quadrats in Stage III.

<table>
<thead>
<tr>
<th>1988-90</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.24</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Fire Monitoring Plots
As at July 2004, 114 fire plots had been sampled for fauna. Arnhem rock-rats have been recorded in 3 of those plots (Watson and Woinarski 2004). The set of all fire plots provides some baseline for ongoing monitoring of this species.

Importance of Kakadu NP relative to total range
High: Kakadu includes about one quarter of the known range of this species, and is the only area in which it occurs that is managed with a priority for biodiversity conservation.

Compiled by
John Woinarski
[March 2002]

References


3. RESEARCH AND MANAGEMENT IMPLICATIONS AND PRIORITIES


The last planning document for a threatened species program for Kakadu National Park (Roeger and Russell-Smith 1995) provided a set of research and management recommendations for the period 1995-2002. These recommendations are collated in Table 5, and serve to provide a context and baseline for current priorities. In general, these recommendations were explicitly or implicitly included within the Kakadu Plan of Management for the period 1999-2004 (Kakadu Board of Management and Parks Australia 1999).

As evident from Table 4, most of the recommended actions were undertaken, to at least some degree, over the 1995-2002 period. For the purposes of this report, activities conducted in 2002-04 are also included. In addition, Kakadu threatened species benefited from broad-scale park management of fire, feral animals and weeds; and the establishment of a broad-scale monitoring program for terrestrial vertebrates (Watson and Woinarski 2003, 2004) provided some additional information on the abundance, distribution and trends in status for some threatened animal species, and served to highlight concerns for some species not yet listed as threatened.

The relevance of the set of recommended actions for threatened species management from 1995 has also been affected by the substantial increase in the number of threatened species listed since 1995; with many actions undertaken in recent years for species that were not considered as threatened at the time of writing of the 1995 report.

The recommendations not fully enacted over the 1995-2004 period most notably include:

(i) specific surveys for gouldian finch, golden-backed tree-rat, false water-rat, oenpelli python, and yellow-snouted gecko;

(ii) establishment of monitoring programs for the brush-tailed phascogale and pig-nosed turtle (and of an ethnoecological study of the latter, considering particularly issues related to sustainable use);

(iii) the development of an invertebrate issues paper; and

(iv) the development of an enhanced GIS, data base and data entry facility more widely used by Kakadu staff and visitors.
Table 5. Recommendations for actions proposed for the 1995-2002 Endangered Species Program in Kakadu NP (Roeger and Russell-Smith 1995), along with assessment of whether the recommended action was taken and successful.

<table>
<thead>
<tr>
<th>Reference no.</th>
<th>species affected</th>
<th>Described recommended action</th>
<th>Activity 1995-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2. (i)</td>
<td>loggerhead turtle</td>
<td>Given the low numbers of these turtles sighted in Kakadu coastal waters no specific research or monitoring program is warranted. A general survey of the Van Diemen Gulf area is warranted, in conjunction with the CCNT, as well as the undertaking of a more extensive survey of the Arafura Sea to the east. Such a survey would benefit from the involvement of Aboriginal custodians and communities throughout the region, given that they hold detailed ecological knowledge of this species.</td>
<td>Marine resource inventory of east Van Diemen Gulf, Goulburn Islands area and Castlereagh Bay to be conducted in November 2004, in collaboration with NLC, NOO, NT DIPE and MAGNT.</td>
</tr>
<tr>
<td>3.2. (ii)</td>
<td>green turtle</td>
<td>as above</td>
<td>Survey conducted of foraging turtles adjacent to Field Island in 2002 and 2003, and samples contributed to national population genetics (stock assessment) program under the national recovery plan for marine turtles.</td>
</tr>
<tr>
<td>3.2. (iii)</td>
<td>olive ridley</td>
<td>As for loggerhead turtle generally, but given that this species is known to nest occasionally on Field Island and at West Alligator Head in the Park, ongoing monitoring of nesting success of this species is warranted. Such a program has been undertaken over the past two years in the Park, focusing on the unlisted flatback turtle; ongoing support for this program is required.</td>
<td>Monitoring program on Field Island was maintained, as recommended. Note that no nesting of this species was recorded at Field Island over this period.</td>
</tr>
<tr>
<td>3.2. (iv)</td>
<td>gouldian finch</td>
<td>Evident need for a comprehensive survey of potential breeding habitats in the Park, and also of woodland habitats in the late dry season in general to assess the status of Kakadu as a refuge for this species. This survey should be undertaken in conjunction with the Gouldian Finch Recovery Team and Plan. Advice of Aboriginal custodians should be sought also given detailed local knowledge and information concerning this species.</td>
<td>No specific survey undertaken, but some incidental records acquired as part of more broadly-based wildlife survey and monitoring programs.</td>
</tr>
<tr>
<td>3.2. (v)</td>
<td>ghost bat</td>
<td>There appears little requirement for further survey work on this species in Kakadu at the present time.</td>
<td>subsequently de-listed</td>
</tr>
<tr>
<td>3.2. (vi)</td>
<td>red goshawk</td>
<td>There is little need for further survey work in Kakadu concerning this species. Monitoring of nests may be required to stop human predation. Opportunistic monitoring of known nesting sites by reputable</td>
<td>As recommended, no substantial action.</td>
</tr>
<tr>
<td>Reference no.</td>
<td>species affected</td>
<td>Described recommended action</td>
<td>Activity 1995-2004</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------</td>
<td>-------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>researchers should continue, but the location of nest sites should not be made known to the public.</td>
<td></td>
</tr>
<tr>
<td>3.2. (vii)</td>
<td>golden-backed tree-rat</td>
<td>Further survey work in the vicinity of the recent sighting in Kakadu should be undertaken, in consultation with the CCNT</td>
<td>Some detailed search undertaken around the Gerowie Creek possible sight record.</td>
</tr>
<tr>
<td>3.2. (viii)</td>
<td>false water-rat</td>
<td>A survey of potential habitat in Kakadu should be undertaken, but only after seeking expert advice. Survey to be undertaken in conjunction with CCNT</td>
<td>No survey conducted.</td>
</tr>
<tr>
<td>6.2.1. (i)</td>
<td></td>
<td>ANCA continue to support a long-term program for marine and estuarine inventory in the Park</td>
<td>As recommended, estuarine fish surveys were conducted in collaboration with MAGNT (Larson, 1997, 1999 and 2002). Further marine surveys to be conducted in 2004 (see 3.2 (i) above.</td>
</tr>
<tr>
<td>6.2.1. (ii)</td>
<td></td>
<td>ANCA should provide no consultancy funding to the Australian Littoral Society until their unfinished and long-overdue report on tidal wetlands and marshes in Kakadu is completed.</td>
<td>Wetlands survey data were recovered by eriss and a follow-up survey undertaken by them in 2003 (Saynor et al. 2003; Mitchell et al. 2003).</td>
</tr>
<tr>
<td>6.2.1. (iii)</td>
<td></td>
<td>ANCA continue to support botanical survey work targeting sandstone heath communities of the Arnhem Land plateau and escarpment.</td>
<td>Major surveys for threatened plants were commissioned in 2003 and 2004, with focus particularly on sandstone environments (Kerrigan 2003 and 2004). Ongoing work has been undertaken examining the response of fire-sensitive obligate seeder, heath shrub species, with two papers published (Russell-Smith et al. 1998, 2002). Further studies are being undertaken with respect to reproductive ecology of Callitris intratropica, and Petraeomyrtus (syn. Regelia) punicea, and more generally associated with sandstone fire monitoring plots.</td>
</tr>
<tr>
<td>6.2.1. (iv)</td>
<td></td>
<td>ANCA commission an invertebrate issues paper addressing prioritised survey requirements for the Park. Further, it is recommended that such a paper should target: (a) species/groups of the escarpment and plateau, particularly those which may provide useful indicators with respect to fire regime; and (b) freshwater and marine groups which likewise may</td>
<td>No specific invertebrate issues paper was commissioned. eriss has conducted studies on freshwater invertebrates as indicators of water quality (for assessing mining impact), and taxonomic and distribution/abundance</td>
</tr>
<tr>
<td>Reference no.</td>
<td>species affected</td>
<td>Described recommended action</td>
<td>Activity 1995-2004</td>
</tr>
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<tr>
<td></td>
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<td>act as useful indicators of water/habitat quality.</td>
<td>studies (esp. endemic stone country taxa) to contribute to understanding World Heritage values (Bruce 1993, Bruce &amp; Short 1993). Apart from type specimens referred to in published taxonomic studies, the substantial collection of invertebrates held by eriss is yet to be catalogued.</td>
</tr>
<tr>
<td>6.2.1. (v)</td>
<td>Leichhardt’s grasshopper</td>
<td>ANCA fund the undertaking of research into the fire ecology of the flagship invertebrate species, the Leichhardt’s grasshopper, and other grasshoppers in sandstone escarpment and plateau habitats.</td>
<td>As recommended, a major study on Leichhardt’s grasshopper was commissioned (Wilson et al 2003, Barrow 2004).</td>
</tr>
<tr>
<td>6.2.2. (i)</td>
<td></td>
<td>ANCA fund the undertaking of ecological research into the role of fire in Arnhem Land escarpment and plateau communities as a matter of high and urgent priority. Such research should target also the Leichhardt’s grasshopper and a number of other identified faunal species.</td>
<td>Fire monitoring plots established to record response of plants and animals to fire regimes, with particular emphasis on sandstone environments (Turner et al. 2001).</td>
</tr>
<tr>
<td>6.2.2. (ii)</td>
<td></td>
<td>ANCA continue to support research into the control and monitoring of important feral plants (especially Mimosa, Salvinia, Para grass, Mission grass, Gamba grass and legumes in general), and animal species (especially pigs, buffalo, horses, cats, cane toads, and European bees).</td>
<td>Ongoing funding for management and collaboration with partners including eriss, Charles Darwin University and CSIRO into feral and weed control and management (Cook et al. 1996, Cook 1998, Douglas et al. 2001, Hoffman and O’Connor 2004 ). A feral animal strategy was commissioned in 2001 with final report due in 2004.</td>
</tr>
<tr>
<td>6.2.3. (i)</td>
<td></td>
<td>Key identified data sets need to be digitised and thus made available on Kakadu’s GIS; in particular, the CSIRO fauna survey of Stages I and II of the Park, and the unfinished Australian Littoral Society’s tidal wetlands survey</td>
<td>As recommended, the CSIRO fauna data have been recorded in data files. Wetlands survey data were recovered by eriss and a follow-up survey undertaken by them in 2003 (Saynor et al. 2003; Mitchell et al. 2003).</td>
</tr>
<tr>
<td>6.2.3. (ii)</td>
<td></td>
<td>Key fauna sites need to be relocated, their locations accurately recorded with GPS, and the sites themselves permanently marked; in particular five as yet unrelocated fauna sites from the CSIRO Stages I and II survey, and all CSIRO Stage III survey sites.</td>
<td>A high proportion of the CSIRO Stage III survey sites were re-visited and their location precisely recorded with GPS.</td>
</tr>
<tr>
<td>6.2.3. (iii)</td>
<td></td>
<td>All future biological survey consultancies in Kakadu to provide data in</td>
<td>All major fauna surveys have provided data</td>
</tr>
<tr>
<td>Reference no.</td>
<td>species affected</td>
<td>Described recommended action</td>
<td>Activity 1995-2004</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>6.2.3. (iv)</td>
<td></td>
<td>That recording of incidental sightings of notable fauna species be undertaken in conjunction with the CCNT’s Biological Records Scheme</td>
<td>No database for entry of incidental sightings has been established and promulgated; but records of some such sightings have been data based.</td>
</tr>
<tr>
<td>6.2.3. (v)</td>
<td></td>
<td>ANCA continue to support the development of a fine-scale (1:25,000) habitat map of the Park. Such development needs to be staged, with the mapping of sandstone escarpment and plateau habitats a first and high priority. Mapping of lowland and floodplain habitats should then be undertaken sequentially.</td>
<td>Some fine-scale vegetation mapping of the western Arnhem Land plateau is currently being undertaken.</td>
</tr>
<tr>
<td>6.2.3. (vi)</td>
<td></td>
<td>ANCA provide a full-time designated position for undertaking the management and curation of databases acquired over the years in a range of project areas in Kakadu, including those assembled for the Park’s GIS. This is an urgent and high priority given that millions of dollars have been spent acquiring these data.</td>
<td>Some management and curation of data bases is being maintained.</td>
</tr>
<tr>
<td>7.1</td>
<td></td>
<td>Species surveys*. Surveys should be conducted to determine the status of gouldian finch (priority 1); golden-backed tree-rat, false water-rat (priority 2); oenpelli python, yellow-snouted gecko, partridge pigeon, and brush-tailed rabbit-rat (priority 3).</td>
<td>Of the 7 species listed, studies of the status of two species (partridge pigeon (Fraser 2000, 2003), brush-tailed rabbit-rat) have been conducted.</td>
</tr>
<tr>
<td>7.2</td>
<td></td>
<td>Species monitoring*. Monitoring programs should be implemented for the flatback turtle, pig-nosed turtle, and brush-tailed phascogale. An ethno-ecological study should be implemented for the pig-nosed turtle.</td>
<td>Of the 3 species listed, a monitoring program has been maintained for one (flatback turtle – Schauble 2002; KNP 2004).</td>
</tr>
</tbody>
</table>

* the list of species suggested for survey and monitoring included additional species that were not listed as threatened in either 1995 or now, and these species are not listed here.
Current priorities: Introduction and collation

The collection of threatened species reported here from Kakadu NP spans an extraordinary range of taxonomic groups, habitats and management issues. The urgency and significance of management actions is great for some species, but relatively minor for others. Management obligations are complex, affected by a web of regulations arising from Australian legislation, laws operating in the Northern Territory and international treaties. Limitations on resource availability will inevitably constrain research and management actions. In this section of the report, the information from all threatened species is collated (Table 6) in order to attempt to distil priorities for ongoing research and management.

There are a set of overlapping or independent criteria that can be used to help guide prioritisation for management action. These are each summarised below.

1. Legislative requirements. Australia’s overarching environmental legislation, the *EPBC Act*, places particular emphasis on the conservation and management of species listed as threatened at national level. For Kakadu, this set comprises:

   *Boronia laxa*
   *B. rupicola*
   *B. suberosa*
   *B. verecunda*
   *B. xanthastrum*
   *Sauropus filicinus*
   speartooth shark
   northern river shark
dwarf sawfish
freshwater sawfish
loggerhead turtle
green turtle
olive ridley
flatback turtle
red goshawk
partridge pigeon
masked owl
northern shrike-tit
gouldian finch
golden bandicoot
bare-rumped sheath-tail bat
golden-backed tree-rat
false water-rat.

Further, this legislation states that agencies responsible for managing Commonwealth lands (a category which includes Kakadu NP) should prepare inventories/surveys that assess the abundance of those terrestrial species and the range of those marine species that are listed as threatened under the *EPBC Act*.

While recent targeted surveys have provided some assessments of the abundance of the six federally-listed plant species, for most of the listed animal species, there is little suitable abundance data available. It follows that one priority action should be targeted surveys that aim to assess the population size within Kakadu NP of the 16 federally-listed animal species.
2. Persistence in Kakadu. Some of the listed threatened species have not been recorded in Kakadu for many years. In some case, the species may no longer be present within the Park area; and such ghost species should not influence ongoing management. The species not recorded in recent years from Kakadu are:

<table>
<thead>
<tr>
<th>species</th>
<th>last recorded in Kakadu</th>
<th>notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>northern shrike-tit</td>
<td>1976</td>
<td>the only report from Kakadu</td>
</tr>
<tr>
<td>golden bandicoot</td>
<td>1967</td>
<td>one of only two reports from the Kakadu area, the previous being in 1903</td>
</tr>
<tr>
<td>bare-rumped sheathtail-bat</td>
<td>1980</td>
<td>one of only two reports from the Kakadu area, the previous being in 1979</td>
</tr>
<tr>
<td>golden-backed tree-rat</td>
<td>1969</td>
<td>one of only two reports from the Kakadu area, the previous being in 1903</td>
</tr>
<tr>
<td>false water-rat</td>
<td>1903</td>
<td>the only report from Kakadu</td>
</tr>
</tbody>
</table>

There is merit in attempting to clarify the currently very uncertain status of these species in Kakadu, by explicit carefully targeted searches.

3. Significance of Kakadu for the conservation of the species. For some threatened species, Kakadu includes all or most of their known range and population. For other species, Kakadu populations are peripheral, marginal or relatively minor. Management in Kakadu may make more contribution to the conservation for the former set of species rather than for the latter. The threatened species for which Kakadu comprises an important part of the range or population are:

- *Acacia* D19063 Graveside Gorge
- *Boronia laxa*
- *B. rupicola*
- *B. suberosa*
- *B. verecunda*
- *B. xanthastrum*
- *Calytrix inopinata*
- *Hibiscus brennani*
- *Lithomyrtus linariifolia*
- *Sauropus filicinus*
- pig-nosed turtle
- yellow-snouted gecko
- Arnhemland egeria
- oenpelli python
- partridge pigeon
- white-throated grass-wren
- yellow chat
- northern brush-tailed phascogale
- Arnhem leaf-nosed bat
- Arnhem rock-rat;

with uncertain but possibly high significance for the freshwater tongue sole, speartooth shark, northern river shark, freshwater sawfish, golden bandicoot, bare-rumped sheathtail-bat, golden-backed tree-rat and false water-rat.

4. Degree of threat. It can be argued that prioritisation for remedial actions and management should reflect the urgency of threat, with endangered species meriting more attention than vulnerable species. On either national or Northern Territory lists, the following species are considered:
critically endangered: speartooth shark
bare-rumped sheath-tail bat

endangered: Utricularia subulata,
freshwater tongue sole
northern river shark
loggerhead turtle
olive ridley
yellow chat
gouldian finch
golden bandicoot
golden-backed tree-rat.

The currently unlisted plant Acacia D19063 Graveside Gorge has been proposed to be listed as Critically Endangered in the forthcoming revision of the Northern Territory’s listing.

5. Decrease prioritisation to species likely to be de-listed. Largely because of research commissioned by PAN, increased information now suggests that the current listing of some species is not justified. These species are:

Boronia suberosa, Calytrix inopinata, Helicteres D21039 linifolia, and freshwater tongue sole (all to be de-listed from the Northern Territory threatened species list); and

Boronia laxa, B. rupicola, B. suberosa, B. verecunda and B. xanthastrum. (all considered to be no longer eligible for threatened status at national level).

These species should not be discounted completely, because all are undoubtedly rare and/or relatively restricted, and most continue to be affected by some threatening processes. Also, the process of de-listing (especially for federally-listed species) can take some considerable time, even after submission of a case for such de-listing, so these species may well be retained on Kakadu’s list of threatened species for many years yet, and it would be inappropriate to omit them from management considerations at least over that period.

There are a range of other factors that can affect prioritisation of research and management actions for Kakadu’s threatened species. These include the cultural significance of the species; the significance of the species for ecological function; the achievability (and cost-effectiveness) of research and management actions for the species; the value of the species as an indicator for a broader range of species or management concerns; and the extent to which work on the species is being conducted outside Kakadu.
### Table 6. Summary list of threatened species recorded from Kakadu NP, indicating significance of Kakadu, major threats, existence of any monitoring program and habitat.

Abbreviations: CE=Critically Endangered; EN=Endangered; VU=Vulnerable. For Northern Territory status only: NT=Near Threatened, LC=Least Concern and DD=Data Deficient.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common Name</th>
<th>NT Status</th>
<th>EPBCA Status</th>
<th>significance of Kakadu to species</th>
<th>major threats</th>
<th>existing monitoring in Kakadu</th>
<th>habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia D19063 Graveside Gorge</td>
<td>NA* not listed high Fire baseline sandstone</td>
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<tr>
<td>Boronia laxa</td>
<td>NT VU high Fire recently established sandstone</td>
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<tr>
<td>Boronia rapicola</td>
<td>NT VU high Fire recently established sandstone</td>
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<tr>
<td>Boronia suberosa</td>
<td>VU# VU high Fire recently established sandstone</td>
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<tr>
<td>Boronia verrucosa</td>
<td>NT VU high Fire recently established sandstone</td>
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<tr>
<td>Boronia xanthastrum</td>
<td>NT VU high Fire recently established sandstone</td>
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<tr>
<td>Calytrix inopinata</td>
<td>VU# not listed high Fire recently established sandstone</td>
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<tr>
<td>Cyas armstrongii</td>
<td>VU not listed low fire, exotic grasses nil lowland woodland</td>
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<tr>
<td>Dubouchezia australiensis</td>
<td>EN not listed low-medium Fire recently established sandstone</td>
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<tr>
<td>Gleichenia diartha</td>
<td>VU# not listed medium Fire nil sandstone</td>
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<tr>
<td>Helicteres D21039 linifolia</td>
<td>VU# not listed medium Fire recently established lowland woodland</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hibiscus brennanii</td>
<td>VU not listed high Fire recently established lowland woodland</td>
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<tr>
<td>Lithomyrtus linariifolia</td>
<td>VU not listed high fire recently established sandstone</td>
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<tr>
<td>Malaxis latifolia</td>
<td>VU not listed medium feral pigs nil lowland rainforest</td>
<td></td>
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<tr>
<td>Monotormia hastata</td>
<td>VU not listed low exotic grasses; saltwater intrusion recently established swamp</td>
<td></td>
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<tr>
<td>Sauropus filicinus</td>
<td>DD VU high fire recently established sandstone</td>
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<td></td>
</tr>
<tr>
<td>Utricularia subulata</td>
<td>EN not listed low hydrological change nil lowland wet heath</td>
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<td></td>
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<tr>
<td>Taractrocera ika ika</td>
<td>Northern Grassdart Butterfly VU not listed medium fire nil lowland wet heath</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Cynoglossus heterolepis</td>
<td>Freshwater Tongue Sole EN not listed high fishing nil f/w river</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyphis sp. A.</td>
<td>Speartooth Shark EN CE high fishing nil estuarine; f/w river</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyphis sp. C.</td>
<td>Northern River Shark EN EN high fishing nil estuarine; f/w river</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristis clavata</td>
<td>Dwarf Sawfish VU not listed medium fishing nil marine; estuarine; f/w river</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristis microdon</td>
<td>Freshwater Sawfish DD VU high fishing nil estuarine; f/w river</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caretta caretta</td>
<td>Loggerhead Turtle EN EN low fishing; harvesting nil coastal&amp;marine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chelonia mydas</td>
<td>Green Turtle LC VU medium fishing; harvesting nil coastal&amp;marine</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Lepidochelys olivacea</td>
<td>Olive Ridley DD EN low fishing; harvesting limited coastal&amp;marine</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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150
<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common Name</th>
<th>NT Status</th>
<th>EPBCA Status</th>
<th>Significance of Kakadu to Species</th>
<th>Major Threats</th>
<th>Existing Monitoring in Kakadu</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natator depressus</td>
<td>Flatback Turtle</td>
<td>DD</td>
<td>VU</td>
<td>medium</td>
<td>fishing, harvesting; nest predation by feral pigs, dogs and goannas</td>
<td>regular, at breeding sites</td>
<td>coastal &amp; marine</td>
</tr>
<tr>
<td>Carettabevs insculpta</td>
<td>Pig-nosed Turtle</td>
<td>NT</td>
<td>(VU)**</td>
<td>high</td>
<td>feral pigs; water quality; harvesting</td>
<td>baseline</td>
<td>f/w river</td>
</tr>
<tr>
<td>Diplophactylus occultus</td>
<td>Yellow-snouted Gecko</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>fire; exotic grasses</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Egernia obiri</td>
<td>Arnhemland Egernia</td>
<td>DD*</td>
<td>not listed</td>
<td>high</td>
<td>?cats; fire</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Morelia oenpelliensis</td>
<td>Oenpelli Python</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>?illegal take</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Diplodactylus occultus</td>
<td>Yellow-snouted Gecko</td>
<td>VU</td>
<td>not listed</td>
<td>low</td>
<td>fire</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Egernia obiri</td>
<td>Arnhemland Egernia</td>
<td>DD*</td>
<td>not listed</td>
<td>high</td>
<td>?cats; fire</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Morelia oenpelliensis</td>
<td>Oenpelli Python</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>?illegal take</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Diplodactylus occultus</td>
<td>Yellow-snouted Gecko</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>fire; exotic grasses</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Ardeotis australis</td>
<td>Australian Bustard</td>
<td>VU</td>
<td>not listed</td>
<td>low</td>
<td>?fire; hunting</td>
<td>nil</td>
<td>lowland woodland; grassland</td>
</tr>
<tr>
<td>Geophys ps smithii smithii</td>
<td>Partridge Pigeon</td>
<td>NT</td>
<td>VU</td>
<td>high</td>
<td>fire; predation by feral cats, dogs and pigs</td>
<td>some irregular counts</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Tyto novaehollandiae kimberli</td>
<td>Masked Owl</td>
<td>NT</td>
<td>VU</td>
<td>low</td>
<td>?fire</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Amytornis woodwardi</td>
<td>White-throated Grasswren</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>fire</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Amytornis woodwardi</td>
<td>White-throated Grasswren</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>fire</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Epthianura crocea tunneyi</td>
<td>Yellow Chat</td>
<td>EN</td>
<td>not listed</td>
<td>high</td>
<td>fire; exotic grasses; feral stock</td>
<td>nil</td>
<td>floodplain</td>
</tr>
<tr>
<td>Falco rupicola (frontatus) whitei</td>
<td>Northern Shrike-tit</td>
<td>DD</td>
<td>VU</td>
<td>low</td>
<td>?fire</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Euptibra gouldiae</td>
<td>Gouldian Finch</td>
<td>EN</td>
<td>EN</td>
<td>medium</td>
<td>fire; exotic grasses; grazing</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Dasyurus hallucatus</td>
<td>Northern Quoll</td>
<td>VU</td>
<td>(VU)**</td>
<td>?</td>
<td>toads; fire</td>
<td>nil</td>
<td>sandstone; lowland woodland</td>
</tr>
<tr>
<td>Phascogale (tapinata) pirata</td>
<td>Northern Brush-tailed Phascogale</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>?fire</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Isoodon auratus auratus</td>
<td>Golden Bandicoot</td>
<td>EN</td>
<td>VU</td>
<td>?</td>
<td>?fire; predation by feral cats</td>
<td>nil</td>
<td>sandstone (?)</td>
</tr>
<tr>
<td>Saccolaimus saccoaimus rudiclinatus</td>
<td>Bare-rumped Sheathail Bat</td>
<td>DD</td>
<td>CE</td>
<td>?</td>
<td>?fire</td>
<td>nil</td>
<td>lowland woodland</td>
</tr>
<tr>
<td>Hipposidera (diadema) inornata</td>
<td>Arnhem Leafnosed Bat</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>?fire; predation by feral cats; grazing; exotic grasses</td>
<td>nil</td>
<td>sandstone</td>
</tr>
<tr>
<td>Conilurus penicillatus</td>
<td>Brush-tailed Rabbit-rat</td>
<td>VU</td>
<td>not listed</td>
<td>medium</td>
<td>?fire; predation by feral cats; grazing; exotic grasses</td>
<td>some baseline</td>
<td>lowland woodland</td>
</tr>
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<td>NT Status</td>
<td>EPBCA</td>
<td>significance of Kakadu to species</td>
<td>major threats</td>
<td>existing monitoring in Kakadu</td>
<td>habitat</td>
</tr>
<tr>
<td>----------------------------------</td>
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<tr>
<td>Mesembrionys macrurus</td>
<td>Golden-backed Tree-rat</td>
<td>EN</td>
<td>VU</td>
<td>?</td>
<td>?fire; predation by feral cats; grazing; exotic grasses</td>
<td>nil</td>
<td>sandstone (?)</td>
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<td>Xeromys myoides</td>
<td>Water mouse (False water-rat)</td>
<td>DD</td>
<td>VU</td>
<td>?</td>
<td>?fire; grazing; exotic grasses; predation by feral cats</td>
<td>nil</td>
<td>floodplain; swamps; mangroves</td>
</tr>
<tr>
<td>Zygomys maini</td>
<td>Arnhem Rock-rat</td>
<td>VU</td>
<td>not listed</td>
<td>high</td>
<td>fire</td>
<td>some baseline and re-sample</td>
<td>sandstone</td>
</tr>
</tbody>
</table>

* These species is not currently listed, but are likely to be added in the near future.
** These species have been nominated as Vulnerable in 2004, and are now in the process of assessment.
# downlisting proposed
Review of main threatening processes

Threatened species occur across all of Kakadu’s management districts (Appendix B). They occur in most of Kakadu’s main habitats (Table 6), but probably especially so in sandstone plateau and escarpment areas.

The threatened species span a broad range of life forms and management issues. In some cases, populations in Kakadu are quarantined from the factors that have detrimentally affected the species elsewhere (for example, gill-netting). In other cases (such as marine turtles), protection of populations in Kakadu does not provide such a quarantine, because individuals range widely from Kakadu to areas that offer far less protection. In yet other cases, the factors that affect the threatened species operate across the entire landscape and may be little or no more controlled in Kakadu than in lands under other tenure: feral cats may be such an example.

Table 6 provides a coarse summary of the main threatening factors affecting listed species in Kakadu. In some cases, there is little or no certainty about which factors are actually affecting threatened species, or the relative importance of individual factors. In almost all cases, there is little or no quantitative data on the extent of response of threatened species to differing levels of management control of putative threatening processes, such that it is impossible to derive any detailed or justified cost-benefit information for a range of possible management alternatives. Nonetheless, some major threat themes are evident from the collation of species in Table 6. Each is discussed briefly below.

fire

Fire is a presumed threatening process for almost all of the listed terrestrial plant and animal species, and may be the factor most amenable to management intervention. For most of the threatened species affected by fire, the preferred fire regime would seem to be less frequent – or requiring greater temporal and spatial heterogeneity - than that currently operating. This appears to apply particularly to species associated with the stone country, and especially so to a set of obligate re-seeder plant species. Management for threatened species in the stone country should aim to reduce fire frequency and extent.

In the lowlands, fewer threatened species are as clearly affected by fire. The preferred fire regime of threatened lowland species (such as partridge pigeon and northern quoll) may be a fine-scale mosaic of burnt and unburnt patches, with fires optimally being relatively small (<10 ha) and cool.

feral animals

There is little evidence that feral animals are a major factor affecting threatened species in Kakadu NP. In part, this may be because the influence of feral animals is more diffuse and less noticeable than the operation of fire on the landscape.

Predation by feral cats may be a primary cause of decline in some of Kakadu’s threatened mammals (golden-backed tree-rat, brush-tailed rabbit-rat, false water-rat, golden bandicoot, northern brush-tailed phascogale) and possibly ground-dwelling and -nesting birds (such as partridge pigeons), but there are few data to support or refute this case. Management of feral cats in Kakadu is difficult (Watson and Woinarski 2004), but broad-based control mechanisms
specifically targeting feral cats are being developed in other jurisdictions, and may become more widely available and feasible over the course of the next decade.

The recent arrival of cane toads in Kakadu has led directly to the precipitous decline of northern quoll, and marked reduction in some other species not currently listed as threatened (notably some goanna species). At this stage, there is no management action that is likely to reduce the abundance of cane toads over large areas of Kakadu. One alternative response has been the translocation of some of Kakadu’s northern quolls to “safer” locations – islands off the coast of Arnhem Land, which have a much reduced probability of colonisation by cane toads. A broader management option may be to include consideration of such translocations for other susceptible native animal species. Given the rapid spread of toads throughout Kakadu, such action is probably now too late. In the near future, some native species currently not listed as threatened may qualify for listing because of their rapid decline caused by cane toads.

Feral pigs are probably a main cause of decline for at least one threatened plant species (Malaxis latifolia), and may reduce nesting success for threatened marine and freshwater turtles. The threatened plant is highly localised, and may be amenable to exclosure fencing. The impact of feral pigs on other threatened species is unknown.

Grazing by livestock and feral stock has contributed to the extensive decline of some bird and mammal species across much of northern Australia. Much of the rest of the north Australian landscape is managed for pastoral production, and away from pastoral leases and conservation reserves feral stock remain largely unchecked. Within this landscape context, a prime conservation attribute of Kakadu is the relatively minor impact of grazing by stock. Nonetheless, feral horses, cattle and buffalo are present across many areas of Kakadu, and this presence reduces the distinction in conservation benefit between Kakadu and surrounding lands. At least some threatened species (probably including yellow chat and the aquatic plant Monochoria hastata) have probably benefited substantially by the great reduction in numbers of feral buffalo that occurred in Kakadu from the 1960s to 1990s. There are few data that describe the relationships between differing densities of stock and responses of threatened plant and animal species, so it is not yet possible to describe cost-effective strategies for managing feral stock numbers for the benefit of threatened species.

Feral dogs are known to have a substantial impact on the breeding success of marine turtles in many areas of northern Australia. There are few turtle breeding areas on the Kakadu mainland, and predation of eggs and hatchlings by feral dogs at these sites is not yet considered a substantial management problem.

None of the threatened species present in Kakadu are known to be affected by exotic invertebrates (such as big-headed ants and honey bees). This may be because there is no such detrimental response; because the conservation status of native invertebrates (the group most likely to be threatened by exotic invertebrates) has not yet been adequately considered; or because the incidence, extent and/or abundance of exotic invertebrates in Kakadu has not yet reached a threshold sufficient to have marked detrimental impacts on threatened species.

Weeds

Exotic plants are listed as a direct threat to few of Kakadu’s threatened species. In part, this may be because weeds have been kept relatively well in check to date in Kakadu; and in part it may be because there has been little research on the impacts of weeds on threatened species. Several lowland animal species (including yellow chat, partridge pigeon and yellow-snouted gecko) are considered to be adversely affected by the spread of exotic pasture grasses (especially gamba and mission grass), and the compounded effect of such grasses and increasingly intense fire regimes will probably increase the risks to many more threatened lowland plant and animal species. One
threatened wetland plant species (*Monochoria hastata*) may be affected by invasion of its wetland habitat by the exotic para grass.

**fishing**

The listed threatened shark and sawfish species have been adversely affected across their range by fishing, particularly commercial gill-netting. Kakadu offers security for such species from this threat. Line-based recreational fishing is a less serious threat to these threatened fish, but there are documented cases elsewhere of substantial rates of mortality for at least the threatened sawfish *Pristis microdon* due to recreational fishing (Thorburn *et al.* 2003).

**hunting**

Within Kakadu, some threatened species are subject to some hunting pressure by traditional owners. These species include bustard, emu, partridge pigeon, marine turtles and pig-nosed turtle. In most cases, the level of take is probably very small, but there are few data available to demonstrate sustainability or otherwise.

**hydrological and climate change**

Kakadu’s environments are changing in response to local management and global factors, and the rate of this change may accelerate. Sea level rises leading to saltwater intrusion to floodplain and lowland wetland areas may be the most marked manifestation of this change, and this process is affecting, or is likely to affect, some threatened species (such as the plant *Monochoria hastata* and yellow chat) in these environments. Kakadu is likely to experience increased temperatures over the next few decades (Hennessy *et al.* 2004), and such climate change may increase fire intensity and extent, and thus magnify the impact of fire on a broad range of threatened species.

**Assessing overall priorities**

The previous sections have described some criteria for assigning research and management priorities amongst the set of threatened species in Kakadu. There is no objective or mathematical way of collating these disparate criteria to develop a single index for the relative priority for management response across different species, or amongst possible recovery actions within any single species. In the general recommendations below, and in the tabulation of recommended actions for each species (Table 7 below), I have used my judgement to integrate and distil the many elements into a more systematic array of priorities and coherent set of actions. In general, this prioritisation does not consider cultural values that may influence prioritisation, as this factor is beyond the brief of this consultancy.

In addition to prioritisation based on the likely contribution of any action towards species recovery, I have attempted to provide a guide to the practicability of that action in achieving conservation gain ("feasibility"). This assessment is not necessarily easy to derive, nor to compare across very different activities and taxonomic groups; and achievability is likely to be much influenced by the amount of resources available for a specified action. Again, my categorisation of feasibility is a subjective one, based on the best information available, and following consideration of the now extensive history of the fate of research and management actions for different threatened species in northern Australia.
Recommended actions

Based on the information and obligations reported above, a threatened species management plan for Kakadu for 2004-2010 should include the following actions.

**Recommendation 1. Undertake targeted survey to define the abundance, distribution and status of those threatened species for which current status information is inadequate.**

**Justification:** (1) This is an explicit obligation under the *EPBC Act* for federally-listed species on lands managed by Commonwealth agencies. (2) Management for these species requires a firm foundation of knowledge of their current status.


**Prioritisation:** Within the set above, prioritisation should be given to those species for which the importance of Kakadu is designated as high in Table 6.

**Comment:** Over the last two years, targeted surveys (Kerrigan 2003, 2004) have provided such necessary baseline information for most of Kakadu’s threatened plants. Recent general vertebrate surveys (Watson and Woinarski 2003, 2004) have provided adequate information on distribution and abundance for some of the more widespread threatened vertebrate species (such as Arnhem rock-rat, brush-tailed rabbit-rat, northern quoll).

Note that there is a fine but indistinct line between species that are now exceedingly threatened in Kakadu (and hence which may demand substantial management priority) and species that have become extinct in Kakadu sometime over the course of the last hundred years (and hence which are now irrelevant for management). Five animal species listed above (in the section “persistence in Kakadu”) fall into this currently unresolved situation: their status may be so parlous that they need urgent management intervention, or alternatively, they are now defunct in Kakadu and merit no further management consideration. Such ambiguity can be resolved, if at all, only following targeted and intensive search.

**Targets:** By 2010, specific surveys for each species will have provided robust estimates of the abundance and distribution of every threatened species in Kakadu.

**Recommendation 2. Establish, implement and/or maintain specific monitoring programs that provide regular assessments of the trends in status for each threatened species in Kakadu NP, and relates such trends to management actions.**

**Justification:** (1) Natural resource management funding will be increasingly tied to reporting on the outcomes of such management, with trends in the status of significant species being an explicit measure of management efficacy; (2) Sound knowledge of the
trends in status of threatened species will help determine research and management priorities, and help improve management actions.

Species involved (* indicates federally-listed species):

(i) **Existing monitoring programs:** Monitoring programs have been in place for about a decade for flatback turtle*. Monitoring programs were established in 2003-04 for the threatened plants Acoela D19063 Graveside Gorge, Boronia laxa*, B. ripicola*, B. suberosa*, B. verecunda*, B. xanthastrum*, Calytrix inspinata, Helicteres D21039 linifolia, Hibiscus brevuni, Lithomyrtus linariifolia, Monobaria bastata and Sauropus filicinus*. Monitoring programs are being established in 2004 for yellow chat and Arnhemland egernia.

(ii) **Baseline information sufficient to seed a monitoring program.** For another set of species, although there is no current “formal” monitoring program, there is adequate information on abundance at one or more sites for this to form a baseline for ongoing monitoring. Such species include: pig-nosed turtle, partridge pigeon*, white-throated grasswren, northern quoll, brush-tailed rabbit-rat and Arnhem rock-rat.

(iii) **Monitoring program needs to be established.** For all other species, there is no current monitoring program, and an inadequate basis for establishing one from existing information. Most of these species are in the set of species described in Recommendation 1 above (for survey to assess status), and the survey suggested in that action should incorporate a component that establishes a baseline monitoring.

Comment: (i) The monitoring programs established need to be robust, useful, and of sufficient power; they should also shed light on responses of the focal species to management actions, and on potential causes of decline. (ii) The necessary frequency and intensity of ongoing monitoring episodes should be assessed through analysis of existing data, either from Kakadu or elsewhere. (iii) Monitoring data should be properly data based, archived and stored; (iii) Monitoring results should be analysed annually, to a regular reporting framework. (iv) Where possible, monitoring programs in Kakadu for a threatened species should be integrated with, or at least complementary to, any comparable monitoring of that species occurring outside the Park.

Targets: By 2008, a monitoring program for every threatened species will be established in Kakadu. By 2010, annual reporting of trends in each threatened species will be implemented.

**Recommendation 3. Maintain existing broad-scale plant and animal monitoring programs (notably the Kakadu Fire Plots).**

Justification: (1) The existing monitoring programs (notably the Kakadu Fire Monitoring Program) are well established and provide a major assessment of the trends in Kakadu’s biodiversity generally, and the response of this to one of the main management issues, fire. (2) These monitoring programs provide some information on trends in the status of some threatened species, and may provide early warnings of unfavourable trends in species likely to be, but not yet, listed as threatened.

Species involved (* indicates federally-listed species): The fire plot sampling has included records of the following threatened species: Boronia verecunda*, B. xanthastrum*, emu, partridge pigeon*, white-throated grasswren, northern quoll, northern brush-tailed phascogale, Arnhem leaf-nosed bat and Arnhem rock-rat. The CSIRO
fauna plots include records of oenpelli python, partridge pigeon*, masked owl*, white-throated grasswren*, gouldian finch*, northern quoll, northern brush-tailed phascogale, brush-tailed rabbit-rat and Arnhem rock-rat.

Prioritisation: Monitoring of these existing fire and fauna monitoring plots should continue on a 5-year cycle.

Comment: Recent analyses of fire plot monitoring results from Kakadu (Edwards et al. 2003) and fauna plot monitoring data from both Kakadu (Watson and Woinarski 2003, 2004) and Litchfield (Woinarski et al. in press) conclude that biodiversity monitoring in conservation reserves should comprise two main components – a broad-brush approach that considers as many species as practicable, complemented by more specifically targeted monitoring programs for threatened species. This two-prong approach is necessary because threatened species are typically rare and/or highly restricted and hence unlikely to be well represented in more general survey.

Targets: Complete re-sampling of all existing fire plots and fauna monitoring plots on a 5-year rotation as scheduled. Analyse and review all results within a year of major re-sampling events.

Recommendation 4. Assess the conservation status of sandstone heathland communities against criteria for listing as a threatened ecological community; and nominate it if appropriate.

Justification: (1) Most of Kakadu’s threatened plant species and many of its threatened animal species are restricted to the sandstone plateau and escarpment of western Arnhem Land. There is obvious efficiency in considering management at the whole ecological community level rather than idiosyncratic management responses to each of a long list of individual species. (2) This recommendation is an extension of a recommendation [6.2.1.(iii): see Table 5 above] from the 1995 threatened species program (Roeger and Russell-Smith 1995), that has not yet been completely enacted.

Prioritisation: The prioritisation of this action is dependent upon assessment of the management benefit that may flow from listing. Perhaps the most important benefit will be in helping attract resources to management in that currently poorly-resourced part of the sandstone plateau that lies in Arnhem Land itself rather than in Kakadu.

Comment: Nomination of sandstone heathland as a threatened ecological community is not necessarily a responsibility of PAN. Indeed, any individual or group can provide such a nomination. Any nomination would first involve considerable consultation and collaboration with traditional owners and their representatives from across the extent of the Arnhem Land plateau.

Recommendation 5. Develop a strategic program for assessment of the conservation status of invertebrates in Kakadu.

Justification: (1) Compared with plants and vertebrates, there has been no substantial attempt to consider the conservation status of invertebrates in Kakadu. (2) This recommendation echoes one [recommendation 6.2.1.(iv): see Table 5 above] from the 1995 threatened species program (Roeger and Russell-Smith 1995), that has not yet been enacted.
Comment: Invertebrates have received far less attention than plants and vertebrate animals in Kakadu’s inventory, monitoring and management. With the notable exception of a recent research project on Leichhardt’s grasshopper (a species not currently considered threatened), most of the study of invertebrates in Kakadu has involved the ecology of relatively common species and/or management of pest species, rather than species of conservation concern.

Targets: By 2007, develop a strategic plan for the conservation of invertebrates in Kakadu. By 2010, complete a conservation status assessment for representative invertebrate groups.

**Recommendation 6. To an appropriate extent, integrate conservation and management actions on threatened species in Kakadu with that of the broader region**

Justification: (1) Only a minority of the threatened species occurring in Kakadu are restricted to Kakadu. The maintenance of threatened species in the landscape (including Kakadu) is ultimately dependent upon their management across the full extent of their range. There is obvious efficiency and enhanced capability in coordinating conservation responses in Kakadu with those actions taken beyond its borders. (2) The management of many threatened species is coordinated through national recovery plans and teams, and actions taken in Kakadu should be consistent with such plans.

Comment: This is at least partly an administrative issue. Where Kakadu is a significant component of the range of a threatened species, PAN should be represented on any Recovery Team for that species. More generally (for relatively few of the set of threatened species occurring in Kakadu are served by an existing Recovery Team), there should be at least an annual forum/meeting involving those NRM officers responsible for threatened species management in Kakadu with those in the Northern Territory as a whole; with that meeting serving to coordinate management responses, resourcing, revisions to lists, and other related issues.

Targets: By 2006, establish an at least annual meeting of PAN staff involved in threatened species recovery and management with their counterpart NT Government staff, and other relevant agencies and individuals.

**Recommendation 7. Enhance the entry, storage and display of threatened species data in Kakadu**

Justification: (1) Reliable information on the location of threatened species should be a fundamental ingredient in the management actions of District managers and other staff. At present such information is widely scattered and probably not readily accessible to many District staff. (2) Many PAN staff, Aboriginal residents and visitors may have valuable observations of threatened species, but there is no straightforward and consistent system in place for data entry for such records, and hence they tend to be lost. (3) This recommendation is an extension of a recommendation [6.2.3.(vi): see Table 5 above] from the 1995 threatened species program (Roeger and Russell-Smith 1995), that has not yet been completely enacted.

Species involved: All threatened species.
**Targets:** By 2006, a collated data base of current threatened species records is distributed across the Park’s GIS, and is routinely used by Park managers. By 2006, a consistent consolidated data entry scheme is established that captures ongoing and past records of threatened species from Parks staff, Aboriginal residents and others.

**Recommendation 8. Continue to conduct targeted research on the response of selected threatened species to selected threatening processes and to management actions**

**Justification:** (1) There is only very limited information about the ecology of many of Kakadu’s threatened species, and this information is insufficient to critically assess the relative impacts of different threatening processes or to fine-tune management responses. While recommended actions above (notably 1 and 2) will provide substantially more data on distribution and abundance, there is still a need for targeted ecological studies of at least some of the threatened species. To most usefully enhance management responses, such studies should be positioned within an adaptive management framework.

**Species involved:** (1) life history studies and modeling (responses to a range of fire regimes) for the set of fire-sensitive (obligate seeder) plant species;

(2) habitat requirements, life history studies (and responses to fire) for northern grassdart butterfly, white-throated grasswren and oenpelli python; and habitat requirements, life history studies (and responses to fire and/or exotic pasture grasses) for northern brush-tailed phascogale and yellow chat.

**Comment:** Note that the species included in this action were selected primarily because of the relatively little existing relevant information about their ecology. Some other threatened species may be selected as higher priority for ecological research if populations are (re-)located in Kakadu (e.g. golden-backed tree-rat).

**Targets:** By 2010, ecological information is adequate to provide a detailed description of optimum management for most of Kakadu’s threatened species.

**Recommendation 9. Continue to manage to mitigate those factors that detrimentally affect threatened species.**

**Justification:** (1) Threatened species are affected by a broad array of factors. As a National Park, Kakadu offers protection from some of these factors (e.g. land clearing) and mitigation from others (e.g. invasion of exotic pasture grasses and feral animals, inappropriate fire regimes). One of the objectives of Kakadu is to manage the lands to deliver a conservation benefit, and particularly so for threatened species.

**Species involved:** All threatened species.

**Prioritisation:** The wise management of fire, feral animals, weeds and visitor impacts is the primary operational mechanism for PAN staff and Aboriginal residents.

**Comment:** This recommendation recognises that most threatened species in Kakadu derive much benefit from the current major investments in management of fire, weeds, feral animals and visitor impacts. Any threatened species management plan for Kakadu will always be dependent upon this foundation. Such management has been and will continue to be refined, as impacts of management actions (or inactions) are increasingly being measured. With improved and more frequent monitoring of the status of
individual threatened species (recommendation 2 above), and with increased understanding of the responses of threatened species to particular threats and management interventions (recommendation 8 above), there will be increasing power to quantify and compare the impacts of different putative threats, and to quantify the costs and benefits of a variety of management responses. This should produce increasingly sophisticated, cost-effective and efficient management of threatened species, and natural resource generally.

**Targets:** By 2010, establishment and implementation of precise, costed, cost-effective management guidelines for most individual threatened species.

**Recommendation 10. Enhance communication about, and reporting on, threatened species in Kakadu.**

**Justification:** (1). Historically, much of the information about Kakadu’s threatened species is widely scattered and largely retained only in limited copies of reports. Given the marked changes in composition of threatened species lists, general knowledge of threatened species issues in Kakadu is often somewhat dated. (2). Increased dissemination of information is likely to increase awareness and hence lead to an contribution of records from ranger staff and others.

**Species involved:** All threatened species.

**Comment:** One mechanism for enhanced communication would be to disseminate the dossiers presented here for individual species, to all ranger staff, District offices, the Kakadu Board, and Aboriginal residents and Associations, and to make these available to Park visitors. A plain English annual overview of activity on threatened species should be distributed to Kakadu stakeholders. Annual summaries of trends in status of each monitored threatened species should be distributed to ranger staff and resource managers, to provide feedback on the efficacy of management actions.

**Targets:** By 2006, an annual report on trends in monitored threatened species should be established and circulated to all ranger staff as feedback on Park management.
### Table 7. Summary of management and other recommendations for individual threatened species recorded from Kakadu.

For each listed action, a prioritisation (P) is assigned as *** high; ** medium, * low; and a feasibility (F) of the action is assigned as *** high, ** medium, * low. Note that the prioritisation indicated here takes into account the relative importance of Kakadu for the species’ survival: that is, actions for species for which Kakadu is relatively insignificant are generally accorded relatively low priorities.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common Name</th>
<th>Research activities priorities</th>
<th>Survey activities priorities</th>
<th>Monitoring activities priorities</th>
<th>Management activities priorities</th>
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<td><em>Acacia</em> D19063</td>
<td>Graveside Gorge</td>
<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P***, F*</td>
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<tr>
<td><em>Boronia laxa</em></td>
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<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
</tr>
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<td><em>Boronia rupicola</em></td>
<td></td>
<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
</tr>
<tr>
<td><em>Boronia suberosa</em></td>
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<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
</tr>
<tr>
<td><em>Boronia verecunda</em></td>
<td></td>
<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
</tr>
<tr>
<td><em>Boronia xanthastrum</em></td>
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<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
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<td><em>Calytrix inopinata</em></td>
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<td>identify optimum fire regimes</td>
<td>P***, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
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<td>Survey activities</td>
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<td>Cycas armstrongii</td>
<td>nil</td>
<td>assess total population size and extent of Kakadu population</td>
<td>P*, F***</td>
<td>establish monitoring program for this species; monitor distribution of exotic pasture plants</td>
<td>P*, F***</td>
</tr>
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<td>Dubouzetia australiensis</td>
<td>identify optimum fire regimes</td>
<td>P**, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F*</td>
<td>maintain monitoring of plants at 2-5 yr intervals, and fire history annually</td>
</tr>
<tr>
<td>Gleichenia dicarpa</td>
<td>identify factors regulating distribution and abundance</td>
<td>P**, F*</td>
<td>search suitable locations to seek new populations</td>
<td>P**, F*</td>
<td>establish baseline for monitoring, and thence monitor at 2-5 year intervals</td>
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<tr>
<td>Helicteres D21039 linifolia</td>
<td>identify optimum fire regimes</td>
<td>P**, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F**</td>
<td>maintain monitoring of plants at 2-5 yr intervals, and fire history annually</td>
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<td>Hibiscus brennannii</td>
<td>identify optimum fire regimes</td>
<td>P**, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F**</td>
<td>maintain monitoring of plants at 2-5 yr intervals, and fire history annually</td>
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<td>search suitable locations to seek new populations</td>
<td>P*, F**</td>
<td>maintain monitoring of plants at 2-5 yr intervals, and fire history annually</td>
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<td>identify factors regulating distribution and abundance</td>
<td>P**, F**</td>
<td>search suitable locations to seek new populations</td>
<td>P**, F*</td>
<td>attempt to re-locate plants at single known site; and thence, establish ongoing monitoring</td>
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<td>identify factors regulating distribution and abundance</td>
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<td>search suitable locations to seek new populations</td>
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<td>Sauropus filicinus</td>
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<td>identify optimum fire regimes</td>
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<td>search suitable locations to seek new populations</td>
<td>P*, F**</td>
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<td>Utricularia subulata</td>
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<td>identify factors regulating distribution and abundance</td>
<td>P**, F*</td>
<td>search suitable locations to seek new populations</td>
<td>P*, F**</td>
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<td>Taractroera ilia ilia</td>
<td>Northern Grassdart Butterfly</td>
<td>identify optimum fire regimes ; identify food plants</td>
<td>P***, F**</td>
<td>estimate population size and extent of Kakadu population, and identify key habitats</td>
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<td>Cynoglossus heterolepis</td>
<td>Freshwater Tongue Sole</td>
<td>identify habitat preferences and threats</td>
<td>P*, F*</td>
<td>assess population size and distribution</td>
<td>P*, F*</td>
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<tr>
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<td>Spearooth Shark</td>
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<td>P*, F*</td>
<td>assess population size and distribution</td>
<td>P*, F*</td>
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<tr>
<td>Glyphis sp. C.</td>
<td>Northern River Shark</td>
<td>identify habitat preferences and threats</td>
<td>P*, F*</td>
<td>assess population size and distribution</td>
<td>P*, F*</td>
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<td>Dwarf Sawfish</td>
<td>identify habitat preferences and threats</td>
<td>P*, F*</td>
<td>assess population size and distribution</td>
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<td><em>Chelonia mydas</em></td>
<td>Green Turtle</td>
<td>examine dispersal patterns, and relationships with other Australian stocks</td>
<td>P*, F*</td>
<td>assess population size, distribution and critical habitat</td>
<td>P*, F*</td>
</tr>
<tr>
<td><em>Lepidochelys olivacea</em></td>
<td>Olive Ridley</td>
<td>examine dispersal patterns, and relationships with other Australian stocks</td>
<td>P*, F*</td>
<td>assess population size, distribution and critical habitat</td>
<td>P*, F*</td>
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<tr>
<td><em>Natator depressus</em></td>
<td>Flatback Turtle</td>
<td>examine dispersal patterns, and relationships with other Australian stocks</td>
<td>P*, F*</td>
<td>assess population size, distribution and critical habitat</td>
<td>P*, F*</td>
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<td><em>Carettochelys insculpta</em></td>
<td>Pig-nosed Turtle</td>
<td>assess levels of use and sustainability</td>
<td>P*, F**</td>
<td>assess population size, distribution and critical habitat</td>
<td>P*, F*</td>
</tr>
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<td>P**, F*</td>
<td>assess population size and distribution</td>
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<td>Egerinia obiri</td>
<td>Arnhemland Egernia</td>
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<td>P**, F*</td>
<td>assess population size and distribution</td>
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<td>Oenpelli Python</td>
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<td>P**, F*</td>
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<td>Dromaius novaebollandiae</td>
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<td>assess population size and distribution</td>
<td>P**, F**</td>
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<td>Red Goshawk</td>
<td>identify threats</td>
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<td>assess population size and distribution</td>
<td>P*, F*</td>
</tr>
<tr>
<td>Ardeotis australis</td>
<td>Australian Bustard</td>
<td>identify optimum fire regimes; assess levels of use and sustainability</td>
<td>P*, F**</td>
<td>assess population size and distribution</td>
<td>P*, F**</td>
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<td>Geophaps smithii smithii</td>
<td>Partridge Pigeon</td>
<td>identify response to exotic grasses</td>
<td>P**, F*</td>
<td>assess population size and distribution</td>
<td>P**, F**</td>
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<tr>
<td>Tyto novaebollandiae kimberli</td>
<td>Masked Owl</td>
<td>identify habitat preferences and threats</td>
<td>P**, F*</td>
<td>assess population size, distribution and optimum survey protocol</td>
<td>P**, F**</td>
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<td>Northern Shrike-tit</td>
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<td>P*, F*</td>
<td>P**, F**</td>
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<td>Gouldian Finch</td>
<td>P**, F*</td>
<td>P**, F**</td>
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<tr>
<td>Dasyurus hallucatus</td>
<td>Northern Quoll</td>
<td>P**, F**</td>
<td>P**, F**</td>
<td>P**, F**</td>
<td>P**, F**</td>
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<tr>
<td>Phascogale (tapoatafa) pirata</td>
<td>Northern Brush-tailed Phascogale</td>
<td>P***, F***</td>
<td>P***, F***</td>
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Activities priorities:
P** = Priority 1, F** = Priority 2, P* = Priority 3, F* = Priority 4, P = Priority 5, F = Priority 6

Activities priorities:
P** = Priority 1, F** = Priority 2, P* = Priority 3, F* = Priority 4, P = Priority 5, F = Priority 6
<table>
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<th>Monitoring activities priorities</th>
<th>Management activities priorities</th>
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<tbody>
<tr>
<td>Isoodon auratus auratus</td>
<td>Golden Bandicoot</td>
<td>if population located, identify habitat preferences and threats</td>
<td>P**, F*</td>
<td>undertake targeted search at sites where previously recorded</td>
<td>P**, F* if re-located, establish baseline monitoring, and monitor at 2-5 year intervals</td>
</tr>
<tr>
<td>Saccolaimus saccolaimus nudichionatus</td>
<td>Bare-rumped Sheathtail Bat</td>
<td>undertake intensive research to assess status, habitat requirements and threats; undertake genetic study to determine the taxonomic status of NT population</td>
<td>P*, F*</td>
<td>undertake targeted search at sites where previously recorded</td>
<td>P*, F* if re-located, establish baseline monitoring, and monitor at 2-5 year intervals</td>
</tr>
<tr>
<td>Hipposideros diadema inornata</td>
<td>Arnhem Leafnosed Bat</td>
<td>identify habitat preferences and threats</td>
<td>P*, F*</td>
<td>assess population size and distribution</td>
<td>P*, F**</td>
</tr>
<tr>
<td>Conilurus penicillatus</td>
<td>Brush-tailed Rabbit-rat</td>
<td>identify habitat preferences and threats</td>
<td>P**, F*</td>
<td>assess population size and distribution</td>
<td>P**, F**</td>
</tr>
<tr>
<td>Mesembriomys macrurus</td>
<td>Golden-backed Tree-rat</td>
<td>identify habitat preferences and threats</td>
<td>P**, F*</td>
<td>undertake targeted search at sites where previously recorded; if successful, assess population size and distribution</td>
<td>P**, F*</td>
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</table>

*P* = Priority, *F* = Focus, *F* = Focal
<table>
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<th>Management activities</th>
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<tr>
<td><em>Xeromys myoides</em></td>
<td>Water mouse (False water-rat)</td>
<td>identify habitat preferences and threats</td>
<td>P**, F*</td>
<td>undertake targeted search in potentially suitable habitat; if successful, assess population size and distribution</td>
<td>P***, F**</td>
<td>establish baseline for monitoring, and monitor populations, at 5 year intervals</td>
<td>P**, F*</td>
<td>reduce incidence of feral cats; reduce incidence and extent of exotic pasture plants</td>
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<tr>
<td><em>Zyzomys maini</em></td>
<td>Arnhem Rock-rat</td>
<td>identify optimum fire regimes</td>
<td>P**, F**</td>
<td>assess population size and distribution</td>
<td>P*, F**</td>
<td>maintain existing monitoring programs, and sample these at 2-5 yr intervals</td>
<td>P*, F**</td>
<td>reduce fire frequency in stone country</td>
<td>P**, F**</td>
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</tbody>
</table>
ACKNOWLEDGEMENTS

Craig Hempel prepared the maps for all species accounts. Information presented here on threatened plants derives mainly from recent reports from Raelee Kerrigan. Kym Brennan, Martin Armstrong, Greg Miles, Raelee Kerrigan and Damian Milne kindly supplied photographs. For further information on particular threatened species, I thank Helen Larson and Rod Kennett.

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Oakwood, M. (2004). The effect of cane toads on a marsupial carnivore, the northern quoll, *Dasyurus hallucatus*. Progress report to Parks Australia North. (Envirotek, Nana Glen, NSW.)


Rose, A.L. (1972) *Notes on a proposal for a National Park in the Alligator River Area of the far north of the Northern Territory*. (NT Reserves Board: Alice Springs.)


Appendix A. Schedule for consultancy NHTKNP01 Threatened plant and animal species in Kakadu National Park - 2004

THE SCHEDULE

Consultancy Services

The consultancy service ... will involve:

i) Compiling a review of the status in Kakadu NP of all nationally and NT-listed threatened plants and animals. This should include:
   • a collation of all documented distributional records;
   • where appropriate, an explanatory note describing any variation in assigned conservation status between national and NT lists; and
   • information on abundance and/or status within Kakadu, wherever possible.

ii) Preparation of a management strategy for threatened species in Kakadu NP, for 2004-2011. This should include, for every listed species:
   • assessment of threats and their probable impact;
   • description of any existing monitoring programs;
   • recommendations for ongoing monitoring; and
   • recommendations for management.

iii) Carrying out fieldwork to assess the conservation status and/or to establish baseline monitoring for at least two listed animal species in Kakadu NP. The species to be surveyed will be identified by the Consultant and Project Officer by March 2004.
Appendix B. Known distribution of threatened species across Kakadu management districts.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common Name</th>
<th>South Alligator</th>
<th>Mary River</th>
<th>Nourlangie</th>
<th>East Alligator</th>
<th>Jim Jim</th>
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Appendix C. Species occurring in Kakadu that are listed migratory species under the **EPBC Act.** CAMBA=China-Australia Migratory Bird Agreement; JAMBA=Japan-Australia Migratory Bird Agreement; BONN=Bonn Convention. “Threatened” = listed as threatened under either the **EPBCA** and/or Northern Territory legislation.

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