



The Ranger Uranium Mine in the Northern Territory, photo Dr Mike Saynor, Australian Government's Supervising Scientist Branch.



**Northern Australia
Environmental
Resources
Hub**

National Environmental Science Programme

Recommended standards for fauna recovery at rehabilitated mine sites

Wrap-up factsheet

Rehabilitation standards assess the success of a rehabilitation project

Rehabilitation standards specify the minimum levels a rehabilitation project must meet before it is considered a success. They distill the broad goals of the project into specific objectives that can be reliably measured using ecosystem attributes such as species richness, community structure and ecosystem function. The ecosystem attributes of the rehabilitation project are compared with those of a reference ecosystem used as the target for the project. For mine sites, rehabilitation standards specify the set of objectives that a mining company must meet before it is released from its rehabilitation obligations.

Animals should be included in rehabilitation standards

Rehabilitation projects rarely specify standards for fauna. Measures of rehabilitation success typically focus on vegetation and soil development with the assumption that fauna will naturally return to the site if appropriate habitat is created. Yet scientists have found that simply re-establishing plant structure and composition may not be enough to ensure the recolonisation of fauna. If one of the goals of rehabilitation is the recovery of fauna, then specific targets for fauna need to be set as part of the rehabilitation standards.

Key findings

These issues should be considered whenever rehabilitation standards for fauna are being developed:

- Both vertebrate and invertebrate communities should be included.
- Reference sites must be matched to the aim of the rehabilitation, for example, restoring a target ecosystem or recovering a particular land use.
- The number of reference sites sampled must be sufficient to characterise natural variability, and each reference site must be sampled intensively enough to provide reliable data.
- Only species that are sufficiently detectable using available survey techniques should be included in rehabilitation assessment. Naturally rare species may be more meaningfully considered when grouped together on the basis of their trophic guild or specific habitat requirements.
- Sampling effort must be robust enough to characterise faunal communities to a confidence level that reflects the rehabilitation goals.

A major challenge in setting rehabilitation standards for fauna is that many animal species are naturally rare or are otherwise difficult to detect, making them poor candidates for assessment. Identifying species that are relatively easy to detect using robust, standard field methods is essential to the development of measurable rehabilitation standards for fauna.

A structured approach to developing recommended faunal standards for Ranger Uranium Mine

The major rehabilitation program underway at Ranger Uranium Mine in the Northern Territory provided an opportunity to develop a structured approach to setting recommendations for faunal rehabilitation standards at the site. The 79 km² Ranger Project Area, which lies within World-Heritage-listed Kakadu National Park, is due to be rehabilitated by 2026.



Although these recommended rehabilitation standards were developed for the Ranger mine, the approach is transferable to other mine-site rehabilitation projects.

While the overall goal for the rehabilitation of the project area is to establish an environment similar to the surrounding national park, standards for faunal rehabilitation are yet to be specified. Scientists have recommended five principles for setting the fauna rehabilitation standards for Ranger.

1. Species to be included in the standards must be able to be reliably surveyed

Scientists used data from the Three Parks Fireplot Monitoring Program to identify 50 vertebrate species present in the lowland woodlands of northern Kakadu that can be detected with high confidence using standard survey methods. They recommended 34 bird, 5 mammal and 11 reptile species for inclusion within the faunal rehabilitation standards (Table 1, Figure 1).

Ants dominated the catches of ground-dwelling invertebrates on trial landforms within the Ranger Project Area and in undisturbed sites surrounding the mine. Scientists recommend that ants be included in ongoing monitoring because of their dominance, along with their strong capacity to discriminate between mine sites and reference sites. They also recommend selecting one or more invertebrate species from the grass-layer to complement the information gained from ant communities.

2. Several attributes of faunal communities should be monitored

Plant and animal communities are highly variable over space and time. Measurements of species richness (the simple count of the number of species) should be accompanied by measurements of species evenness and species and functional composition. The proportion of sites at which a vertebrate species is present (species occupancy) should also be assessed.

Table 1. Fifty vertebrate species are recommended for incorporation into faunal standards for rehabilitation at Ranger Uranium Mine. * denotes threatened species.

Birds	Bar-shouldered Dove	Mistletoebird	Sulphur-crested Cockatoo
	Black-faced Cuckoo-shrike	Northern Fantail	Torresian Crow
	Black-tailed Treecreeper	Partridge Pigeon*	Varied Triller
	Blue-faced Honeyeater	Peaceful Dove	Weebill
	Blue-winged Kookaburra	Pied Butcherbird	White-bellied Cuckoo-shrike
	Brown Honeyeater	Rainbow Bee-eater	White-gaped Honeyeater
	Brush Cuckoo	Rainbow Lorikeet	White-throated Honeyeater
	Dusky Honeyeater	Red-backed Fairy-wren	White-winged Triller
	Grey Shrike-thrush	Red-winged Parrot	Willie Wagtail
	Grey-crowned Babbler	Rufous Whistler	Yellow Oriole
	Leaden Flycatcher	Silver-crowned Friarbird	
	Little Friarbird	Striated Pardalote	
Mammals	Agile Wallaby	Black-footed Tree-rat*	Northern Brown Bandicoot
	Antilopine Wallaroo	Dingo	
Reptiles	Skinks	Geckos	Dragons
	<i>Carlia amax</i>	<i>Gehyra australis</i>	<i>Diporiphora bilineata</i>
	<i>Ca. gracilis</i>	<i>Heteronotia binoei</i>	
	<i>Ca. munda</i>		
	<i>Cryptoblepharus metallicus</i>		
	<i>Cr. plagiocephalus</i>		
	<i>Ctenotus arnhemensis</i>		
	<i>Ct. essingtonii</i>		
	<i>Morethia storri</i>		



Figure 1. Birds, reptiles, mammals and ants are recommended for inclusion in the faunal rehabilitation standards for Ranger Uranium Mine, including the threatened Partridge Pigeon (top) and Black-footed Tree-rat (second from top). Photos Alan Andersen and Kym Brennan.

3. Appropriate reference conditions must be specified

The reference conditions must reflect the rehabilitation goals for the site. The dominant vegetation type in the surrounding Kakadu National Park is lowland savanna woodland, and so this is the appropriate reference target ecosystem for the Ranger rehabilitation.

4. Rehabilitation standards must specify an appropriate level of similarity to reference conditions

Rehabilitation standards must specify how similar, in statistical terms, the rehabilitation sites must be to the reference sites in order for the goals of the rehabilitation project to have been met. In the case of the Ranger Project Area, scientists recommend using a similarity-assessment matrix that considers the proportion of the benchmark that has been achieved at a rehabilitated site, and the number of rehabilitation sites that have achieved that level of recovery. The abundance of feral animals should be no higher than in surrounding Kakadu NP, and no new exotic species to the region should be present.

5. Robust survey methods are necessary to meaningfully compare reference and rehabilitation sites

Survey methods for fauna must be sufficiently robust to overcome the challenges of detectability. The most recent survey protocol used by the Northern Territory Top End National Parks Ecological Monitoring Program is recommended as appropriate for vertebrates in assessments of Ranger rehabilitation (Figure 2).



Figure 2. Monitoring methods include camera trapping for vertebrates (top) and pitfall traps for invertebrates (bottom), photos NESP Northern Hub and Alan Andersen.

The approach used for Ranger is transferable to other rehabilitation projects

The structured approach used to recommend rehabilitation standards for the Ranger Project Area is transferable to other mine-site rehabilitation projects, and to restoration projects more generally. The expected incorporation of the Ranger Project Area into Kakadu National Park means that rehabilitation standards for the site will likely differ from those set for other mine sites. Although the particular specifications of the rehabilitation standards will vary on a project-by-project basis, the principles used to develop a robust and meaningful set of standards will be the same.

Key recommendations

The following recommended faunal specifications for the rehabilitation of Ranger Uranium Mine were provided to the Australian Government's Supervising Scientist Branch who is overseeing the Ranger rehabilitation.

- Fifty vertebrate species and ant communities are considered suitable for assessment. At least one grass-layer invertebrate group should also be targeted.
- Four attributes of faunal communities should be measured: species diversity (richness and evenness), species composition, functional group representation, and species occupancy (vertebrates only).
- The faunal assemblages of the lowland savanna woodlands of northern Kakadu constitute the target reference conditions for the rehabilitation, as identified by the Australian Government's Environmental Research Institute of the Supervising Scientist.
- To be considered acceptable, at least 60% of the rehabilitation sites must achieve at least 80% of the benchmark or at least 80% of the sites must achieve at least 60% of the benchmark.
- The survey protocol of the Northern Territory Top End National Parks Ecological Monitoring Program is recommended as a robust sampling method.



Lowland savanna woodland such as this in Kakadu is the appropriate reference target ecosystem for the Ranger rehabilitation, photo Alan Andersen.

Further information

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This factsheet, final reports and further information are available from the project webpage at nespnorthern.edu.au/projects/nesp/ranger-faunal-rehab

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