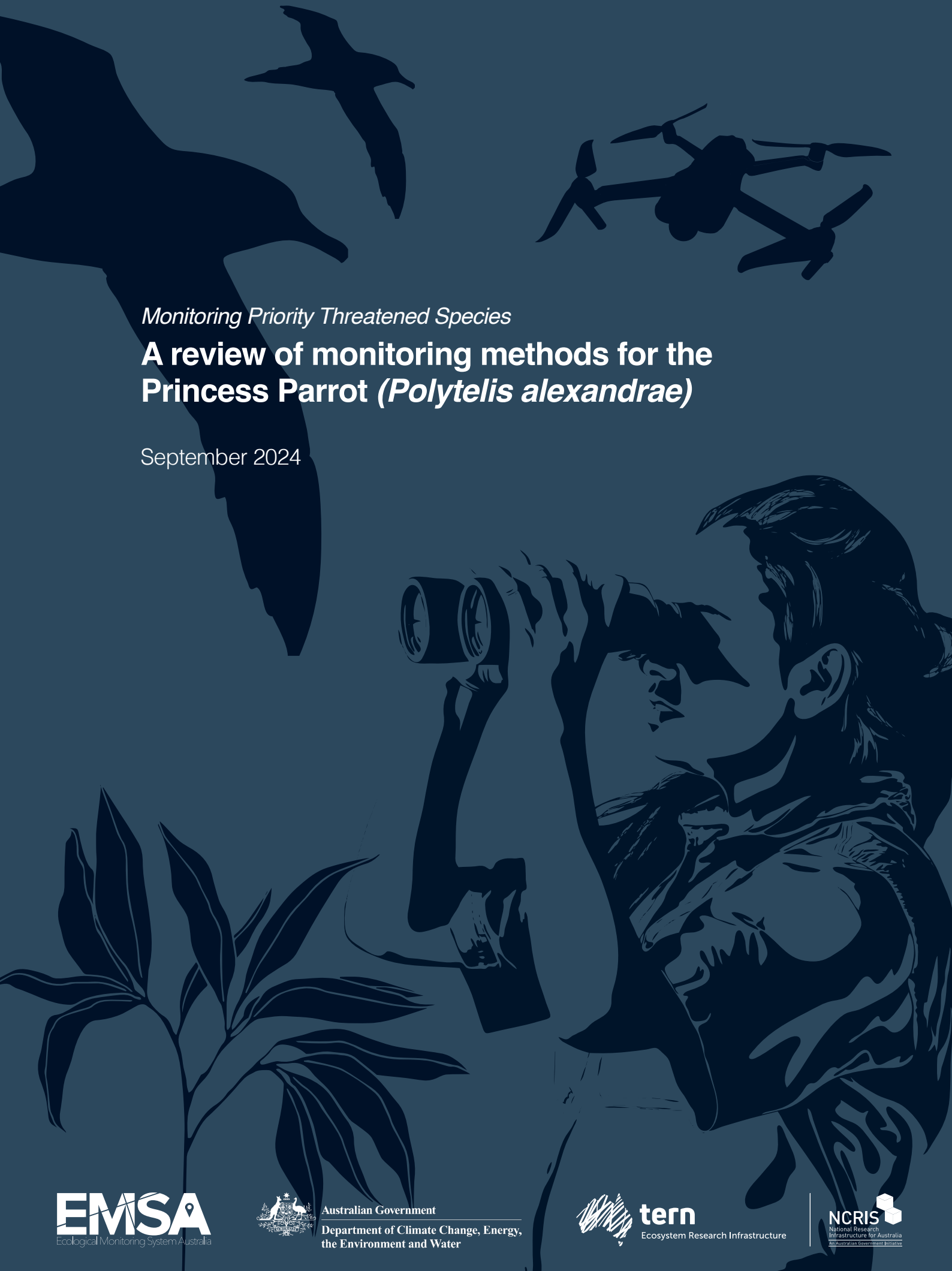

Monitoring Priority Threatened Species

A review of monitoring methods for the Princess Parrot *(Polytelis alexandrae)*

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Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

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About

This literature review collates information on one of the 110 priority threatened species identified in the *Threatened Species Action Plan 2022-2032* and has been reviewed by invited practitioners experienced in monitoring the species.

The *Survey Guidelines for Monitoring Threatened Species* project, a collaboration of the Department of Climate Change, Energy, the Environment, and Water (DCCEEW) and the Terrestrial Ecosystem Research Network (TERN), aims to improve our knowledge of threatened species by enhancing accessibility and sharing of quality scientific threatened species data. By developing best practice field survey guidelines and recommendations, practitioners will be better equipped to conduct standardised, repeatable surveys.

By identifying the monitoring methods typically implemented by practitioners, documenting and assessing the techniques known to work, and identifying opportunities to standardise the methods, we can move towards ensuring all monitoring is species-appropriate, comparable between practitioners and populations, and repeatable over time. Further, together with consistent terminology, guidelines, instructions, and data collection, we can refine efforts and resources to measure and share information. Data collected using robust, standardised methods will improve our knowledge of threatened species and underpin threatened species recovery at scale. This project is essential to establishing monitoring protocols and data repositories to enhance the accessibility and sharing of threatened species data.

TERN has prepared the literature reviews for the Department of Climate Change, Energy, the Environment, and Water. For further information, please visit the EMSA Threatened Species Survey Guidelines website. Additional information, particularly monitoring methods and techniques not included that should be considered, can be brought to the author's attention by emailing tern@adelaide.edu.au for consideration for future updates.

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1 Background

1.1 Species name

Princess Parrot (*Polytelis alexandrae*) is endemic to Australia, and Indigenous groups in South Australia know the species as Wipu Wara (Friends of the Great Victoria Desert 2020).

1.2 Conservation status

The Princess Parrot is listed as Vulnerable under the *Environmental Protection and Biodiversity Conservation Act* (Cth). Table 1 identifies the species conservation status under Commonwealth, state and territory, and the International Union for Conservation of Nature's (IUCN) listings.

The EPBC Conservation Advice for Princess Parrot was updated in 2018 (previously 2008), with the listing retained as Vulnerable, given insufficient evidence to support transferring it to a different category (TSSC 2018). The IUCN conservation status is Near Threatened as the population may be as low as 1,000 mature individuals (Pavey et al. 2021). The certainty of the status is low, with little having been learnt about this species since it was assessed in 1990 (Pavey et al. 2021).

Table 1. National, state, territory, and international conservation status of the Princess Parrot

Jurisdiction	Status	Legislation or listing
Commonwealth	Vulnerable	*Environment Protection and Biodiversity Conservation Act 1999*
Northern Territory	Vulnerable	*Territory Parks and Wildlife Conservation Act 1976*
Queensland	Endangered	*Nature Conservation (Animals) Regulation 2020 (Qld)*
South Australia	Vulnerable	*National Parks and Wildlife Act 1972*
Western Australia	Priority 4: Rare, Near Threatened or other species in need of monitoring	Not legislated, however Priority 4 DBCA Priority species
IUCN	Near Threatened	IUCN Red List of Threatened Species

1.3 Summary of data held in the Threatened Species Index

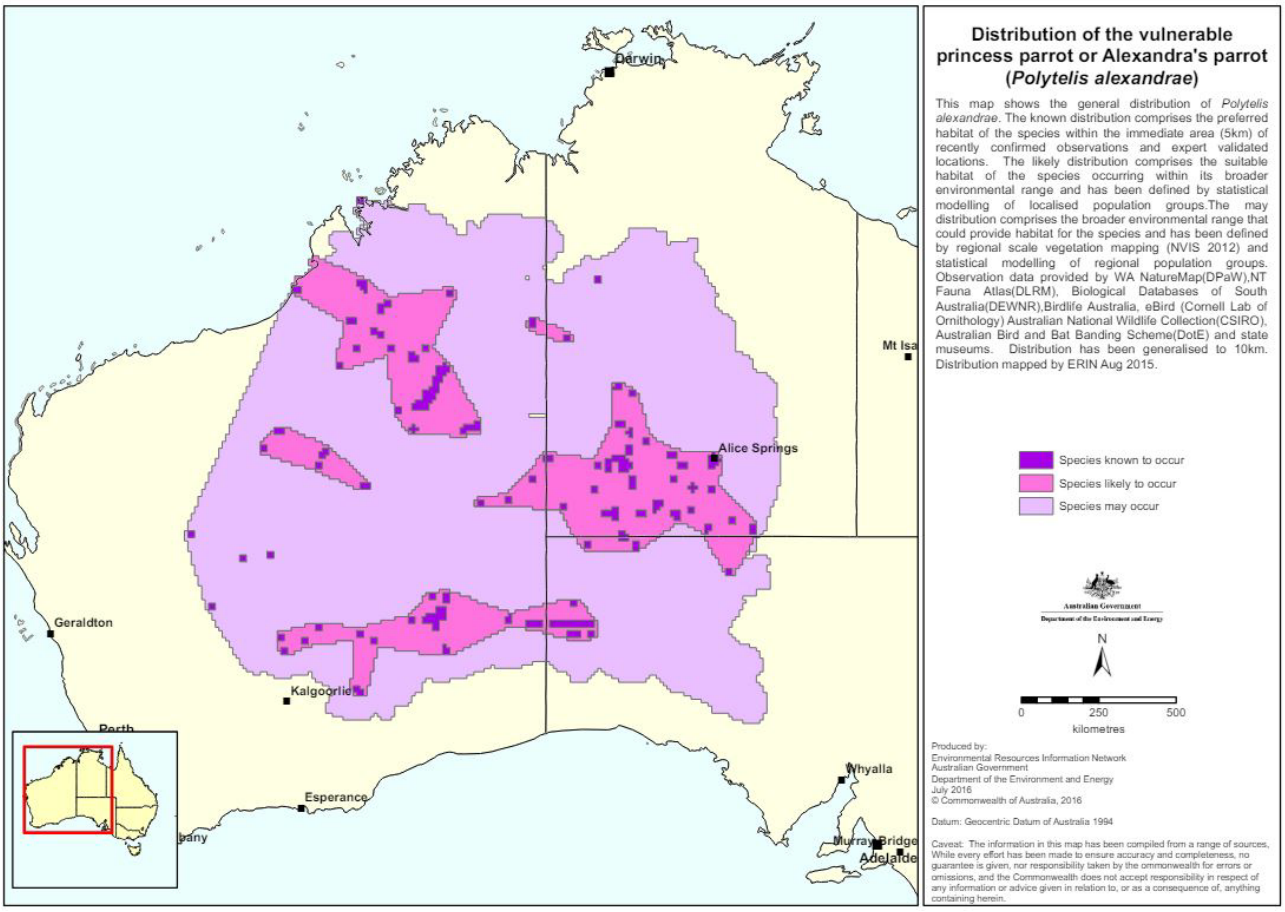
The Threatened Species Index (TSX) provides reliable and robust measures of change in the relative abundance of Australia's threatened and near-threatened species at national, state and regional levels. Understanding these changes in species populations is crucial for monitoring Australia's conservation progress and allows users to measure and report on the benefits of conservation investments, and to justify and design targeted management responses. Currently, the index is restricted to birds, plants and mammals, with new groups to be added in the near future.

The TSX does not hold data on the Princess Parrot. More information on the TSX, including how to contribute threatened species monitoring data to the index, can be found at tsx.org.au

1.4 Distribution and abundance

Princess Parrots occur in the arid zone of north-west South Australia, south-west Northern Territory and most of inland Western Australia in an area that encompasses the Great Sandy, Gibson, Tanami and Great Victoria Deserts (Blyth & Burbidge 1997; DotEE 2016)(Figure 1). Sightings are scattered and irregular across its range which has its outer limits of Oodnadatta in South Australia, west to near Coolgardie and the upper Murchison River in Western Australia, north to near the Fitzroy River in Western Australia and north-east to Howell Ponds and Alice Springs in the Northern Territory (Baxter & Henderson 2000; Higgins 1999; North 1896; Pavey et al. 2021; Pavey et al. 2014).

Figure 1.Distribution of the Princess Parrot.



Source: DotEE (2016)

It is proposed that the species has distinct core and irruptive ranges, although the location of the core range is not well understood. Pavey *et al.* (2014) states that some research suggest the core range is centred on the eastern Great Sandy Desert (e.g. Blyth & Burbidge 1997), although recent expeditions suggest that it may be the eastern Gibson Desert and western Great Victoria Desert (Pavey et al. 2014).

Princess Parrot is a species variable in numbers and distribution (Legge et al. 2018). The extent of occurrence is estimated as 1,000,000 km² and area of occupancy estimated as 10,000 km. The population trend is considered stable but with low reliability (Pavey et al. 2021), as it is difficult to assess given the species' sporadic movements and the remoteness and vastness of the species' distribution (TSSC 2018). Records on the periphery of the species' range may have become less frequent since the 1950s, but the extreme variability confounds any change in distribution (Pavey et al. 2021; TSSC 2018). Some occurrences, such as flocks present along water courses in the central ranges of NT, have been attributed to movements away from areas in drought (DEWHA 2010).

There have been three reports of large concentrations of Princess Parrots in the last 50 years; up to 300 on Canning Stock Route in the early 1990s (Carter 1993), a maximum of 172 at the best known breeding event, during 2010 on the eastern edge of their range, a region which was also occupied in 1894 (Pavey et al. 2014), and a flock of at least 110 at Newhaven Reserve in winter 2012 (C Pavey, unpublished). Over the last decade, there have been sightings over a large range in the Great Victoria, Little Sandy and Gibson Deserts both before and during the most recent documented breeding event (BirdLife International 2023; Pavey et al. 2021).

Other than the three large breeding events recorded for the species, records consist of spasmodic sightings of relatively few birds. At mass breeding events, the birds have reportedly disappeared with their young as abruptly as they arrive (Baxter & Henderson 2000).

There are no biogeographic barriers across the distribution, and as a result, the species is considered a single widespread population, which can undergo population fluctuations in response to conditions (BirdLife International 2023; Pavey et al. 2021). Population estimates are unreliable, conservatively estimated at fewer than 1,000 individuals in poor years, but could be at least ten times that number (BirdLife International 2023). It is unknown whether the Princess Parrot population is experiencing a continuing decline in abundance and distribution (TSSC 2018). It has been suggested that the species was declining before the 2010 breeding event recorded in central Australia (BirdLife International 2023; Pavey et al. 2021).

1.5 Habitat requirements

Princess Parrots occur in savanna woodlands and shrublands on dunes and sand flats, typically with a ground layer of spinifex (*Triodia* spp.). They are associated with *Allocasuarina decaisneana* (Desert oak), *Eucalyptus gongylocarpa* (Marble gum), *Corymbia chippendalei* (Sand-dune bloodwood) and mallee Eucalypt species, and shrubs such as *Acacia*, *Grevillea*, *Hakea*, *Cassia* and *Eremophila* among scattered trees (mainly eucalypts). They also frequent riverine areas with *Eucalyptus* or *Allocasuarina* trees (DEWHA 2010; DOE 2022).

Princess Parrots nest in tree hollows that feature a hollow spout, branch or hole (Gibbons & Lindenmayer 2002), in *Eucalyptus camaldulensis* (River red gum) and other Eucalyptus species growing beside watercourses, and in *E. gongylocarpa* (Marble gum) and *Allocasuarina decaisneana* (Desert oak) away from water(DEWHA 2010; Higgins 1999; Pavey et al. 2014). Although *A. decaisneana* is considered as a nesting tree (Higgins 1999), Pavey et al. (2014) note that it does not readily form hollows and that Princess Parrots were not recorded nesting in this species during the 2010 breeding survey, despite it being common in the study area.

1.6 Biology and ecology

Princess Parrots are medium-sized birds with a total length of 40–45 cm and a body mass of 90–120 g. They are easily identified by their pale pink chin and throat, lime green shoulders, dull olive-green body, blue-grey crown, reddish bill and long tapering tail (DEPWS 2021).

1.6.1 Breeding

Princess Parrot breeding is reported to occur from September to January. However, dependent young have been recorded in July (Carter 1993), and it is possible that breeding may occur at any time of the year following rainfall (DOE 2022; Higgins 1999). Notable breeding events have been documented along *Eucalyptus camaldulensis* (River red gum) lined creeks around Alice Springs (Baxter & Henderson 2000; Pavey et al. 2014).

Based on observations of captive birds, the Princess Parrot begins to breed in its first or second year (most birds start in the second year), and captive individuals have survived to 30 years (DOE 2022). Clutch size can vary between 3–6 eggs (Higgins 1999; North 1896; Pavey et al. 2014). Several pairs can occupy one tree (North 1896). Generation time (the average interval between an individual's birth and its offspring's birth) is estimated at 6.3 years (Bird et al. 2020).

Pavey et al. (2014) recorded details of the breeding and foraging ecology and abundance of the Princess Parrot during a population irruption in the southern Northern Territory in 2010-2011, representing the most detailed study of the species in the wild. The breeding event was consistent

with the species breeding in core areas in wet years, then irrupting or dispersing more (Higgins 1999; Pavey et al. 2021).

During this study, Pavey et al. (2014) observed 22 active nests, all in *E. gongylocarpa* (Marble gum) (the dominant tree in the study area), with trees having an average height of 14.06 +/- 0.70 m (range 7.85-18.06 m) and the mean height of nest entrances being 6.76 +/- 0.37 m (range 4.40-9.88 m). Pairs were observed to fledge one or two young, with a maximum of five recorded. The percentage of groups with three or more birds (assumed to be a pair with offspring) increased through September, October and November. Fledglings peaked in October and November.

1.6.2 Diet

Princess Parrot feeds on seeds, flowers, and other plant material on the ground and within foliage (Carter 1993)(Carter 1993; Higgins 1999; Pavey et al. 2014). The species was recorded by Pavey et al. (2014) as feeding on 11 different plant species over three months of intensive sampling in 2010 (August to October), including flowers of *Acacia aneura* (Mulga), *Grevillea juncifolia*, *Leptosema chambersii*, *Hakea lorea*, *Eremophila* spp.), seeds of grasses *Digitaria ammophila* and *Eragrostis eriopoda*, seed pods of *Acacia maitlandii*, leaf stems of *Euphorbia ferdinandii*, and *Amyema miquelii*, and unidentified plant material of *Ptilotus polystachyus*. Birds were also observed feeding on lerps on *Eucalyptus* sp. The composition of feeding records changed across the study period (Pavey et al. 2014).

1.6.3 Movements

The movements of the species are poorly known. The pattern of occurrence has previously been referred to as nomadic, irruptive, or both (Carter 1993; Blyth & Burbidge 1997; Higgins 1999). Evidence suggests they may be dispersive, though little information is available, and thus, patterns of movement are mostly speculative. There is a general consensus that Princess Parrot exhibits irruptive population dynamics (Baxter & Henderson 2000; Blyth & Burbidge 1997; Garnett et al. 2011), with birds not present for long periods and then large numbers being seen in an area for a short periods (Pavey et al. 2021; Pavey et al. 2014).

1.6.4 Behaviour

Princess Parrots are gregarious and are usually seen in small groups (DEWHA 2010; Higgins 1999). They can be quite vocal (DEWHA 2010). Birds are reported to perch in trees when flushed from the ground (DEWHA 2010; Higgins 1999).

1.7 Threats

The spread of *Cenchrus ciliaris* (buffel grass) is considered the greatest potential threat to Princess Parrots, as it increases fire spread and intensity, reducing the abundance of spinifex and damaging old hollow-bearing trees (Pavey et al. 2021).

Their habitat may also have been degraded, and food availability reduced by introduced Rabbits (*Oryctolagus cuniculus*) Camels (*Camelus dromedarius*), and Cats (*Felis catus*) could also be a threat. Psittacine Beak and Feather Disease, and poaching of eggs or young from nests are considered potential threats. Increasing temperatures may also affect the species, given climate predictions for the region (Pavey et al. 2021). An assessment of threats sourced from Pavey et al. (2021) is provided in Table 2.

Table 2. Princess Parrot assessment of threats

Threat	Current risk	Certainty	Research priority	Management priority	Management feasibility	Principal source
Increase in scale, frequency or intensity of fire	Medium	Low	High	Medium	Medium	Pavey et al (2014)
Buffel grass promoting fire	Low	Low	High	Medium	Low	Pavey et al (2014)
Feral camel grazing and trampling	Low	Low	Low	Low	Medium	Higgins (1999)
Cat predation	Low	Low	High	High	Medium	Woinarski et al. (2017)
Rabbit grazing	Low	Low	Low	Medium	Low	Higgins (1999)
Rising temperatures and heat waves	Low	Low	High	Medium	Low	Jacobs et al. (2013)

Source: Pavey et al. (2021)

2 Existing monitoring

2.1 Overview of monitoring methods

Princess Parrots are difficult to monitor given their large distribution, irruptive dynamics, high mobility, the lack of understanding of their movement ecology, and their occurrence in relatively inaccessible locations (Legge et al. 2018; TSSC 2018).

The presence of Princess Parrots is typically determined by direct observation (sighting and call). They are visually and vocally distinct and therefore difficult to confuse with other parrot species (DEWHA 2010). They are active, noisy and conspicuous in the early morning, but well-hidden and difficult to detect when resting quietly in the heat of the day (DEWHA 2010). Their call is usually heard when in flight or before leaving the roost (Higgins 1999).

Dedicated monitoring would require a significant investment of time and coordination among several parties, and may yield limited results (Legge et al. 2018). Many Princess Parrot records are opportunistic, highlighting the potential application of citizen science in monitoring this species (Baxter & Henderson 2000).

2.1.1 Indicators of presence

There are no specific indicators of the presence of Princess Parrot. The presence of suitable habitat, suitable nesting hollows and the availability of surface water could be used as predictors of potential occurrence, but this approach is problematic given the species' large range and sporadic movements.

2.2 Monitoring resources

There is no recovery plan for the Princess Parrot, nor is one considered required (TSSC 2018). There are no existing monitoring protocols specific to Princess Parrot. An assessment of the adequacy of monitoring for Australian bird taxa listed as threatened under the EPBC Act (Department of Energy and the Environment 2017) identified that Princess Parrot has had no monitoring attention, probably owing to the remoteness and inaccessibility of areas in its distribution, rather than detectability (Legge et al. 2018).

Key resources with information for monitoring Princess Parrot are listed below.

- The Survey guidelines for Australia's threatened birds (DEWHA 2010), provides recommendations for monitoring of Princess Parrot:
  - area searches or transect surveys of suitable habitat (in areas less than 50 ha), in the early morning, with detection by sighting or call.
  - targeted searches and subsequent watches of waterholes in suitable habitats during the dry season.

- The EPBC Conservation Advice for the Princess Parrot (TSSC 2018) identifies the need to undertake monitoring and targeted surveys to:
  - more precisely assess the Princess Parrot population size, population trend and distribution
  - monitor the response of the species to fire, using an appropriate measure (e.g. occupancy, abundance, mortality, ranging behaviour and breeding success) based on knowledge of the ecology of the species, and with a monitoring design that aims to improve understanding of the species' response to fire
  - monitor changes in habitat use as a result of increased water availability at stock watering

points, with a particular focus on detecting changes in long term distribution and any associated deleterious effects of increased competition on the Princess Parrot for breeding and feeding resources.
  - monitor the spread of weeds, particularly buffel grass, within Princess Parrot habitat to inform ongoing management actions.
  - monitor the Princess Parrot population for the presence of Psittacine Circoviral Disease.
  - monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them in necessary
  - better understand the habitat use of the Princess Parrot, its movements, response to rainfall and threatening processes.

- The text book Wildlife Research in Australia: Practical and Applied Methods (Smith et al. 2022) provides survey procedures for methods relevant to the study of parrots.

2.3 Survey methods

2.3.1 Direct counts

Direct counts are based on the human detection of birds by sighting or call. Key data from direct counts include survey date, location, habitat type, observed birds (presence/absence), number observed, bird sex and age, and observational information (e.g. details of roosts and foraging).

Area searches and transect surveys

DEWHA (2010) recommends area searches and transect surveys of suitable habitat should be undertaken in the early morning (DEWHA 2010) and provide a survey effort guide of 20 hours over 10 days for area searches or transect surveys (in areas less than 50 ha). Monitoring locations would need to be determined in collaboration with local ecologists, land managers and project partners, considering the location of existing records and suitable habitat.

Surveys may be best undertaken in the 'core' habitat area, with a concentration of recent records (refer to database records). Existing records of the species have been recorded across all months of the year (Atlas of Living Australia 2023). A gazetteer of record locations (up to 2000) is provided in Baxter and Henderson (2000). Based on the frequency of records, Lake Tobin, in the Great Sandy Desert may be a focus area (DOE 2022).

Targeted searches

Targeted searches can be undertaken along rivers and of waterholes during the late dry season in suitable habitats. DEWHA (2010) provide a survey effort guide of 20 hours over 10 days for targeted searches of waterholes during dry season. Existing records can guide targeted search locations. The significant breeding event near Glen Edith, NT, was associated with "one of only two events of well above-average mean annual rainfall in the area in the past 20 years" (Pavey et al. 2014).

Baxter and Henderson (2000) identify a possible link between the Princess Parrot and marble gum woodland in the Great Victoria Desert of SA and recommended that this habitat be searched more thoroughly and frequently for evidence of Princess Parrot presence and breeding.

Opportune records

Opportune records represent an essential component of monitoring this species, with the current understanding of the species distribution and population size mostly inferred from opportunistic observations. There has been an increased frequency of sightings in recent times as remote four-wheel driving has become more popular (Baxter & Henderson 2000). Most records of the species

have been made from 2010 onwards. The few records from 2020 onwards are all within close proximity to the NT State route 4 (Lasseter Highway) (Atlas of Living Australia 2023). Given the limited knowledge of the species' movements, any sightings are of interest and citizen science involvement could be encouraged.

2.3.2 Other survey methods

Acoustic monitoring

Automated acoustic recorders could be located across the remote arid range of the Princess Parrot. The Australian Acoustic Observatory has acoustic recorders erected, or planned, at locations on the edge of the range of the Princess Parrot: four on the Matuwa Indigenous Protected Area (WA), four at Newhaven (NT), four planned for the Alice Mulga TERN SuperSite, ~200 km north of Alice Springs on Pine Hill Cattle Station (NT), and four planned for Tjoritja (West MacDonnell National Park), NT.

Bioacoustics and camera traps are increasingly used to monitor known nests of other species (e.g. for Swift Parrots) (Smith et al. 2022).

Camera trapping

Camera traps could potentially be used to detect the presence of Princess Parrots (and other species of interest) at targeted locations, e.g. remote ephemeral waterpoints, such as Lake Tobin, in the Great Sandy Desert. Solar-powered camera traps that can transmit the photos back via satellite/cellular network technology, combined with artificial intelligence to send real-time alerts when a species of interest is detected, would be ideal.

eDNA sampling

eDNA samples (e.g. water or faecal) could potentially be used to confirm the species' (recent) presence or non-detectable absence within an area. Repeat survey (i.e. of waterholes) would be needed to obtain a better picture of seasonal use, given the DNA in water degrades over time.

UAV

Unmanned aerial vehicles, also known as drones, have been used to track the movement and search large landscapes for Swift Parrots (Smith et al. 2022), and thus have potential use in large-scale surveys of Princess Parrot.

DNA sampling

DNA sampling could potentially be used to assess if the birds comprise one large arid-zone population or multiple sub-populations. This would require the capture of birds.

Trapping

Trapping is undertaken to obtain data on individual birds and to enable the fitting of tracking devices and identification bands. Trapping and handling of birds requires specialised training and equipment. Nestlings and adults can be captured at the nest. Ground feeding birds may be caught when foraging or drinking on the ground, using whoosh and mist nets. Leg banding is a common marking method used on various parrot species. Other techniques include short-term methods such as tail feather marking and wing tags (Smith et al. 2022).

Satellite tracking

Satellite tracking devices could be used to track the movements, distribution and habitat use of individual Princess Parrots, over landscape scales. Tracking studies of parrots have used GPS and satellite devices attached as back or tail mounts (Smith et al. 2022). Herrod et al. (2013) successfully trialled a "backpack" harness attachment for a 5 g solar-powered satellite tag, which was used without effect on body mass or behaviour (after an initial adjustment period) within a captive

environment. Retention of tracking devices without damage can prove challenging when working with parrots, given their intelligence and problem-solving ability, strong beaks used for chewing and crushing, and dexterous feet. Unlike most other medium to large parrots, captive Princess Parrots are recognised for their placid nature and limited chewing capacity (Herrod et al. 2013).

Habitat assessment

Some work has been conducted to record the distribution of habitats known to be used by the species. The Friends of the Great Victoria Desert have supported research projects, including the recording *Eucalyptus gonglyocarpa* (Marble gum) distribution, and recording sightings of Princess Parrot.

3 Key agencies and organisations involved in the species research and recovery

Key agencies, organisations or individuals identified as having been previously or currently actively involved in monitoring Princess Parrot include:

- CSIRO (particularly Chris Pavey)
- Desert Wildlife Services
- Parks and Wildlife NT, Alice Springs
- Various Indigenous groups: the species is known to occur on the lands of at least 32 Indigenous groups (Pavey et al. 2021). Monitoring programs should involve indigenous groups, the Central Land Council (for records on Aboriginal Land Trusts), and the Central Land Management Association (for records on NT pastoral leases).

4 Key survey guideline recommendations gathered from the literature

The literature review of the monitoring methods relating to the Princess Parrot has identified some key points that must be addressed when developing species-specific guidelines. These points include:

- There are difficulties obtaining repeat monitoring data for this species, given its unknown movements across a vast, remote, and difficult to access landscape. Whilst traditional approaches to monitoring in the form of human-observed area searches and transect surveys have been recommended (DEWHA 2010), remote monitoring options such as acoustic recorders and camera traps may have merit. Targeted monitoring at watering locations (e.g. rivers lined with old trees with hollows) is also recommended.
- Discussion with experts and people actively involved in the survey of Princess Parrots and parrots generally will help to ascertain the most suitable approaches to monitoring, with due regard to technological advances.
- Interrogation of recent database records and discussion with local experts and land managers may assist the approach to monitoring in terms of target habitat, survey locations, and timing.
- Further research into the species' movements, possibly through satellite tracking of individual birds, would also help fill knowledge gaps to guide future monitoring (Baxter & Henderson 2000).

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