

## Supplementary Material

### The Arid Zone Monitoring Project: combining Indigenous ecological expertise with scientific data analysis to assess the potential of using sign-based surveys to monitor vertebrates in the Australian deserts

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**Table S1.** Common names of animals displayed in Fig. 4, with their scientific names.

Common name	Scientific name
<b>Mammals</b>	
Agile wallaby	<i>Notamacropus agilis</i>
Greater bilby	<i>Macrotis lagotis</i>
Brush-tailed mulgara	<i>Dasycercus blythii</i>
Camel	<i>Camelus dromedarius</i>
Cat	<i>Felis catus</i>
Cow	<i>Bos taurus</i>
Crest-tailed mulgara	<i>Dasycercus cristicauda</i>
Dingo	<i>Canis familiaris lupus</i>
Donkey	<i>Equus asinus</i>
Dusky hopping mouse	<i>Notomys fuscus</i>
Euro	<i>Osphranter robustus</i>
European red fox	<i>Vulpes vulpes</i>
Goat	<i>Capra hircus</i>
Horse	<i>Equus caballus</i>
Large macropod	<i>Macropus fuliginosus, M. giganteus, Osphranter robustus, O. rufus</i>
Long-haired rat	<i>Rattus villosissimus</i>
Marsupial mole	<i>Notoryctes caurinus, N. typhlops</i>
Northern nail-tail wallaby	<i>Onychogalea unguifera</i>
Rabbit	<i>Oryctolagus cuniculus</i>
Red kangaroo	<i>Osphranter rufus</i>
Sheep	<i>Ovis aries</i>
Short-beaked echidna	<i>Tachyglossus aculeatus</i>
Small mammal	
Southern hairy-nosed wombat	<i>Lasiorhinus latifrons</i>
Spectacled hare-wallaby	<i>Lagorchestes conspicillatus</i>
Spinifex hopping mouse	<i>Notomys alexis</i>
Warru	<i>Petrogale lateralis centralis</i>
<b>Reptiles</b>	
Central military dragon	<i>Ctenophorus isolepis</i>
Central netted dragon	<i>Ctenophorus nuchalis</i>
Centralian blue-tongue	<i>Tiliqua multifasciata</i>
Desert skink	<i>Liopholis inornata</i>
Dragon	Family Agamidae
Gecko	Family Gekkonidae
Goanna	<i>Varanus</i> spp.
Gould's goanna	<i>Varanus gouldii</i>
Great desert skink	<i>Liopholis kintorei</i>
Legless lizard	<i>Lerista</i> spp. <i>Pygopus</i> spp., <i>Lialis burtoni</i> , <i>Delma</i> spp.
Mulga snake	<i>Pseudochis australis</i>
Night skink	<i>Liopholis striata</i>
Perentie	<i>Varanus giganteus</i>
Sand slider	<i>Lerista</i> spp.
Shingle-back	<i>Tiliqua rugosa</i>
Small reptile	
Snakes	
Spiny-tailed monitor	<i>Varanus acanthurus</i>
Thorny devil	<i>Moloch horridus</i>

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<b>Common name</b>	<b>Scientific name</b>
Western brown snake	<i>Pseudonaja mengdeni</i>
Woma python	<i>Aspidites ramsayi</i>
Yellow-spotted monitor	<i>Varanus panoptes</i>
<b>Birds</b>	
Australian bustard	<i>Ardeotis australis</i>
Bush stone-curlew	<i>Burhinus grallarius</i>
Emu	<i>Dromaius novaehollandiae</i>
Malleefowl	<i>Leipoa ocellata</i>
Birds	

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**Video S1.** AZM video. See <https://www.nespthreatenedspecies.edu.au/video-gallery/reading-the-sand-arid-zone-monitoring>.

**File S1.** Arid Zone Monitoring: Species Profile (see next pages).

# Arid Zone Monitoring Species Profile

## Australian Bustard

*Ardeotis australis*

### Language names

Arengwerrpe, Artewe, Arwengerrp, Arwengerrp, Barnarr, Itua, Jirri, Jurlaka, Kiparra, Kurtinja, Nganurti, Parrayan, Parrkarra, Parulpa, Wardilyka

National status in the EBPC Act: Not listed

IUCN Red List: Least concern



*Australian bustard (female).*



*Young Australian bustard.*

### Animal Description

Australian bustards are large ground-dwelling birds, up to 1 m tall with long pale legs. The adult male has a black capped head, grey face and neck, mottled brown body with black and white checks on the edge of wings, a black band across their creamy chest. The female is similar but smaller.

Australian bustards are not nationally threatened, but the IUCN Red List notes that the population is declining, and the species has disappeared from some parts in the south of its former range.

### Key threats

- Habitat change from too much grazing by feral herbivores (livestock, camels, rabbits and mice)
- Predation by cats and foxes
- Wrong-way fire
- Climate change (changing rainfall, temperature, droughts)



## Habitat

Australian bustards like open woodlands and grasslands, including sand plains with spinifex and semi-arid heath. They also like to hunt in recently burnt country. They can be seen on their own, in pairs or family groups. They can move long distances in response to fire and rainfall, which affect their food supplies. They are omnivores and eat leaves, buds, fruit, frogs, lizards and insects (especially grasshoppers).

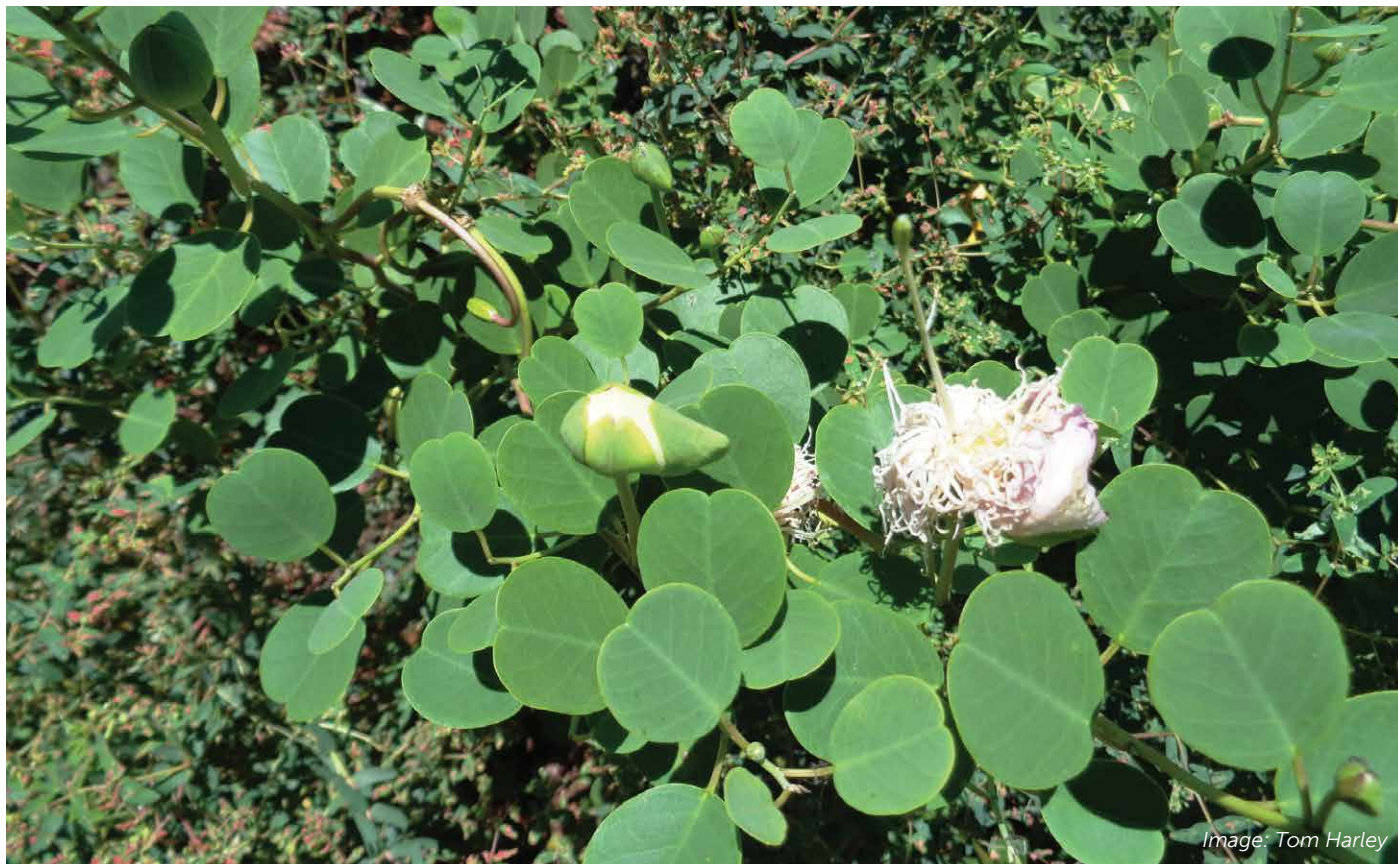


Image: Tom Harley

One of the food plants of the Australian bustard, the moonflower (*Capparis spinosa*).



Image: Tissa Ratnayake

Spotted spur-throated locust (*Austracris basalis*).



## Australian bustard tracks

Australian bustards have three front-facing toes. They walk like supermodels, with their feet placed in front of one another, so the tracks appear in a straight line.



Image: Justine E. Hausheer, The Nature Conservancy

Bustard prints.



Image: Justine E. Hausheer, The Nature Conservancy

Bustard tracks in sand (arrow shows which way the bustard is moving).



Image: Ian Fraser

Bustard tracks in soft sand (arrow shows which way the bustard is moving).

## Animals that might be confused with the bustard during a survey

- Emu
- Malleefowl
- Bush-stone curlew

Emu have larger tracks (>120 mm long) with a long middle toe. Malleefowl tracks have a back toe. Bush stone-curlews have smaller tracks (45-60 mm long) with a narrow middle toe.



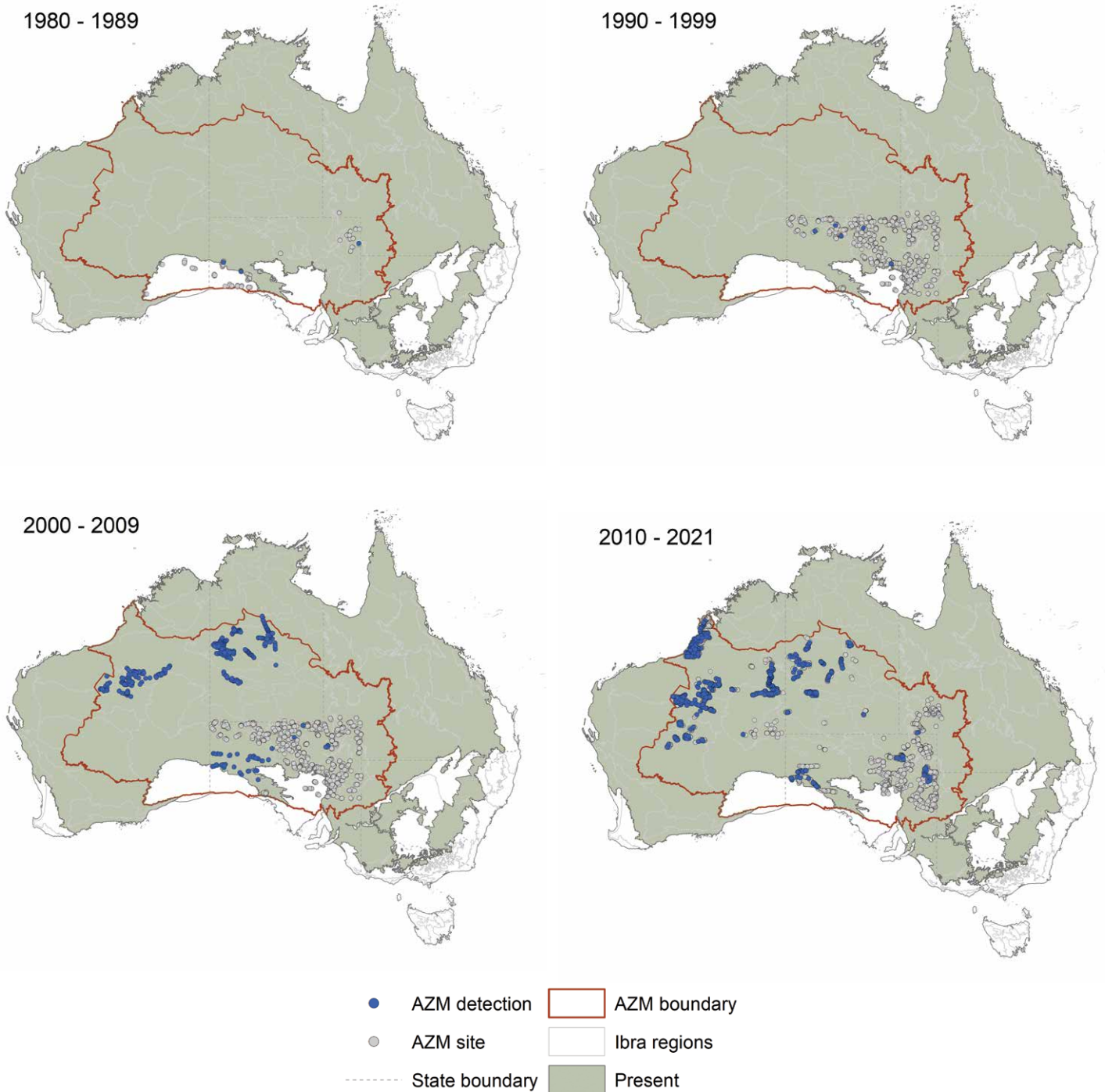
Australian bustard scat.



## Arid Zone Monitoring project findings

### Australian bustard distribution

The maps summarise the detections of bustards over time in the AZM dataset. They show that Australian bustards have been recorded across most parts of the deserts. Each blue dot shows a survey site where Australian bustards were recorded in that decade. The grey dots show all the other sites that were surveyed, but where Australian bustards were not recorded in that decade. Australian bustards are also found outside the AZM project area (all of the dark shaded bioregions on the map), but their numbers are declining in parts of southern Australia, and they are now mainly found in central and northern Australia. These records were made by Indigenous Ranger groups, land councils, NGOs, government agencies and university researchers. The information about the overall distribution in the map background is taken from Australian Faunal Directory<sup>1</sup>.



The maps above show data shared by data providers with the AZM project. The data are from track and sign surveys. This method is great for detecting species that live in sandy deserts, but not as good for species that prefer rocky habitats, or species with distributions that are mostly outside the central deserts. The method also works best for larger-bodied animals with tracks that are easily identified.

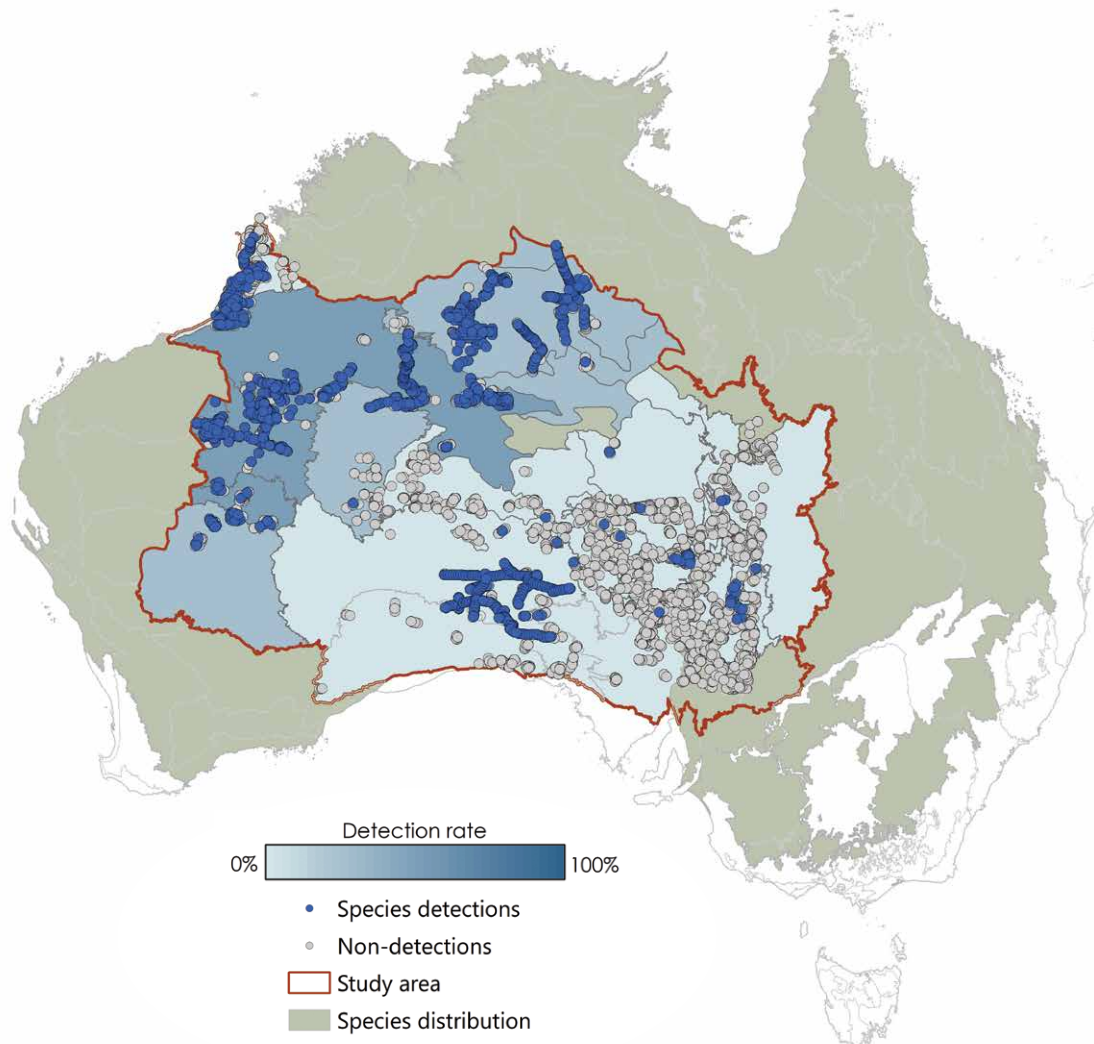
It is possible that extra surveys have been carried out that have not yet been shared. If you see 'gaps' in the maps that you could fill by sharing your data, let us know.



## Australian bustard detection rates

Australian bustards were detected at over 13% of all surveys in the AZM dataset. It was the seventh most commonly recorded species, and the most commonly recorded native bird species.

The map shows the average bustard detection rate across all surveys carried out in each bioregion, since the 1980s. Detection rates for bustards have been highest in bioregions with the darkest blue shading, in the northern and western deserts. A detailed analysis of bustard detections at a subset of AZM sites that were revisited over five or more years, shows that bustard detections increase in long-unburnt areas, and as the amount of green vegetation increases.



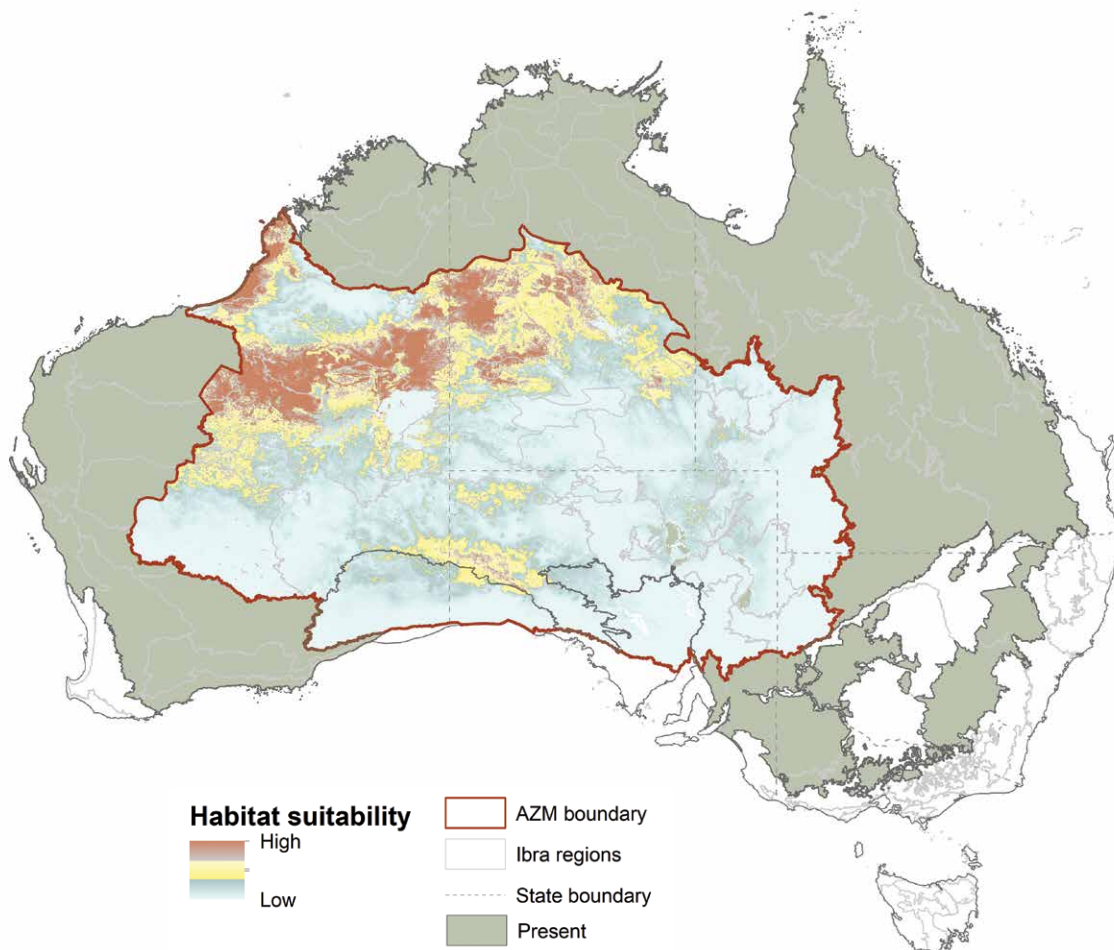
## Things to think about when surveying for Australian bustards

- Survey during good conditions (in the early morning is best, not too windy or straight after rain).
- Organise to do surveys at regular times every year – for example, before the wet or hot season (October) and in the early dry season or early cool time (April).
- Follow advice of experienced trackers - know how to tell bustard tracks apart from other species before you go to survey.
- If you want to see changes over time, you will need to go back to the same areas to sample over several years. If you want to see if management actions (feral animal culling or fire) are working, you need to sample many different sites, before and after the action. You might need help from a scientist to make the sampling design strong.

## Australian bustard habitat suitability

The habitat suitability model can tell us about where Australian bustards are most likely to be found. The analysis considered climate factors like annual, seasonal and daily temperature and rainfall; landform factors like elevation and slope; soil factors; and habitat factors like the amount of vegetation (NDVI) and fire frequency.

The model suggests that bustards are widespread, but are now more commonly detected in the northern deserts, in areas with more stable, higher average temperatures. These are the red-brown shaded areas of the map. The map only shows habitat suitability inside the AZM project boundary, but bustards are also found in large area outside that boundary. The habitat suitability model does not predict well in large areas where there has not been any sampling, for example in parts of the Great Sandy Desert and the Great Victoria Desert; getting more survey data from these areas would improve the model.



### Further information

Arid Zone Monitoring project

<https://www.nespthreatenedspecies.edu.au/projects/arid-zone-monitoring-surveys-for-vertebrates-across-arid-and-semi-arid-zones>

### References

<sup>1</sup> Australian Faunal Directory. <https://biodiversity.org.au/afd/home>. Accessed June, 2021.



National Environmental Science Programme

This project received support from the Australian Government's National Environmental Science Program.

The Arid Zone Monitoring project is a collaboration between the NESP TSR Hub and over 30 Indigenous ranger groups and Indigenous organisations, 8 NGOs and NRM groups, 5 government agencies institutions, and many individual researchers and consultants. The project has gathered track and sign data from across Australia's deserts, using it to map the distributions of desert species and their threats. The national database includes almost 50,000 species presence records from over 5300 unique sites and almost 15,000 site visits, over the period from 1982 to 2020. The project area was defined by using IBRA subregional boundaries - the project boundary captures Australia's desert subregions where track and sign-based surveys are commonly used. The project showcases the collective work carried out by all groups working across the arid zone, and lays the groundwork for creating ongoing, national-scale monitoring for desert wildlife. Cite this publication as NESP Threatened Species Recovery Hub, 2021. Arid Zone Monitoring Species Profile: Australian bustard, Project 3.2.5 findings factsheet.