Science for Saving Species

Research findings factsheet

Project 3.2.2.2

Threatened Species Recovery Hub

National Environmental Science Programme

Including Indigenous Traditional Ecological Knowledge into Mankarr (bilby) distribution modelling for increased ecological insights

In brief

Indigenous knowledge systems can hold detailed information about current and past environments, but only limited examples of Indigenous Traditional Ecological Knowledge being incorporated into ecological models exist.

In a collaborative manner, we designed a structured interview process and statistical framework to combine Traditional Ecological Knowledge with survey data to model the distribution of a threatened and culturally significant species, the greater bilby or Mankarr (*Macrotis lagotis*).

We used knowledge from Martu Traditional Owners in the western deserts, and data from field surveys to create predictive species distribution models with the Maxent program. Predictions of Mankarr distribution based on Martu knowledge were broader than those created with survey data. The models showed potential local declines, which were supported by Martu observation.

Martu provided additional information about habitat associations and locations of decline. They also described ecosystem dynamics and disturbance regimes that could influence Mankarr distribution. Intercultural approaches that draw on multiple sources of knowledge and information may improve species distribution modelling and better inform management of threatened or culturally significant species.

Background

The knowledge systems of Indigenous people can hold detailed information on the current and past environment, as well as the dynamics that shape the condition and diversity of the natural world. Indigenous Traditional Ecological Knowledge emerges from long periods of shared human observation and experimentation, and offers understanding of species distributions, animal behaviour, habitat relationships and complex feedback loops between humans and nature.

Indigenous and non-Indigenous managers can often have related goals for natural resource management. The conservation and recovery of the greater bilby or Mankarr (*Macrotis lagotis*) is of national significance in Australia and a priority for Martu, the traditional custodians of the Martu Native Title Determination Area in Western Australia, and for other Aboriginal Australians who are also custodians of this species.

The Mankarr is the last surviving desert bandicoot. Once found across most of the interior of Australia, the species' distribution has contracted to the north-western parts of its former range and is thought to be in decline. We have limited understanding of the Mankarr's current distribution and abundance, which makes planning recovery actions for this species challenging.

To the Aboriginal people living in these deserts, the Mankarr forms an integral part of culture and Jukurrpa (Dreaming and Law). The knowledge of Aboriginal people has the potential to reveal crucial ecological insights into historical species distributions and the timeline of a species' decline.

Species distribution modelling is a technique that identifies environmental variables that correlate with occurrence to predict a species distribution. Local knowledge can potentially be used in ecological modelling to fill gaps in survey data or provide novel insights into a species habitat preferences and distribution.

The University of Melbourne

Kanyirninpa Jukurrpa
Martu Cultural Knowledge Program
Building Sustainable Martu Communities

The Nature Conservancy Australia

The University Of Queensland Australia

Aims

We aimed, first, to develop a species distribution model (SDM) approach that could incorporate both Martu local knowledge of Mankarr ecology and occurrence, and georeferenced survey data to better understand the Mankarr's distribution. Second, we aimed to be able to predict the current spatial distribution of the Mankarr to provide valuable information to aid recovery planning for this species.

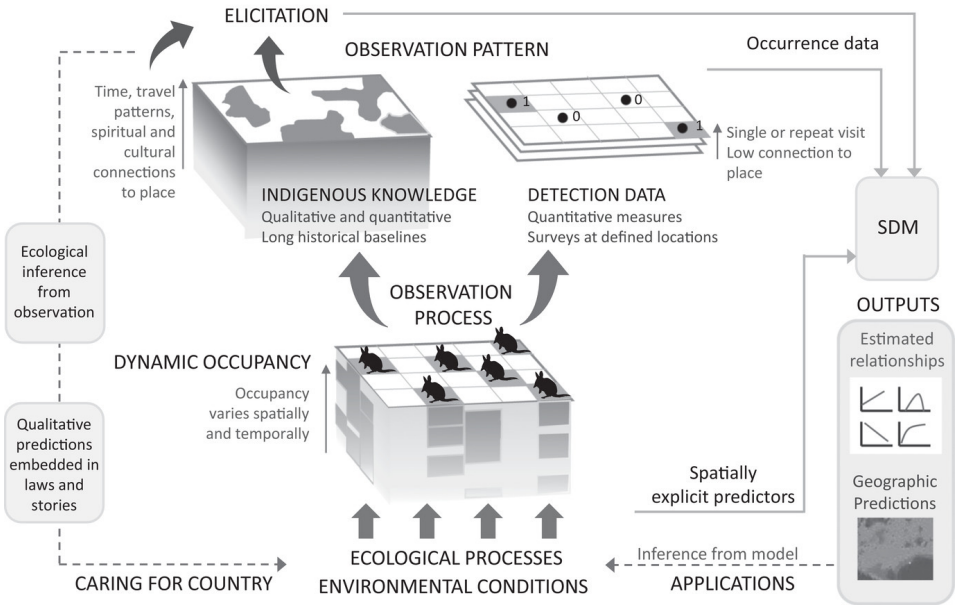

Figure 1. *The process we went through in the development of our species distribution modelling which incorporated observation data from western science and indigenous methods.*

Mankarr. Image: Bernard DUPONT CC BY-SA 2.0 Wikimedia Commons

What we did

The study area comprised the 13.6 million ha Martu Native Title Determination Area in Western Australia. We worked in Parnngurr and Punmu communities in 2016 with 10 Martu who were identified by their community as holding knowledge on Mankarr and Country, endorsed to speak on these topics, and willing to participate.

We carried out semi-structured interviews with these Martu to identify knowledge that could inform mapping and natural resource management, such as where Mankarr are likely to be present, indications of whether the species distribution has been changing, and information on habitat presence.

Surveys by Kanyirninpa Jukurrpa (Martu) ranger teams from 2008 to 2015 also provided records of Mankarr presence. These surveys were conducted by searching 2 ha areas for recent signs of Mankarr and included examining tracks, scat, digging and burrows.

We collated data for a set of 10 environmental variables that are potential predictors of Mankarr distribution. These were: elevation; roughness; relief; index of rock fertility; percentage sand; percentage lacustrine (landforms and deposits associated with lakes); percentage rock; percentage alluvium (sediment left by floodwaters such as on floodplains); percentage calcrete (weathered soil crust usually held together by calcium rich minerals); and pre-European vegetation. Relief and exposed rock were predictors of habitat suitability for Mankarr as it is a burrowing animal.

We generated two species distribution models, one based

on the species presence derived from local knowledge and a second from the ranger surveys. The species distribution models were created using Maxent version 3.4.1, and they provide an estimate of the relative likelihood of Mankarr occurrence. We created predictive maps of Mankarr distribution for both models and examined the importance of environmental predictor variables in each model. We then compared the predictions from local knowledge model to the model incorporating survey data.

BELOW: KJ Jigalong rangers pointing out an active mankarr burrow in mulga and claypan habitat. Image: Anja Skroblin

What we found

Local knowledge

We recorded Martu Elders personal knowledge of Mankarr occurrence that spanned over 50 years, including from when Martu were living traditional lifestyles before contact with non–Aboriginal people (not including cultural and other knowledge acquired over thousands of years). This knowledge was acquired through a combination of direct experience, shared information (between Martu, other Indigenous groups and ecologists) and childhood teaching by Elders and parents.

In total, Martu identified 39 areas where the Mankarr occurred, with the locations clustered around the Punmu and Parnngurr communities. These habitat areas ranged from 2.8 to 504km^2 in size, covered a total of 3500km^2 and included areas where Martu had seen the species in the past.

Martu provided information on habitat associations, locations of decline and descriptions of the ecosystem dynamics and disturbance regimes that influence Mankarr. Mankarr were thought to occur in six habitat types: verges of salt lakes; mulga; laterite; sandplain; claypan; and dune fields. Martu also described suitable habitat as requiring certain soil properties for burrow formation and a low number of feral predators. From the Martu descriptions, the areas of local decline were mainly in sand plain country, where populations were of low density and moved around more due to disturbance. In contrast, Martu said populations near salt lakes and drainage channels tended to stay locally and were easier to detect.

The interviewees detailed how the right combination of fire and rain was necessary to make food resources available. They indicated how Martu fire practices, which create a patchy mosaic of vegetation at different ages, were important in maintaining habitat suitability.

All interviewees from Parnngurr reported local declines in Mankarr, suggesting that the species was now less common and its distribution had become more restricted in the past several decades. Punmu Elders said the Mankarr shift their distribution as environmental condition change, usually returning to areas when fire regimes and predator pressure improve. Elders suggested that patterns of regional and local declines were influenced by the Martu moving off their lands in the 1960s with traditional practices and ceremonies ceasing, changes in rainfall, and introduced predators.

Species distribution models

Taken together, the Martu and ranger survey models showed potential local declines in Mankarr distribution, which were supported by Martu observations. Predictions of the Mankarr's distribution based on the Martu knowledge model were broader than those created with the survey data model.

Both of the models predicted Mankarr distribution to be in country surrounding salt lakes (lacustrine landforms) and inactive drainage channels. The survey model predicted Mankarr habitat to be restricted to the vicinity of salt lakes in the central north. On the other hand, the local knowledge model suggested Mankarr habitat was in diffuse patches across most of the study area, and also emphasised sandy, clay and calcrete substrates as suitable environments for the Mankarr. Both models suggested that the rocky ranges to the west were relatively less likely for Mankarr occurrence.

In the local knowledge model, the important environmental predictors were lacustrine, sand, alluvium, calcrete and roughness (variation in elevation). In the model fitted to the ranger survey data, the environmental predictors were of minor importance once a correction for a sampling bias was performed. We detected a sampling bias between the Mankarr locations and the distance to the nearest road in both models, with the bias greatest in the survey data model. We could not test whether one model was more accurate than the other due to the different types of data used to create each model.

Implications

Our research shows that an intercultural approach to eliciting and modelling with local Traditional Ecological Knowledge can play an important role in understanding species distribution on Indigenous lands. There is no one optimal species distribution modelling technique for all local knowledge models; this work outlines one potential pathway.

Our findings emphasised the importance of understanding how the observation and cultural transmission process associated with Traditional Ecological Knowledge may affect predictions and interpretations. Martu observation of Mankarr distribution seemed to be related to the species behaviour: the outlined areas for populations near salt lakes were smaller and more precise, while the outlined areas in sand plain country encompassed larger areas, signalling the mobile nature of this species. This bias toward larger potential habitat areas in sand plain country could result in an overestimate of the relative importance of those environmental conditions which would impact the accuracy of the model.

Collaborations that combine multiple types of knowledge may play an increasing role in enhancing our capacity to have a more holistic understanding of an animal's ecology, improve recovery planning and ultimately halt the loss of both biodiversity and cultural knowledge. Including Traditional Ecological Knowledge in research can make it more relevant while helping to maintain and conserver language and culture.

Our findings suggest that the Mankarr's distribution is getting smaller; however, further monitoring is required to ascertain its current status. In particular, work is needed to investigate the impact of landform, fire and food resources on Mankarr habitation, and the differences in detectability between sandplain and salt-lake country.

Tracy Carboon talking with Parnngurr women Rangers. Image: Anja Skroblin

Cited material

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Further Information

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