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Ninety years of change on the TGB Osborn Vegetation Reserve, Koonamore: a unique research opportunity

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Abstract. The TGB Osborn Vegetation Reserve, on Koonamore station in the NE pastoral area of South Australia, is the longest-running vegetation monitoring project of its type in Australia. In 1925, a 4-km^2 rectangle in a heavily overgrazed area was fenced to exclude rabbits and sheep, and permanent quadrats and photo-points set up to record changes. The area is predominantly chenopod shrubland, with an open woodland tree layer. After the initial elimination of rabbits, control slackened and rabbit numbers increased until the 1970s, when intense elimination efforts resumed, together with the arrival of myxomatosis and rabbit haemorrhagic disease viruses. Consequently, the reserve has had 50 years without sheep, followed by 40 years virtually without either sheep or rabbits. Changes over that time have been very striking, and they have been recorded regularly via mapped quadrats and photopoints.

The objective of this paper is to highlight opportunities for making use of this database for researching several interesting ecological questions.

Additional keywords: grazing pressure, long-term monitoring, rabbits, sheep.

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Introduction

The Koonamore Vegetation Reserve (KVR), officially 'The TGB Osborn Vegetation Reserve, Koonamore' encompasses nearly 4 km^2 of vegetation that has not been grazed by stock for nine decades and has been effectively protected from rabbits for ~40 years. In 1925 the area was severely overgrazed, and was fenced to exclude permanently sheep and (hopefully) rabbits, to study the regeneration of natural vegetation after grazing was excluded. The Reserve, and its archived records, now presents a unique opportunity for study of questions requiring a very long time sequence of vegetation data.

The objective of this paper is to present some suggestions for future research.

Description of site

The Reserve is located in the centre of Koonamore Station, a pastoral lease grazed by sheep in north-east South Australia (Lat. 32.117°S, Long. 139.340°E) (Fig. 1) (http://location.sa.gov.au/viewer?map=hybrid&x=139.34008&y=-32.11583&z=14, accessed 19 February 2018). The average annual rainfall is 200 mm, but is variable, with minimum 52.5 mm (1902) and maximum 850.4 mm (1974) based on 100 years of records. The soils are a complex of low sand dunes alternating with sand plain and harder loam soils with travertine limestone on the intervening flats. Dominant vegetation is open woodland with chenopod shrubland understorey. Dunes carry *Acacia aneura* F.Muell. (mulga), *A. burkittii* F.Muell. and *Eremophila* spp., the sand plain a stand of *Casuarina pauper* F.Muell. (blackoak, belah), and harder soils carry a mixed community of *Myoporum platycarpum* R.Br. (false sandalwood) and *Alectryon oleifolius* Desf. (bullock bush, rosewood). Understorey shrubs include *Atriplex vesicaria* Benth. (bladder saltbush), *A. stipitata* Benth. and *Maireana sedifolia* F.Muell.(bluebush) with numerous other chenopod shrub species. Grass and ephemeral herb cover varies with the seasons. (Osborn 1925; Wood 1936; Osborn *et al*. 1932, 1935; Hall *et al*. 1964; Sinclair 2005).

Vegetation data

A series of permanent quadrats (100 × 100 m, 10 × 10 m and 1 × 1 m) and fixed photo-points record vegetation changes (Fig. 2). Many have been sampled regularly, some almost annually, up to the present. Initially, presence of plants only was mapped, but since 1978 both presence, height and canopy dimensions are recorded. Permanent transects inside and outside the reserve are read to record presence of *Atriplex* spp., and another to record kangaroo activity by dung counts. This monitoring continues annually.

The project has accumulated a database covering 90 years of changes in vegetation, with detailed information on the populations of key plant species (Table 1). Although the Reserve was originally rabbit-proof fenced, the rabbits were never completely eradicated. Effective rabbit control since the mid-1970s has led to a remarkable establishment of seedlings of several tree and shrub species previously showing little

Fig. 1. Aerial view of the reserve, 2009.

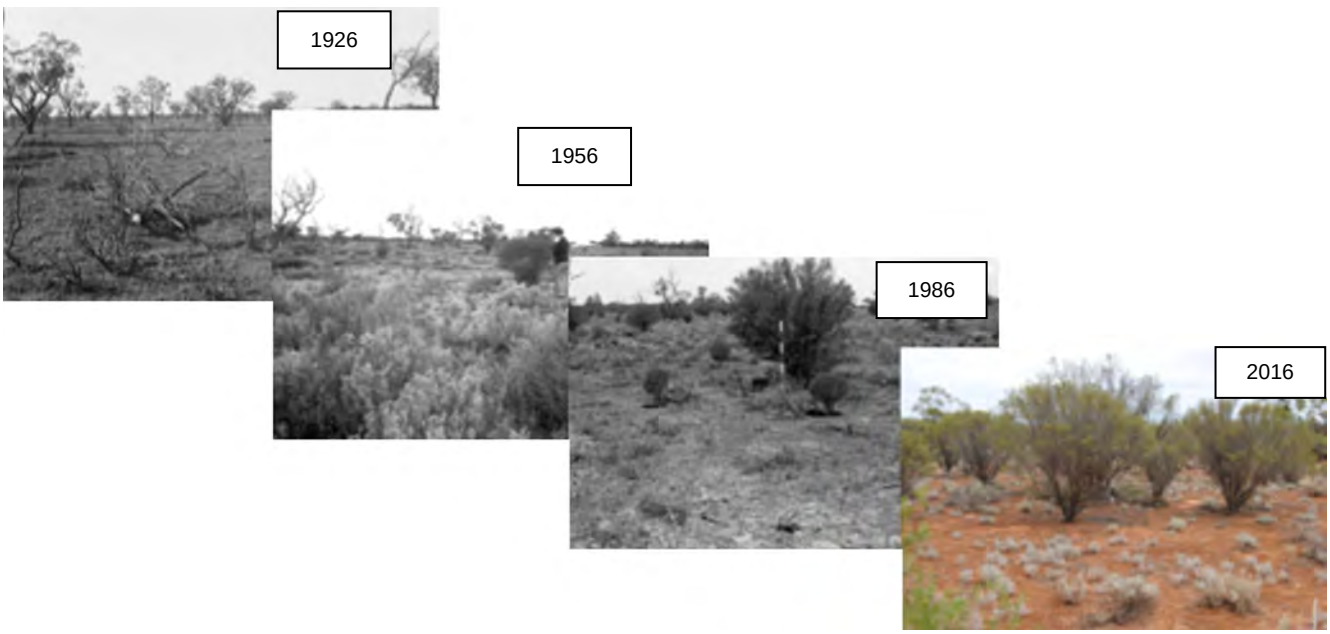

Fig. 2. Photopoint images from Quadrat 100 NE, at 30-year intervals, showing changes over 90 years.

Table 1. Summary of types of data available

Type	Period monitored	Comments
Quadrats		
Position of plants	1926–present	Trees and shrubs
Height of plants	1978–present	Trees and shrubs
Canopy dimensions	1978–present	Trees and shrubs
Photopoints	1926–present	Clearly distinguished plants identified; biomass of herbs can be estimated
Transects	1930–present	*Atriplex vesicaria*, *A. stipitata*, inside and outside reserve
Kangaroos	1968–present	Droppings counted along transect across reserve and outside
Rabbits	1977–present	Active warren entrances counted before fumigation
Birds		Irregular, surveys by visitors

regeneration. The Reserve records now contain a history of the vegetation over 50 years without sheep grazing, followed by over 40 years without significant grazing by either sheep or rabbits. Kangaroos and emus are not excluded from the Reserve, and their numbers vary with the seasons.

Research opportunities

For ecologists, the reserve has much to offer, both as a site for studies of the present conditions (e.g. comparisons of ecological patterns and processes inside and outside the reserve), and by using the long-term data from quadrats and photopoints. The accumulated database is available through AEKOS (http://www.aekos.org.au/, accessed 7 September 2018). This unique database and the KVR field research facilities are available for interested scientists. We welcome collaboration to explore in full the potential of the information available.

This database is particularly valuable now because it not only includes the process of recovery of the vegetation after some very intense grazing degradation, but also represents a period of time covering several climatic fluctuations (i.e. alternations of El Niño and La Niña events) not to mention initial stages of the climate change process driven by human emissions.

Some examples of possible projects:

1. Life-span of shrubs

Many individual plants on quadrats are mapped and recorded from germination to death. Such data are obtainable in no other way, and thus such a long record is rare and valuable.

2. Germination and seedling survival

Records of total plant numbers indicate several germination events, but detailed study of the database will allow measurement of survival of seedlings and effects of rainfall events following germination. Neighbourhood and density dependent effects on survival and growth can also be ascertained.

3. Microphytic crust

The microphytic crust has developed markedly over much of the Reserve in the absence of sheep trampling, and provides opportunities for studying its composition and ecological function. A series of photos taken vertically show its development. See also Rogers (1974).

4. Population genetics

The record of date of establishment can be used, together with modern molecular techniques, to study the genetic dynamics of plant populations recovering after severe decline due to grazing. This information would be relevant for restoration and conservation programs in arid lands.

5. Comparison of gaseous fluxes in and out of disturbed and undisturbed vegetation

A group from Flinders University has been monitoring changes in soil moisture and carbon dioxide fluxes into and out of soil inside the Reserve compared with adjacent grazed land. More could be done. Such work is relevant for assessing the carbon balance over the very extensive arid lands.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgements

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