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Are incentive programs working? Landowner attitudes to ecological restoration of agricultural landscapes

Sacha Jellinek [a,*], Kirsten M. Parris [a], Don A. Driscoll [b], Peter D. Dwyer [c]

[a] ARC Centre of Excellence for Environmental Decisions, The NERP Environmental Decisions Hub, School of Botany, University of Melbourne, Parkville, VIC 3010, Australia
[b] ARC Centre of Excellence for Environmental Decisions, The NERP Environmental Decisions Hub, The Fenner School of Environment and Society, Australian National University, Canberra, ACT 0200, Australia
[c] Department of Resource Management and Geography, School of Land and Environment, The University of Melbourne, Parkville, VIC 3010, Australia

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ABSTRACT

Private property accounts for much of the planet's arable land, and most of this has been cleared for agricultural production. Agricultural areas retain only fragments of their original vegetation and this has been detrimental to many native plant and animal species. Habitat restoration and revegetation may be able to reconnect and enlarge existing remnant areas in agricultural landscapes and, thereby, enhance native plant and animal communities. However, conservation initiatives will be successful only if landowners actively participate in restoration actions. This study used four hundred postal questionnaires to assess the degree to which landowners in two regions of south-eastern Australia adopt restoration activities, their opinions regarding remnant and revegetated land and their management actions in these areas. One hundred and seventy nine completed questionnaires were received. Three quarters of respondents had undertaken restoration on their property or were planning to revegetate in the future. Landcare members were most likely to have previously revegetated and future revegetation intentions were best predicted by previous restoration activities and a primary income source that was off-farm. Landowners were more likely to manage restored and remnant areas if they perceived threats such as weeds, pest animals and fire risk would be detrimental to their property, than to enhance environmental outcomes. These results indicate that landowners are interested in restoring natural areas, but without greater assistance to restore ground layers and manage perceived threats posed by fire and invasive plants and animals, restoration actions will not have their desired biodiversity benefits.

1. Introduction

Much of the Earth's land is privately owned and used for agricultural production (McDonald et al., 2007; Cox and Underwood, 2011). Many agricultural landscapes contain only fragments of the vegetation that was originally present and, thus, negatively influence native plant and animal species (Fahrig, 2003; Lindenmayer, 2009). In addition, remaining remnant vegetation is seldom representative of previous natural habitats because it is often on the least productive land and is distributed as isolated patches (Fischer and Lindenmayer, 2007; Wilson et al., 2007). Although valuable natural habitats do remain on private land in agricultural areas, it has been argued that the maintenance of biodiversity within these landscapes requires revegetation and restoration to reconnect and enlarge habitats and thereby enhance animal and plant movement and dispersal (Soulé et al., 2004; Carr and Hazell, 2006).

Revegetation and restoration of natural habitats on privately owned land must be initiated and driven by the landowners. A landowner's decision to take these steps will be influenced by personal, social, cultural, and economic drivers (Pannell et al., 2006) and by the practices and policies of natural resource management agencies. For landowners, drivers include personal experiences and the experiences of neighbours in undertaking conservation projects together with the capacity of the farm to remain productive and profitable (Pannell et al., 2006). Values, beliefs, and personal and social norms will also influence landowner decisions to undertake conservation initiatives (Ajzen, 1985; Stern et al., 1995).

It is necessary, therefore, to understand the attitudes landowners hold with regard to native vegetation because these will influence conservation incentives and on-ground action (Morse et al., 2009; Polasky et al., 2011). However, research concerning landowner attitudes towards remnant or restored land and their adoption of

* Corresponding author.
E-mail address: sacha.jellinek@gmail.com (S. Jellinek).

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revegetation practices has been limited (Smith, 2008; Morton et al., 2010). This information is needed if organisations are to provide guidelines and financial incentives for revegetation and, thereby, involve landowners who have not previously been interested in implementing conservation practices (Carr and Wilkinson, 2005; Carr and Hazell, 2006). Such information may also lead to a more strategic approach to revegetation through the involvement of groups of landowners (Twedt et al., 2010; Moon and Cocklin, 2011).

Our study investigated the degree to which landowners adopted revegetation activities and their opinions regarding the benefits, or otherwise, of remnant vegetation and revegetated land. We surveyed private landowners to determine (i) whether they had undertaken or were planning to undertake revegetation on their properties and to predict attitudes about future revegetation activities; (ii) the impediments and incentives to undertake future revegetation; and (iii) the attitudes landowners hold towards remnant and revegetated areas, and how their attitudes influence their intention to manage these areas for conservation.

2. Materials and methods

Landowners in the Wimmera and Benalla regions of south-eastern Australia were surveyed in October 2009 (Jellinek et al., 2013). These temperate regions have been used for intensive agriculture since the 1850's, resulting in natural vegetation being heavily cleared and fragmented (Radford et al., 2007). The Wimmera region is located in the Wimmera Catchment in western Victoria and is largely used for cropping and livestock production. The Benalla region is located in the Goulburn-Broken Catchment in north-eastern Victoria and is used mainly for livestock production and to a lesser degree cropping (Wimmera and Benalla Region.kml). Approximately 5% of the forests and grassy woodlands that were once present remain in patches on private land and along roadsides (Morcom and Westbrooke, 1998).

We used postal questionnaires to establish the adoption of revegetation works on private land, and landowners' attitudes to revegetated land and remnant vegetation. Two hundred landowner names and addresses from each of the two regions were obtained from the Country Fire Authority map-book series (1993–1997) (CFA, 1993). These names were cross-checked in the Whitepages telephone directory to ensure their current validity. Potential participants were included only if they lived on a property outside a major town. To encourage response reply-paid envelopes were enclosed with the survey questionnaires. Postal questionnaires were used because they create no "interviewer effect" (Bryman, 2004). However, the respondents to postal questionnaires are self-selecting, so people with positive attitudes to revegetation may have been more likely to complete the survey.

The questionnaire included three sections (Appendix 1): (1) general demographics; (2) attitudes, practices and preferences with regard to revegetation; and (3) management of and attitudes towards remnant vegetation. Questions were trialled with ten landowners and Landcare coordinators prior to questionnaires being mailed out. Landcare is a community-based natural resource management group that relies on voluntary participation (Yatich et al., 2007) and in Australia is responsible for many of the environmental works on private land (Curtis and De Lacy, 1998). At present Landcare is operating in 22 different countries (Landcare International, 2013).

2.1. Revegetation and remnant vegetation in agricultural areas

2.1.1. Survey questions

We asked respondents whether they had previously undertaken revegetation on their properties and whether they were planning to undertake revegetation in the future. Respondents were also surveyed about possible impediments and incentives for future revegetation.

2.1.2. Data analysis

To identify characteristics of landowners who had previously undertaken revegetation or who were planning to undertake revegetation in the future, we undertook two analyses using a logistic regression with a Bernoulli distribution in WinBUGS (Lunn et al., 2000) using a Bayesian framework (McCarthy, 2007). The Bayesian Bernoulli regression had uninformative priors for the intercept term and the regression coefficients. We used previous revegetation activities as a binary response variable; that is, the landowner had or had not revegetated part of their property. Demographic data were used as explanatory variables that were first analysed using a polychoric correlation analysis in R version 2.9.1 (R Development Core Team, 2009). Correlated variables ($r > 0.4$) were removed from future analysis. The uncorrelated explanatory variables were landowner age, region, enterprise type, primary source of income, property size, and Landcare membership. Responses relating to land ownership were removed as they were correlated with primary source of income. Region was pooled to take into account differences between respondents from the Wimmera and Benalla region, and because responses did not substantially differ between the two regions. To identify landowners who would most likely revegetate in the future, we used planned revegetation activity as the response variable, demographic data as explanatory variables plus a binary variable for previous revegetation activity. We selected the best-supported models using Deviance Information Criteria (DIC) values (Spiegelhalter et al., 2002).

2.2. Attitudes towards revegetated and remnant vegetation, and intention to manage these areas

2.2.1. Attitudes towards revegetated and remnant vegetation

We undertook two analyses to determine the attitudes of landowners to: (i) revegetation and (ii) remnant vegetation on their property. Responses to attitudinal questions were requested on a Likert scale (Bryman, 2004). To analyse this data we used principal components analysis (PCA) with a varimax rotation in SPSS (SPSS, 2009). Variable loading scores were used to categorise the attitudes landowners held to revegetated areas and remnant areas into different factors (Tabachnick and Fidell, 2007). We used Schultz's (2000) general value scale (egoistic, altruistic and biospheric) to classify the factors with eigenvalues >1 onto different motivational scales that reflected different conservation motivations.

2.2.2. Intention to manage revegetated and remnant areas

We also undertook two analyses to determine the likelihood that a landowner intended to manage (i) revegetated and (ii) remnant areas on their property as a function of their attitudes to these areas. Intention to manage was calculated by averaging the response to each management question to gain an intentions index out of five. These scores were then split at the mid-point (3) to give a strong (1–2) or weak (4–5) intention to manage revegetated and remnant areas for conservation purposes (Fielding et al., 2005).

To undertake these analyses we used a logistic regression with a Bernoulli distribution in WinBUGS. The binary responses for the intention to manage scores were response variables in this analysis. The explanatory variables were the attitudinal factor scores, derived from PCA analysis, which explained the greatest variation in the attitudinal matrix. For each of the revegetated and remnant area data-sets the attitudinal factor scores as well as region (Wimmera and Benalla) were added sequentially into WinBUGS. Region was fitted in this model to take into account differences