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Public preferences for controlling an invasive species in public and private spaces

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ABSTRACT

Discrete choice experiments have been used in this case study to assess community benefits for the control of red imported fire ants, an aggressive ant species that were introduced by accident in 2001 to Brisbane, Australia. This invasive species could have substantial impacts on agricultural production, biodiversity, ecosystem services, infrastructure and communities. Values for avoiding impacts on three particular land uses have been assessed in this study with discrete choice experiments. The results indicated that on a per hectare basis, the value estimates to avoid infestation in public areas (schools and parks), were much higher than for private areas (housing) or natural bushland areas (protected native vegetation). There were high levels of support for eradication rather than containment strategies, despite the additional costs involved. The use of both random parameters logit and latent class models demonstrates that there is a significant heterogeneity in preferences and values for controlling or eradicating the invasive species, indicating that it may be challenging to gain and maintain political support for management options, particularly if these involve large costs or inconvenience to households.

Introduction

Identifying and evaluating appropriate management responses to control invasive weeds and animal pests can be challenging for policy makers. Not only do they have to consider the different types of control programme to implement, and the associated likelihood of success, but they also face budgetary limitations and have to consider the relative costs and benefits of different management measures. Invasive species can have substantial impacts on land uses, through effects on agricultural production, biodiversity, ecosystem services, infrastructure and communities (Pimentel et al., 2005; Lovell et al., 2006). For example Pimentel et al. (2005) estimated that invasive species in the United States cost over US$138 billion per year in damages and control, while McLeod (2004) reported that the impact of invasive animals in Australia generates costs of more than AU$700 million annually.

Control efforts can be categorised into three broad strategies: prevention, eradication and containment (Born et al., 2005). Prevention efforts such as quarantine protocols are aimed at preventing the entry and establishment of a new and potentially invasive species. Once an unwanted species has entered the country the initial control effort is likely to be focused on eradication measures, and if this fails then control measures are aimed at containing the spread of the species. In all three cases, increasing investment in the particular strategy will increase the likelihood of success. The justification for each of these measures against doing nothing, and the distribution of effort between measures should be assessed by comparing the potential costs of the control against the benefits that may be generated, such as through the application of cost benefit analysis (Born et al., 2005; Burnett et al., 2008). For example, if the containment strategy also proves unsuccessful and the damage caused by the unwanted species is not too great (benefits of control are low), it might not be cost effective to implement further control efforts.

While there has been some attention paid to identifying the costs of invasive species (e.g. McLeod, 2004; Pimentel et al., 2005; Lovell et al., 2006), little information is available about the values of benefits associated with avoiding or controlling weeds or animal pests. Assessing these benefits is challenging because most involve direct use, indirect use and non-use components, especially those involving reduced impacts on human health and the protection of environmental assets and ecological processes (Born et al., 2005; Lovell et al., 2006). Some studies (e.g. Sinden and Griffith, 2007) have used treatment costs, replacement costs or defensive expenditures as proxies for values, but these are unlikely to represent underlying community preferences for control, particularly where large non-use values are involved (Shogren et al., 2006).

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Most efforts to value the benefits of controlling invasive species have focused on the extractive direct-use values, such as those associated with agricultural losses (Pimentel et al., 2005; Lovell et al., 2006; Olson, 2006). There have also been some studies estimating non-extractive use values for recreation that are affected by invasive species (e.g. Lovell et al., 2006). While direct and indirect use values are important for some types of invasive species, they rarely represent the total economic value, and may not be very relevant for other invasive species, for example, those that impact on biodiversity. A more comprehensive approach to valuing benefits of controlling invasive species requires stated preference techniques such as the contingent valuation method or discrete choice experiments to capture the non-use components together with use and indirect use values.

There has been limited application of stated preference techniques to issues involving invasive species (Born et al., 2005; Lovell et al., 2006). Although the number of studies has increased in recent years, the focus has concentrated on invasive plant species, particularly in aquatic environments. Turpie et al. (2003) report estimates for the loss of existence values in the Cape Floristic Region in South Africa from invasive plant species using the contingent valuation method, while Adams et al. (2011) used discrete choice experiments to estimate public preferences to reduce the impact of invasive plant species in State parks in Florida in the United States of America (USA). Nunes and Van Den Bergh (2004) report the use of a joint travel cost study (to estimate recreation benefits) and a contingent valuation study (to estimate non-use benefits) associated with the removal of harmful algal-bloom species along the coast of The Netherlands.

Other studies have used discrete choice experiments to estimate the benefits from controlling algal blooms in Lake Tenkiller, Oklahoma (Roberts et al., 2008); the Black Sea Coast of Bulgaria (Taylor and Longo, 2010), and in a region of the South Island in New Zealand (Beville et al., 2012). Both Horsch and Lewis (2009) and Zhang and Boyle (2010) have used hedonic pricing models to estimate the impact of a common aquatic invasive species (milfoil) on lakefront property values in Wisconsin and Vermont, respectively. Provencher et al. (2012) also focused on the problem of milfoil in northern USA and Canada. They applied the contingent valuation method to estimate the impacts of a lake invasion in terms of property welfare losses and specifically incorporated respondents' subjective opinions about outcome uncertainty and the potential effectiveness of a control programme. Champ et al. (2005) applied contingent valuation to assess the benefits of a weed control programme in the USA, while Carlsson and Kataria (2008) used discrete choice experiments to assess the benefits from weed-control programmes in both Sweden and the USA. Other studies have transferred benefit estimates from recreation, property, health or environmental valuation studies to infer the benefits of controlling an invasive aquatic pest species (Lovell et al., 2006).

The focus of this paper is on valuing the non-market benefits of controlling an invasive insect pest species using discrete choice experiments. The case study of interest involved red imported fire ants in Brisbane, Australia, where there was potential for impacts on different land uses, including private residential areas, public use areas and bushland. The choice experiments were framed to address the need for marginal benefit value estimates to align with the cost parameters of other spread and bio-economic models. The relative benefits associated with eradication or containment control measures were also assessed. The paper is structured as follows: In the next section a description of the case study and methodological application of the experiment is provided. Experiment results are described in section three, followed by discussion and conclusions in the final section.

The case study: red imported fire ants in Brisbane, Queensland

Red imported fire ants are an aggressive ant species that are native to South America and are viewed as a major risk to Australia for several reasons. They have detrimental impacts on human health, human lifestyle patterns, livestock and wildlife through their aggressive stings, and may also have impacts on crops by feeding on sap, and on electrical equipment and infrastructure through nest building (Jetter et al., 2002; Morrison et al., 2004). The species now inhabits large areas in the southern United States, where it causes extensive damage, mostly through impacts on residential households (Scanlan and Vanderwoude, 2006). There is potential for the species to colonise large areas of non-arid Australia if it is not controlled (Morrison et al., 2004; Scanlan and Vanderwoude, 2006).

Red imported fire ants were introduced by accident to Australia, with infestations found in the port areas and south-western suburbs of Brisbane in February 2001 (Moloney and Vanderwoude, 2002). Follow-up surveillance identified scattered infestations in more than 300 km^2 of the region (Scanlan and Vanderwoude, 2006). Modelling suggested that the pest could invade half of Australia within 35 years if it was not controlled (Kompas and Che, 2001; Scanlan and Vanderwoude, 2006). The Queensland Government has led a vigorous eradication policy funded by the Australian and Queensland governments to identify and control outbreaks, including regular inspections and control efforts, and restrictions over the movement of soil and garden waste in areas at risk (Fig. 1). While control efforts are reducing the rate of new discoveries, the pest had still not been eradicated in 2009, when the valuation survey was conducted, or at the time of writing in 2013.

Ongoing control of the red imported fire ants has involved large and continuing investments of public funds, but no information about benefit values is currently available to assess the efficiency of that funding. In the case study reported in this paper, discrete choice experiments have been applied to assess these values. While discrete choice experiments have been widely used to assess public values for environmental protection (e.g. Bennett and Blamey, 2001), there has been very limited application of these and other non-market valuation techniques to invasive species issues to date, so many practical issues about how tradeoffs are framed and the behavioural responses that are triggered remain to be tested.

There were several advantages in using red imported fire ants as a case study for estimating values for controlling invasive species. First, the benefits of controlling red imported fire ants are largely non-market benefits in terms of avoiding health impacts, maintaining lifestyle and amenity values, and avoiding environmental impacts (Moloney and Vanderwoude, 2002). This made it more suitable for assessment with a stated preference technique compared to other pest incursions where the costs may largely relate to agricultural production losses. Second, it represented an ongoing pest incursion, where public and private effort continued to be invested. This meant there was a rationale for the study to be done, helping to frame it as an important issue for respondents to consider in an ex-ante setting. Third, there was high levels of awareness and knowledge of the pest in the case study area, with few other competing pest issues in the region, making it easier to present different control options to households.

Application of discrete choice experiments to the case study setting involved identifying the frame of the tradeoffs to be offered, the key attributes, levels and labels that were used to define the tradeoffs, and the way in which the payment vehicle was used to define the opportunity costs involved. To ensure that value estimates would be useful for policy analysis, the frame of the survey matched closely with the infestation and spread scenarios reported in Kompas and Che (2001), Scanlan and Vanderwoude (2006) and