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Abstract

Optimal invasive species control depends on the nature of the removal cost function. Obtaining reliable estimates of removal costs, however, is challenging because the effectiveness of invasive species control is often unobserved. As a result, there are few, if any, estimates of invasive species removal costs in the literature. To address this challenge, we couple a spatial population dynamics model with standard econometric methods and estimate a removal cost function when control effectiveness is unobserved. Our cost estimates are based on unique panel data from 2004-2011 for 122 sites in the Invasive *Spartina* Project, a control program in the California San Francisco Bay Area. Contrary to common assumptions on removal costs in the invasive species literature, we find that removal costs are linear in removal suggesting that a bang-bang type of control is optimal, which is largely consistent with the Invasive *Spartina* Project's policy of rapid eradication.

Keywords: Invasive species, control cost, bioeconomics, spatial dynamics

Invasive species are a leading cause of global ecological change, a threat to biodiversity, and can have significant negative impacts on economic welfare (Mack et al., 2000; Pimentel et al., 2005; Olson, 2006). Estimates of total monetized damages and control costs generated by invasive species, based on existing data, exceed $100 billion per year (Pimentel et al., 2005). However, because data on damages and control costs do not exist for many invasive species, the true societal costs are likely several times higher than recent estimates (Pimentel et al., 2005; Bradshaw et al., 2016). Furthermore, there is even less information regarding how the realized societal costs from invasive species compare to the optimal level of control costs and damages. As noted by Olson (2006) and Epanchin-Niell and Hastings (2010), there is a general lack of data and empirical methods needed to estimate the damage and control costs functions, which define the efficient level of invasive species control.

The economics literature on invasive species management is generally divided into: assessments on the optimal prevention of potential invaders (e.g. Keller et al., 2007; McAusland and Costello, 2004; Mérel and Carter, 2008); and the optimal control of extant invaders (e.g. Eiswerth and Johnson, 2002; Olson and Roy, 2002; Epanchin-Niell and Wilen, 2012).[1] In the optimal prevention literature the social planner selects a policy (e.g. trade tariffs or import inspections) to maximize the present value of expected welfare over time, which is comprised of welfare in the invaded and uninvaded states of the world. The optimal control of extant invasive species is equivalent to minimizing the net present value of damages and control costs over

[1]However, some analyses optimize over both prevention and control (e.g. Finnoff et al., 2007; Olson and Roy, 2005; Heikkilä and Peltola, 2004) and some explore the optimal detection of existing invaders (see Mehta et al., 2007).