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When is a “wait and see” approach to invasive species justified?



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ABSTRACT

Predictions of damages and damages that might be avoided from invasive species control policies are marred by uncertainty that has both economic and ecological roots. Public policies directed at invasive species typically lag their detection. One possible explanation is the coupling of uncertainty with political and economic commitments creates an incentive to delay a policy response in order to gain more information on how damaging the invasion will be – a “wait and see” approach. We investigate whether this rationale is justified by identifying invasion characteristics that require the wait and see approach often adopted by lawmakers and government agencies. The model shows that the source of uncertainty and degree of policy irreversibility matter and allows the classification of invasive species with a low rate of spread and low levels of uncertainty as those where policies can be optimally timed in the future.

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1. Introduction

Invasive species are increasing worldwide and are a leading cause of global environmental change (see, e.g., Lodge, 2001; Mack et al., 2000; Vitousek et al., 1996). They pose threats to agricultural

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production (Archer and Shogren, 1996; Feder and Regev, 1975; Lichtenberg and Zilberman, 1986) and can cause damage that extends across landscapes, ecosystems, and economic activities (Bossenbroek et al., 2007; Leung et al., 2002). Since invasive species control is a weak-link public good (Perrings et al., 2002), publicly funded sources of control play a key role. In many observed examples, the policies which fund these public sources of control were delayed. A common justification for this delayed response is based on high levels of uncertainty that surround the expected damages from invasive species and damages that might be avoided with investments of public funds. The real options literature (Dixit and Pindyck, 1994) has made clear that a “wait and see” approach in these investments of public funds may be needed so that society might collect more information on the flow of invasive species damage.

Here we differentiate between continuous control actions and the policies that fund those actions to ask a fundamental question: can a “wait and see” approach to invasive species be justified and if so under what circumstances? Using temporal spread data for a number of well-known invasions, we find that most invasions are spreading too fast and unpredictably to do anything other than immediately respond. For those species where a “wait and see” approach is preferred, they are spreading slowly enough that the optimality of a policy response is in question. However, the optimality of this “wait and see” approach quickly fades as the invasion progresses and depends on the ability to cancel the policy in the future.

The motivation for our policy analysis follows many observed examples of invasive species policy being delayed to gain more information (Simberloff, 2003). When the tropical alga *Caulerpa taxifolia* was first observed in Monaco in 1984, it was restricted to a few square meters. However, public efforts to remove it were delayed for years and the alga now infests several thousand hectares. Policies were delayed as the French marine institute charged with its control argued that more study was needed to determine if *Caulerpa* was going to be a problem. In another example, the South American plant *Lycianthes asarifolia* was found on a few Houston lawns in 1997. By 2003, the plant could be found in yards all over Houston and had spread to New Orleans. During this time, the U.S. Department of Agriculture’s Animal and Plant Health Inspection Service and the state of Texas did nothing to control the invasion citing a lack of definitive knowledge. In both cases, individual citizens and local organizations were engaged in control, while large scale state and federal public policies were delayed.¹

While uncertainty over the impact of invasion is cited as a justification for delay, the uncertainty alone would only change the magnitude of a continuous control decision (D’Evelyn et al., 2008; Horan et al., 2002) but could not explain the delayed response. A potential justification for the “wait and see” approach by state and federal agencies is the coupling of uncertainty and irreversible invasive species policy decisions (Marten and Moore, 2011; Saphores and Shogren, 2005).² Unlike individual or local control, state and federal level invasive species control involves the implementation of broad-scale policies characterized by significant sunk costs or economic commitments which are typically difficult to adjust over time.³ Since invasive species damage estimates are highly uncertain, these commitments may turn out to be undesirable as more information on the invasion is revealed over

¹ In an additional example, Michigan, Wisconsin, Ohio, Minnesota and Pennsylvania filed a federal lawsuit in 2010 seeking to shut down navigational locks near Chicago to prevent the movement of invasive Asian carp from the Mississippi River watershed to the Great Lakes. Illinois lawmakers have opposed this plan citing a need to “better understand the costs and benefits” (Runk, 2010).

² Much of the economic literature has focused on control actions such as pesticide/herbicide application or biomass removal which can be continuously adjusted (Burnett et al., 2007b; Eiswerth and van Kooten, 2002; Horan et al., 2002; Olson and Roy, 2002; Wilen, 2007). While arguments for a delayed response have been suggested on the basis of economies of scale (Olson and Roy, 2008) and the presence of search costs (Burnett et al., 2007a), this work on the continuous adjustment of control actions has generally shown immediate action following detection is preferred and it is typically optimal to be more aggressive with control actions early in the invasion process when the cost of such actions is relatively low. These findings run counter to our broader scale policy analysis.

³ In effect, some policies may be more difficult to repeal than to enact. An example is the building of an electric barrier in the Chicago Ship and Sanitary Canal to prevent invasive fish species from reaching the Great Lakes. Another example is the US Fish and Wildlife Service’s “blacklist” of prohibited animal species considered harmful to natural systems. Updating this list has proved difficult (Simberloff, 2006) with few examples of delisting (Fowler et al., 2007). In a more general sense, a panel discussion moderated by Robert Stavins at the 2012 ASSA meeting in Chicago, reinforced the idea of irreversibility in environmental policy noting that it is hard to kill a policy that fails a cost-benefit analysis once it is in place.

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