Ecological Economics 127 (2016) 173–184

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Evading invasives: How Eurasian watermilfoil affects the development of lake properties

James S. Goodenberger [1], H. Allen Klaiber *

The Ohio State University, 333 Agricultural Administration Building, 2120 Fyffe Road, Columbus, OH 43210, United States

ARTICLE INFO

Article history:
Received 9 March 2015
Received in revised form 9 December 2015
Accepted 18 February 2016
Available online 27 April 2016

JEL classification:
Q57

Keywords:
Invasive species
Housing supply
Hazard model
Milfoil
Lakes

ABSTRACT

Eurasian watermilfoil is an aquatic invasive plant that has spread rapidly through freshwater lakes across the United States. Along with being a hazard to local ecosystems, milfoil is a nuisance to those who use lakes for recreation, and its presence has been shown to lower lakefront property values. This study presents the first evidence of the effects of Eurasian watermilfoil on the probability that undeveloped properties near lakes are developed into single-family housing units. Using a comprehensive dataset from the Twin Cities, Minnesota region, a duration model of land conversion is estimated using data on new home construction from 1990 through 2005. We find that undeveloped parcels of land on and near lakes invaded by Eurasian watermilfoil are less likely to be developed than their counterparts on non-invaded lakes. In counterfactual simulations, we show that absent spread after 1990, total development would increase in 112 of the region's 650 census tracts by an average of 19 houses per tract.

1. Introduction

For more than a century, biologists and ecologists have studied invasive species and the ecosystem modifications that stem from their presence. Whether these modifications are driven by invasive species themselves (Clavero and García-Berthou, 2005) or by exogenous factors which make an ecosystem more vulnerable to an invasion (i.e. habitat destruction (MacDougall and Turkington, 2005), introduction of invasive species often results in an environment of lesser quality than that which existed prior to the introduction. There exists a large body of economic literature that finds individual decision makers responding to changes in their environment in order to avoid, or mitigate, economic losses and improve well being. Therefore, it is likely that the introduction of an invasive species will result in substantial changes in economic behavior.

The economic losses resulting from invasive species' presence in the United States are large. In a study estimating these losses, Pimentel et al. (2005) identified over 50,000 invasive species in the United States, and reported damages totaling $120 billion dollars per year. This number looms even larger when compared with the seemingly trivial $459 million and $556 million spent in 1999 and 2000 by the federal government on invasive species prevention (Lovell and Stone, 2005)[2]. With large damages and government spending on the rise, economists have begun to investigate the effects of optimal control strategies, policy measures, and management practices on limiting the spread of invasive species (Epanchin-Niell and Wilen, 2012; Timar and Phaneuf, 2009; MacPherson et al., 2006).

While land-dwelling invasive species cause significant damage, some of the most infamous invaders are their underwater counterparts. Zebra mussels, Silver Asian carp, and Eurasian watermilfoil have plagued freshwater lakes and rivers for decades and are a major concern for policy makers, especially for those in states where tourism industries rely heavily upon their lakes and rivers. Each species has unique characteristics that affect the environment and economic behavior in different ways. It is this interspecies heterogeneity that makes empirical studies on specific invasive species important as an aid to policymakers. As researchers continue to examine ways to manage invasive species and their associated economic losses in generalized settings, it is important to provide accurate information on the scope and scale of losses as well as the impacts on economic behavior associated with individual species for use in policy decisions.

* Corresponding author. Tel.: +1 614 247 4914.
E-mail addresses: goodenberger.1@osu.edu (J.S. Goodenberger), klaiber.16@osu.edu (H.A. Klaiber).

[1] Goodenberger is a graduate research assistant at The Ohio State University and Klaiber is associate professor in the Dept. of Agricultural, Environmental, and Development Economics at The Ohio State University.

[2] Recently, several states have begun to recognize that invasive species are a serious threat to their natural resources and tourism sectors. This has led some to calls for substantial increases in invasive species prevention spending (Lynch, 2014).

http://dx.doi.org/10.1016/j.ecolecon.2016.02.015
0921-8009/

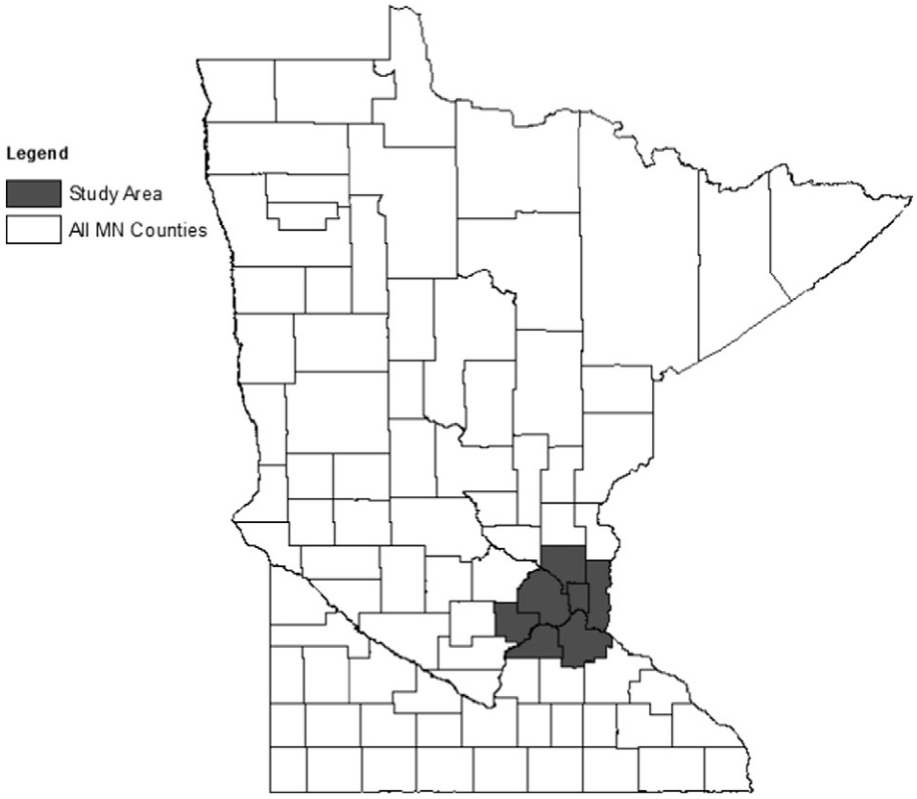

Fig. 1. Seven county study region in Minnesota.

The existing economics literature has surprisingly little to offer with regard to empirical evidence of changes in human behavior driven not by invasive species policy, but rather by the presence of an invasive itself. Since invasive species often cause significant environmental change, it is likely that their presence alters how humans interact with their environment; potentially causing unintended effects on ecosystems through altered behavior. Understanding both the behavioral response of individuals to the presence of invasive species and the larger potential spillover impacts from this behavior is vital for the future development of invasive species policies aimed at reducing potential negative impacts from invasive species.

In this study we provide the first evidence of altered behavior as it impacts the supply side of new housing construction by focusing on the introduction of Eurasian watermilfoil into freshwater lakes. Eurasian watermilfoil is an aquatic invasive plant native to Europe, Asia, and northern Africa. Though the exact date of arrival to North America is unknown, the plant was reported in several states by 1950 (Smith and Barko, 1990). As of 2003, Eurasian watermilfoil was present in nearly every state.

Table 1
Lakes invaded by year.

Year	Full dataset			Estimation dataset		
	Frequency	Percent	Cumulative	Frequency	Percent	Cumulative
Pre-1990	21	21.9%	21.9%	20	21.7%	21.7%
1990	8	8.3%	30.2%	8	8.7%	30.4%
1991	9	9.4%	39.6%	9	9.8%	40.2%
1992	7	7.3%	46.9%	7	7.6%	47.8%
1993	1	1.0%	47.9%	1	1.1%	48.9%
1994	1	1.0%	49.0%	1	1.1%	50.0%
1995	7	7.3%	56.3%	7	7.6%	57.6%
1996	4	4.2%	60.4%	4	4.3%	62.0%
1997	2	2.1%	62.5%	2	2.2%	64.1%
1998	5	5.2%	67.7%	5	5.4%	69.6%
1999	1	1.0%	68.8%	1	1.1%	70.7%
2000	8	8.3%	77.1%	8	8.7%	79.3%
2001	6	6.3%	83.3%	4	4.3%	83.7%
2002	2	2.1%	85.4%	2	2.2%	85.9%
2003	5	5.2%	90.6%	5	5.4%	91.3%
2004	3	3.1%	93.8%	3	3.3%	94.6%
2005	6	6.3%	100.0%	5	5.4%	100.0%
Total	96	100%		92	100%	

The growth and propagation characteristics that make Eurasian watermilfoil such an extreme nuisance also help to explain the invasion spread patterns we observe. Growing up from the bottom of a lake, the plant branches out after reaching the surface, forming a thick canopy of leaves and vines known as a milfoil bed. This canopy is a deterrent to those who recreate, since the vines tangle in boat motors and cling to swimmers.[3] The canopy also changes the ecology of the lake, decreasing native plants beneath the milfoil bed (Madsen et al., 1991) as well as providing hiding places for invertebrates and small fish, thereby changing predation pattern. Eliminating milfoil is nearly impossible given its remarkable reproductive characteristics. Milfoil has the ability to reproduce from stem fragments, so pulling the plants out or mowing them down only serves to further the milfoil's spread (Smith and Barko, 1990). As a result, a primary spread mechanism for milfoil is attachment to boat propellers, explaining the high incidence of milfoil in lakes with public water access and larger size.

Lakefront homeowners and those recreating in nearby lakes are also affected by the presence of milfoil. Along with depleted utility from lake recreation, homeowners on invaded lakes face reduced property values, as several hedonic studies have shown. For one such study done in New Hampshire, Halstead and Michaud (2003) used a dummy variable to identify lakes invaded by milfoil as well as an interaction term between the size of the lake and the presence of milfoil. Using ordinary least squares estimation, the authors conclude that the presence of milfoil led to decreased lakefront property values of 20%–40%.

[3] Eurasian watermilfoil has even been known to be a drowning hazard.