A CRITIQUE ON THE CURRENT STANDARDS FOR EVALUATING COSTS FOR INVASIVE SPECIES IN ECONOMIC LITERATURE

by

Michael Hensley

B.A., Eastern Illinois University 2010

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science

Department of Economics
In the Graduate School
Southern Illinois University Carbondale
May, 2012

RESEARCH APPROVAL

A CRITIQUE ON THE CURRENT STANDARDS FOR EVALUATING COSTS FOR INVASIVE SPECIES IN ECONOMIC LITERATURE

By

Michael Paul Hensley

A Research Paper Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Master of Science

in the field of Economics

Approved by:

Research Chair

Basharat Pitafi

Graduate School
Southern Illinois University Carbondale
April 12, 2001

Copyright by Michael P. Hensley, 2012
All Rights Reserved

ACKNOWLEDGMENTS

I would like to acknowledge the help of Professor Basharat Pitafi for his role in helping prepare me to be a better researcher, and instructor. As his research assistant I learned about the difficulties that can occur when you are searching for data. As his teaching assistant, I encountered, and overcame some of the pitfalls that occur during a student/professor relationship through his guidance. Professor Pitafi also assisted in helping me broaden my knowledge of environmental economics, which I am very grateful.

I would like to acknowledge the help of Cindy Boyer, of who without her help and guidance I wouldn’t be the person I am today.

I am also grateful for the love and support of my mother, grandparents, and twin brother.

TABLE OF CONTENTS

CHAPTER PAGE

ACKNOWLEDGMENTS i

CHAPTERS

1 Introduction 1

2 Literature Review 3

3 Short Comings of the Literature on Invasive Species 7

4 Conclusion 9

REFERENCES 10

VITA 12

1. INTRODUCTION

It is becoming more apparent as time goes by that humanity is having a greater and greater impact on the environment directly through pollution, trade, and over-fishing, and indirectly through the side effects of expanding cities, carbon dioxide emissions, and trade.

One of the effects of human economic activity is the transport of native species from one ecosystem to another. In the new environment the species become classified as an invasive species. A more precise definition is given by the Office of Technology Assessment (OTA) as follows:

"An 'invasive species' is a species that is "1) non-native to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health" (OTA, 1993).

Invasive species are usually able to flourish in their new habitat. The reason is that the new one lacks any predators to enact upon their predation. Although most invasive species fail to make any impact in their new environment, there is a small chance that their success will have a huge economic impact on the region's biodiversity, economy, and future land use (Keller, Lodge, and Finnoff, 2006). Even though the chance for large damage is mitigated, policy makers must make decisions on whether or how an invasive threat should be controlled. This is where policy makers should turn to environmental economists, because environmental economists may suggest efficient strategies to deal with the invaders.

From an economic viewpoint it is rational to take an action which results in a marginal benefit greater than or equal to the marginal cost. For example, Burnett, Kaiser, Pitafi, and Roumasset (2006) determined that they had to weight the economic costs and benefits of three different policies: 1) continue the status quo program of spending $1 million per year ad infinitum 2) increase the spending to $2 million per year ad infinitum 3) the optimal choice of spending $6.27 million dollars initially, and have a lower upkeep costs of $.5 million per year ad infinitum.

A number of studies have examined the possible costs and benefits when dealing with an invasive species. However, some of the studies do not consider the measurement of costs and benefits of an invasive species when trying to estimate their effect on the environment, focusing on biological aspects instead of economic impacts. Moreover, the methodology of the studies is not always clear regarding how their cost measures are derived. Also, a variety of cost/damage measurement methods are used in different studies. There appears to be a lack of systematic or standard framework. This paper attempts to introduce some insights to the literature of invasive species that would help establish a methodology for future researchers to use when dealing with costs associated with invasive species.

The paper proceeds as follows: Section 2 reviews the literature. Section 3 discusses the short comings of other studies regarding evaluation of costs and benefits of invasive species. Section 4 presents the conclusion of the paper.

2. LITERATURE REVIEW

Jeff McNeely (2001) offers three common pathways for invasive species to enter a new environment: a) they are accidentally introduced (example a sea lamprey is transported inside a tanks water ballast), b) species are introduced for a limited purpose (boa constrictors as pets in Florida), or c) intentionally introduced (to combat a different invasive species). Whatever the reason, the species will have the potential to have a positive and/or negative net effect on the environment. McNeely (2001) points out three species that benefitted the economy where they became invasive. The three species are: I) Brush-tailed possums from Australia found a better living environment in New Zealand than their native homeland, which fur traders were able to use to their advantage; II) woody plants were introduced into South Africa, and created a booming charcoal, and firewood industry; III) the Water hyacinth Eichhomia crassipes was introduced into China to help feed the livestock, as well as to absorb heavy metals.

There are three lines of research that have provided influential reviews of the costs of invasive species. The first is the assessment offered by the OTA in 1993. This project covers every aspect of invasive species cost estimation, and control. It covers all invasive species for the United States, as well as pertinent research pertaining to other countries.

The second most influential literature review is a paper offered by David Pimentel, Tori Lach, Rodolfo Zuniga, and Doug Morrison titled “Environmental and Economic Costs of Nonindigenous Species in the United States” (2000) Which is followed by a series of related papers (Pimentel, McNair, Janecka, Wightman, Simmonds, O’Connell, Wong, Russel, Zern, Aquino, and Tsomondo 2000; Pimentel,

Zuniga, and Morrison 2004). They discuss recent calculations for measuring costs of invasive species, divided up by categories. Generally the numbers are consistent from iteration to iteration.

The third influential work is by Sabrina Lovell, and Susan Stone (2005). This paper is different from the Pimentel iterations in two ways: First, it reviews both theoretical, and empirical literature. Second, it is focused on the impacts of aquatic invasive species. However, it does mention non-aquatic literature if their methods are pertinent.

It is widely known that invasive species dominate native species through predation, or through competition of resources. John Loomis and Douglas White (1996) offer way of calculating the costs or benefit of a native species. Their article concentrates on the benefits of rare and endangered species. However, I believe that his methodology can be applied for species that are not endangered. They suggest that the benefits can be grouped together in terms of "(a) use value such as viewing of the species; (b) an option value to maintain genetic information provided by population of T&E species that may be useful for medicinal and genetic engineering applications…(c) existence value derived from the satisfaction of knowing that a particular species has a sustainable population in its natural habitat; (d) bequest value the current generation receives from knowing preservation today provides this species to future generations" (Loomis, and White 1996). The other main benefit from their paper is that they bring together many different surveys to compute an average person's willingness to pay (WTP) to protect an engendered species by type. The high and low values of the surveys are presented, as well as averages for the same species.

Some of the most bio-diverse places in the world are located in politically and economically developing regions. It is difficult for poor countries to pay the high costs of programs that deal with invasive species. Either the direct cost of the program is larger than what they are willing to pay, or the opportunity costs associated with creating a monoculture based cash crap is too high. David Simpson (1999) offers different incentive mechanisms for a country to maintain a natural environment, and implicitly control for invasive species. He offers three methods. The methods are: 1) bioprospecting or “finding compounds in animals and plants that might lead to new improved drugs and commercial products”, 2) non-timber forest products or “commercial products that can be harvested without destroying the forest”, and 3) Ecotourism or the “preservation of natural sites to attract travelers”. With these methods we can monetize the value of biodiversity in regions that may help calculate the costs of a species.

Leung, Lodge, Finnoff, Shogren, Lewis, and Lamberti (2002) offer a theoretical framework for a hypothetical lake with a power plant. They use empirical data in their model to determine the optimal amount of control costs that should be used to fight a Zebra Mussels attack in a hypothetical lake, and compare it to a scenario where the attack does not occur. Their findings suggest that the U.S. government is under-spending when it comes to fighting this invasive threat.

Edward A. Evans (2003) suggests that there are six major impacts of invasive species.

1. Production Impacts: The direct effect of the invasive species on production through the loss or reduction in efficiency.
2. Price and Market Impacts: The introduction of an invasive species can

radically change the demand and supply of a commodity.

3. Trade Impacts: This could be through the closing of borders to trade to inhibit the spread of the invasive species.
4. Food Security and Nutrition Impacts: A major concern for overpopulated developing nations is that their food supplies are not adequate. The introduction of an invasive species could wreak tremendous damage on a country's ability to feed itself.
5. Financial Costs Impacts: This would be the costs associated with the control, eradication and prevention and the expected lost in productivity in the enterprise.
6. Human Health and the Environmental Impacts: This would be the effects of invasive food-borne diseases.

3. SHORT COMINGS OF THE LITERATURE ON INVASIVE SPECIES

The rest of the paper will be set up to point out the shortcomings of the literature of invasive species. The critique will be divided up into two areas: cost estimates, and some shortcomings in the solutions.

Every year budget analysts try to determine the best use of a tax payer's money to produce the maximum amount of welfare. They must decide not only between the programs that will receive funding, but also the amount of funding. Environmental economists face the responsibility of estimating the costs of damage, as well as the optimal amount to be spent given the current political climate. An optimal solution may not be politically feasible.

My first critique of the literature is that the methodology that researchers use to determine the cost of an invasive species is not consistent across the various surveys. The effect of this is that surveys are not directly comparable from article to article. The methodology of Burnett et al. (2006) in determining an optimal spending plan to fight the Miconia, and brown tree snake invasion is significantly different from the methodology of Pimentel et al (2000) in calculating the costs for various species

The second major flaw regarding cost estimates is that researchers are not always open with how they come up with the figures being calculated. Burnett et al. do not make it clear how they determined that an endangered species of bird to be worth $31 per year per household. The researchers only refer to cited literature done by Vice in 2005. However, looking at the referenced source leads us to find that the data were gathered from personal communication; making it difficult for the reader to verify the source of their information. The study of Pimentel also has limitations: either the

methodology behind cost estimation is not clear, or the data are collected through personal communications, which may not be reliable, or from unpublished sources. Loomis and White (1996) mention that “Of the 20 studies, about half are not available in the published literature since they are contract reports, proceedings papers and dissertations”.

Researchers must also be aware that species offer certain benefits to their new environment, and these benefits should be considered in calculating impacts of invasive species.

It is common knowledge that word space in any academic journal is at a premium. We cannot include every piece of detail about our research, or it would be simply too long to fit. However, researchers must not only cite the figures used in their research, but the methodology used to calculate those figures. It would be important for someone reading an article that uses a WTP measures offered by White, and Loomis (1996) to determine if the people in the affected region, are similar to those that completed the WTP surveys.

4. CONCLUSION

As I stated before, researchers need to determine a clear, open, and consistent means for measuring the costs of invasive species to make a better cost-benefit analysis. . My suggestion is that researchers should use six areas described by Edward Evans’ (2003) as the foundation for their cost benefit analysis of invasive species.

However, I would acknowledge that the model of Evans (2003) is not always pertinent to every situation. The first major flaw is that it is very difficult to determine the costs associated with some of his categories, or the descriptions of the various areas

seem to overlap in certain situations. Secondly, if a researcher is trying to determine if the benefit of eradication program outweighs the costs, then calculating some of the costs will be sufficient, because a fraction of the costs could sufficient enough to warrant a invasive species program to be implemented.

Further research could be done to develop cost models for various species, as well as for regions affected by invasive species.

WORKS CITED

Burnett, Kimberly, Brooks Kaiser, Basharat A. Pitafi, and James Roumassett. "Prevention, Eradication, and Containment of Inasive Species: Illustrations from Hawaii." *Agricultural and Resource Economics Review* 35, no. 1 (2006): 63-77.

Evans, Edwards A.. "Economic Dimensions of Invasive Species." *CHOICES Magazine*, Spring 2003.

Jenkins, Peter T.. "Free Trade and Exotic Species Introductions." *Society for Conservation Biology* 10, no. 1 (1996): 300-302.

Keller, Reuben P., David M. Lodge, and David C. Finnoff. "Risk assessment for invasive species produces net bioeconomic benefits." *PNAS* 104 (2007): 203-207.

Leung, Brian, David M. Lodge, David Finnoff, Jason F. Shogren, Mark A. Lewis, and Gray Lamberti. "An ounce of prevention or a pound of cure: bioeconomic risk analysis of invasive species." *Procedings of the Ryoal Society* N/A (2002): 2407-2413.

Loomis, John B,, and Douglas S. White. "Economic benefits of rare and endangered species : summary and meta-analysis." *Ecological Economics* 18 (1996): 197-206.

Lovell, Sabrina J., and Susan F. Stone. "The Economic Impacts of Aquatic Invasive Species: A Review of the Literature ." *Economics Review* NA (2006): 1-64.

McNeely, Jeff. "Invasive Species: A costly catastrophe for native biodiversity." *Land Use and Water Resources Research* N/A (2003): 1-16.

Pimentel, David, Lori Lach, Rodolfo Zuniga, and Doug Morrison. "Environmental and Economic Costs of Nonindigenous Species in the United States." *American Institute of Biological Sciences* 50, no. 1 (2000): 53-65.

Pimentel, David, S. McNair, J, Janecka, J. Wightman, C. Simmonds, C. O'Connell, E. Wong, L. Russel, T. Aquino, and T. Tsomondo. "Ecconomic and environmental threats of alien plant, animal, and microbe invasions." *Agriculture Ecosystems & Environment* 84 (2001): 1-20.

Pimentel, David, Rodolfo Zuniga, and Doug Morrison. "Update on the environmental and economic costs associated with alien-invasive species in the Untied States." *Ecological Economics* 52 (2004): 273-288.

Simpson, R. David. "The Price of Biodiversity." *Issues in Science and Technology* 15, no. 3 (1999): 65-70.

VITA

Graduate School
Southern Illinois University

Michael P. Hensley

Hensley1@unm.edu

Eastern Illinois University
Bachelors of Art, Political Science, August 2010

Research Paper Title:

A Critique on the current Standards for evaluating costs for invasive species in Economic Literature

Major Professor: Basharat Pitafi