

Cost-benefit analysis of pre-import screening¹.
Reuben P. Keller^{2,3}, David M. Lodge² & David C. Finnoff⁴

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Abstract

International commerce in live organisms presents a policy challenge for trade globalization: sales of live organisms create wealth, but some nonindigenous species cause harm. In order to reduce damages, some countries have implemented species screening to limit introductions of damaging species. Adoption of new risk assessment technologies has been slowed, however, by concerns that risk assessment accuracy remains insufficient to produce positive net economic benefits. This concern arises because only a small proportion of all introduced species escape, spread, and cause harm (i.e. become invasive), so a risk assessment will exclude many non-invasive species (which provide a net economic benefit) for every invasive species correctly identified. Here, we develop a simple cost:benefit bioeconomic framework to quantify the net benefits from applying species pre-screening. Because invasive species are rarely eradicated and their damages must therefore be borne for long periods, we have projected the value of risk assessment over a suitable range of policy time horizons (10-100 years). We apply the model to the Australian plant quarantine program and show that this risk assessment program produces positive net economic benefits over the range of reasonable assumptions. Because we use low estimates of the financial damage caused by invasive species and high estimates of the value of species in the ornamental trade, our results underestimate the net benefit of the Australian plant quarantine program. In addition, because plants have relatively low rates of invasion, applying screening protocols to animals would likely demonstrate even greater benefits.

Introduction

If only a small proportion of introduced species are invasive, a screening tool with given error rate will misclassify and exclude many non-invasive species for every invasive species whose introduction it prevents. This may explain why the vast majority of countries have not mandated pre-screening for nonindigenous species introductions, even though such programs are in place for actions that produce comparable environmental risks (e.g. pollution), and even though such policies would clearly produce environmental benefits by excluding many invaders. Two recent advances, however, make it timely to re-examine the concern that the base-rate effect negates the usefulness of pre-screening and border controls for invasive species.

First, new results show that base-rates of invasion are often higher than previously reported (Jeschke & Strayer 2005). Second, recently developed tools for determining the identity of species that will become invasive have been applied to diverse regions and taxonomic groups with high accuracy rates (typically 80%-95%), e.g., fish in the

¹This paper is a shortened version of Keller et al. 2007a. ²Center for Aquatic Conservation, Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA. ³email: rkeller2@nd.edu. ⁴Department of Economics and Finance, University of Wyoming, Laramie, WY 82071, USA.

Laurentian Great Lakes (Kolar & Lodge 2002); fish in California (Marchetti et al. 2004); plants in Australia (Pheloung 1999), the US (Reichard & Hamilton 1997) and globally (Gordon 2008); birds in New Zealand (Veltman et al. 1997); and mollusks in the US (Keller et al. 2007b).

Main Text

We have developed a bioeconomic framework to identify the specific conditions under which pre-screening and border controls produce greater net economic benefits than a policy under which all species proposed for import are allowed. It is assumed that both the cost of screening and the probability of correctly determining whether a species will be invasive are equal for each species assessed. Only species that are assessed as non-invasive are allowed for introduction. We apply this framework to the Australian ornamental plant industry. Because the benefits and costs associated with introduced species are generally poorly resolved, our model variables are simple enough that data are available. This framework is consistent with the need for greater economic analysis of policies that address environmental problems, and is the first rigorous bioeconomic evaluation of a species screening protocol. Full details of the bioeconomic models and their application to the Australian ornamental plants industry are available in Keller et al. (2007a).

Our results show that applying pre-screening tools with accuracies as low as 69-79% would produce net economic benefits for Australia compared to a policy of allowing all ornamental plant species. Considering that the current state-of-the-art for risk assessment tools produces accuracies much greater than this, we believe that this result would also apply to plant introductions to other nations.

Application to pre-screening for animals

Although we have not applied our models to the trade in live animals, for a number of reasons we believe that pre-screening would be even more beneficial for those imports. First, vertebrates have a shorter time between introduction and invasion (Jeschke & Strayer 2005). For these taxa the onset of costs of invasiveness would be earlier, while the timing of benefits would likely not significantly change. The net present value from pre-screening would therefore be greater. Base-rates of invasion for animals are also generally higher than for plants (e.g. fish and mammals introduced to North America from Europe have base-rates of invasion of 25 and 62% respectively, compared to 5% for plant introductions to Australia (Jeschke & Strayer 2005)), further increasing the value of screening for animals. Thus, although we have not applied these models to the issue of pre-screening animals for invasiveness, the indications are that any such efforts would yield economic benefits to the importing country at least as great as those from screening plants.

Conclusions/Recommendations

Tools for predicting the identity of species that will cause economic, environmental and/or human health harm have improved in accuracy over the last two decades. We have demonstrated that these tools are now sufficiently accurate that when used as part of a pre-screening decision system for plants they can produce net economic benefits for the importing country. For a variety of reasons we believe that this result will

apply at least as strongly to the introduction of animals. Thus, we believe that nations who implement pre-screening programs for invasive animals will reap not just environmental and human health benefits, but also large economic benefits.

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