

Maritime Trade and Invasive Species Management Strategies

Linda Fernandez

e-mail: linda.fernandez@ucr.edu
University of California, Riverside, Dept. of Environmental Sciences and Economics
U.S.A.

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ABSTRACT

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The loss of habitat and bioinvasion are main threats to biodiversity worldwide.

This analysis utilizes data on marine biodiversity and maritime trade as a vector of impact on biodiversity at different port locations along the Pacific coast of the NAFTA countries in order to conduct an empirical game theoretic analysis. The recent focus on improving security for countries place maritime at the center of decisions regarding monitoring and inspection of cargo and the boats themselves. This focus can lead to more formal arrangements to address invasive species. In this analysis, ports in different countries are decisionmakers, minimizing costs of invasive species over time subject to the dynamics of the invasive species as a stock variable in the invaded port that threatens surrounding native biodiversity.

Preventative and reactive abatement strategies are compared with differences in costs as a function of flow and stock of invasive species. This paper investigates incentives to control invasive species through a comparison of cooperative and noncooperative applied differential games that include empirical measures for costs, benefits, and damages to native biodiversity. A comparison is also made between preventative policies to avoid effects on native biodiversity, reactive policies resulting in the stock of invasive species affecting native biodiversity in both games.

The transport matrix of maritime trade frequency and volume between trading countries includes random invasive species quantities in order to account for the stochastic nature of the transboundary pollution problem entering with boat flow between ports. The transport matrix of invader flow is defined by the trade patterns spatially and temporally.

The countries are not identical and a comparison of noncooperative game strategies and payoffs to the cooperative game and payoffs and optimal sharing rules is necessary, when investigating different policies that identify trade, resource management, and port transportation issues. The magnitude and sign of the parameter values and a sensitivity analysis of how the flows, stock, damages, and pharmaceutical values are interacting are offered in the next section in order to present a complete comparison of the different game solutions.

Preventative strategies imply more to be gained in terms of pharmaceutical benefits, lower steady state stock of invasive species and corresponding value of damages for both countries with and without cooperation when compared to reactive strategies.

If the reactive strategies are pursued by both countries without cooperation, Canada is worse off than any other scenario, with the highest steady state stock of invasive species and facing damages exceeding revenues and costs. With reactive strategies, the U.S. pays higher costs and has higher damages under noncooperation than cooperation. The value of presenting this analysis is based on the current pulse of policymaking suggesting the need to move towards cooperative strategies in order to improve the situation the GAO and international agencies report as dire due to inefficient unilateral efforts (GAO, 2002). The large focus on security issues worldwide may speed the process of developing management policies for trading ports with shared maritime transportation.