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Economic assessment of managing processionary moth in pine forests: A case-study in Portugal

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Abstract

This paper assesses the private and social profitability of current strategies for managing processionary moth (*Thaumetopoea pityocampa*) in Portuguese pine forests, looking at economic and environmental costs and benefits. Costs include the expenses for forest treatment and the social costs of threats to human health (dermatitis amongst others); benefits are assessed in terms of both revenue and social benefits such as carbon fixation and recreation. The evaluation was done using Cost Benefit Analysis (CBA) as an analytical framework. While this tool is currently applied to forest and environmental assessment and specific applications to pest management strategies are to be found in agricultural economics, rather few attempts have been made in the field of forest pest management. In order to assess and compare with–without options, a case-study was analysed for the Setúbal Peninsula, south of Lisbon, an area where extensive stands of maritime pine (*Pinus pinaster*) grow. The exercise has shown that CBA can be a valuable tool for assessing the economic and social profitability of pest management. The results demonstrate that the loss of revenues in the no-management option is not sufficient to make pest management profitable for private forest owners in the short-term. Conversely, a social profit is gained as pest management minimizes health risks for humans and avoids possible recreational losses.

Keywords: Pest management; Pine processionary moth; Cost Benefit Analysis; *Thaumetopoea pityocampa*; *Pinus*

1. Introduction

Forest pests have considerable impact on the value and functionality of forest ecosystems, both directly (e.g. timber losses) and indirectly, as they may compromise the stand in relation to soil conservation, aesthetic values and avalanche protection. Defoliating insects can also cause tree death, thus reducing the vital functions of the forest and its scenic value. It has often been debated whether or not to adopt control measures against forest insect pests (Wainhouse, 2005). As forest insects are associated with tree decline and forest succession, forest managers and ecologists have put forward arguments both for and against insect pest control. These include tree growth reduction (Larsson, 1983), aesthetic landscape alteration (Mattson et al., 1996), fragile ecosystem disturbance (Simberloff, 2001) and negative human consequences (Vega et al., 2000).

The winter pine processionary moth, *Thaumetopoea pityocampa*, has been at the centre of such discussions in Mediterranean countries (Masutti and Battisti, 1990), because it causes heavy defoliations to pine and cedar forests, and poses serious threats to human health, as the irritating hairs released by the larvae can cause both occupational and non-occupational contact dermatitis (Fuentes Aparicio et al., 2004; Vega et al., 2004). In addition, the pest is very visible to the public due to its large silk nests in the tree canopy, where the larvae spend the winter months. Pest control is

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thus a necessity, and different approaches have been used, including mechanical, chemical and biological methods (Masutti and Battisti, 1990). Management of the processionary moth is now largely based on the use of *Bacillus thuringiensis kurstaki* (Btk) preparations, which have proved successful in preventing the pest multiplying, with limited environmental effects (Demolin and Martin, 1998).

Although effectiveness on the pest population has now been verified, few economic analyses have tested the profitability of using such control methods. This is an important issue for the private forest owner but also for society as a whole, since moth attacks can result in the loss of environmental functions of pine forests, therefore in hidden social costs.

This research attempts to fill this gap by running a cost/benefit assessment of current strategies for managing processionary moth. The objectives of this work are twofold. Firstly, the paper aims to outline a possible framework for bioeconomic analyses of current and new pest management strategies within a broader social context than that attempted so far. The second objective of the work is to attempt an assessment of social profitability of current forest pest control methods in a specific case-study area, i.e. the Setúbal Peninsula, Portugal.

This information should prove highly useful in the formulation of forest policies, as it contributes towards the definition of financial tools and market-based actions to increase pest management profitability for the processionary moth, taking into account the interests of both the private and public sectors.

2. The study area

Portugal is a country where the majority of forests are privately owned (Carvalho Mendes, 2005). Pines represent about one-third of the forest area. It is estimated that as much as 70–80% of these stands have primarily a productive function (Forest Protection Department, personal communication). Protection of dunes from wind erosion, landscape improvement and recreation are also important – although sometimes implicit – secondary functions of these pine forests.

The Peninsula of Setúbal is located in the Estremadura Province, south of Lisbon. It has a total area of about 158,000 ha, of which 30% is farmland and 32% forests, mainly pines. At the end of the 19th century, uncultivated sandy-loam soils dominated this land and vineyards provided the most widespread crop. In the early 20th century, given the need for timber and related processing industries, a major government afforestation plan – mainly with *Pinus pinaster* – rapidly increased the forested area. This has resulted in extensive pine plantations the Setúbal area, most of which are privately owned and supply timber sold on the local market. Today, the economy of the area consists of forestry, together with fishing, mining industries and wine production. Tourism is also a relevant source of income: most visitors come in the spring and summer, spending time picnicking, hiking and biking in the woods.

The winter pine processionary moth attacks the whole area where *P. pinaster* grows. As management of pine stands is not mandatory, the decision to control infestations is up to the plantation owner and as little control is done as producers believe that the costs outweigh the benefits. This paper will determine if plantation owners are operating rationally and the social costs of such inaction. The control strategies available to the producers are mechanical measures that consist of placing insecticide-impregnated adhesive bands around pine trunks to capture caterpillars, or cutting and burning the nests, both methods being on a very small scale. Aerial applications of biological insecticides, mainly Diflubenzuron and Btk, are mostly used for larger areas, often under the supervision of the local Association of Forest Owners, and they usually concentrate on younger age-classes that are the most prone to the attack.

3. Materials and methods

In Mediterranean countries like Portugal, pine forests (mainly *P. pinaster* and *Pinus pinea*) are a valuable economic and environmental asset. They supply wood products, shelter wildlife, provide recreational opportunities and are an essential feature of the landscape. Mediterranean pines are pioneer species that can grow on steep slopes and poor soils, thus preventing soil erosion and stabilizing coastal dunes. In addition, pine stands represent a significant carbon sink.

This wide range of public services and externalities can be partially or totally lost when the ecosystem equilibrium is threatened by the processionary moth. Thus, full accounting of pest management costs and benefits can help policy-makers to assess its profitability in a comprehensive approach that considers both the private and social perspectives.

A literature survey on the economic aspects of forest pest management leads to the conclusion that this type of study, although important for forest and landscape managers, is not common. Conversely, the economic evaluation of pest management has been explored more frequently in the farming sector: examples can be found in Cornejo (1998), who analysed pest management in viticulture and Bangsund et al. (1999), who assessed the economic impact of weed control. Fleischer et al. (1999) provided guidelines for attempting an aggregated economic evaluation of pest management in agricultural crops. Mullen et al. (1997), Cuyno et al. (2001) and Brethour and Weersink (2001) provided estimates of the environmental benefits from reducing pesticide use in agriculture, while Saphores and Shogren (2005) discussed optimal control of exotic pests and the costs/benefits of collecting related bioeconomic data. Other recently published works on the subject have addressed other contexts, or focussed on specific aspects, like Jetter and Paine's (2003), which dealt with pest control in urban areas. Although these researches all contribute towards the scope of this work, few empirical applications have attempted to estimate the *aggregate* environmental effects of pest management in forest ecosystems.

As some of the benefits considered in this study are non-market, we believe that Cost Benefit Analysis (CBA) can be the appropriate methodology to approach the problem. CBA is a consolidated tool for the valuation of investments in