ECOLOGICAL ECONOMICS 59 (2006) 364–374

available at www.sciencedirect.com

www.elsevier.com/locate/ecolecon

ANALYSIS

Economic valuation of a seed dispersal service in the Stockholm National Urban Park, Sweden

Cajsa Hougner[a], *Johan Colding*[b,*], *Tore Söderqvist*[b]

[a]*Department of Economics, Stockholm University, SE-106 91 Stockholm, Sweden*
[b]*Beijer International Institute of Ecological Economics, Royal Swedish Academy of Sciences, Box 50005, SE-10405 Stockholm, Sweden*

ARTICLE INFO

Article history:
Received 15 August 2005
Received in revised form 9 November 2005
Accepted 9 November 2005
Available online 27 December 2005

Keywords:
Replacement cost valuation
Ecosystem services
Seed dispersal
Oak
Eurasian jay

ABSTRACT

Most economic valuation studies of species derive from stated preferences methods. These methods fail to take into account biodiversity values that the general public is not (made) informed about or has no experience with. Hence, production function (PF) and replacement cost (RC) approaches to valuation may be preferable in situations where species perform key life support functions in ecosystems, such as seed dispersal, pollination, or pest regulation. We conduct an RC analysis of the seed dispersal service performed by the Eurasian jay (*Garrulus glandarius*) in the Stockholm National Urban Park, Sweden. The park holds one of the largest populations of giant oaks in Europe, and the oak (*Quercus robur* and *Quercus petrea*) represents a keystone species in the hemiboreal forests. The primary objective was to estimate the number of seed-dispersed oak trees that resulted from jays and to determine the costs of replacing this service though human means. Results show that depending upon seeding or planting technique chosen, the RC per pair of jays in the park is SEK 35,000 (USD 4900) and SEK 160,000 (USD 22,500), respectively. Based on the park's aggregated oak forest-area, average RC for natural oak forest regeneration by jays is SEK 15,000 (USD 2100) to SEK 67,000 (USD 9400) per hectare, respectively. These estimates help motivating investments in management strategies that secure critical breeding and foraging habitats of jays, including coniferous forests and jay movement corridors. The analysis also illustrates the need for detailed ecological–economic knowledge in a PF or RC analysis. The continuous temporal and spatial oak dispersal service provided by jays holds several benefits compared to a man-made replacement of this service. PF and RC approaches are particularly motivated in cases of known functional ecological relationships, and critically important in estimating management measures where mobile link organisms and keystone species form key mutual relationships that generate high biodiversity benefits. In relation to obtained results, we discuss insights for conducting valuation studies on particular species.

1. Introduction

Ecosystem services can be defined as ecosystem functions that support and protect human activities or affect human well-being (Barbier et al., 1994). Alternatively, they can be defined as "…the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life" (Daily, 1997, p. 3). Such

* *Corresponding author*. Fax: +46 8 152 464.
E-mail address: Johanc@beijer.kva.se (J. Colding)

0921-8009/$ - see front matter
doi:10.1016/j.ecolecon.2005.11.007

anthropocentrically defined services include, among others, the maintenance of the atmospheric composition, climate amelioration, flood controls, drinking water supply, waste assimilation, nutrient recycling, soil regeneration, crop pollination, food provisioning, maintenance of species and genetic diversity, the maintenance of the scenery of a landscape, recreational sites, and aesthetic and amenity values (Costanza and Folke, 1996).

A critical challenge in ecological research is to understand what sustains the capacity for the generation of these services (Folke et al., 2004). For example, for long-term sustenance of the flows of natural resources (e.g., seafood, forage, timber, biomass fuels, fibres, pharmaceuticals, and other ecosystem goods), it is important to understand the underlying processes and functions that contribute to and make such flows possible. For instance, nearly one-third of the US food supply by volume depends on animal pollinators (cf. Kremen et al., 2004). Hence, sustaining this productivity requires the sustenance of resources required by pollinators throughout their life-history cycles, such as conservation of critical habitats near agricultural fields (Kremen et al., 2004), or the sustenance of habitats of natural enemies for control of insect pests that may reduce crop productivity (Östman et al., 2003). Such a focus on *life support functions* should play a more central role in biodiversity management and conservation designs, and more ecological research is needed to reveal such functional relationships, in particular in ecosystems that increasingly become humanly appropriated and exploited, such as those in urban areas.

In this paper, we focus on the roles of individual species in providing ecosystem services by performing functions and processes in the ecosystems they are a part of. Once there is more knowledge of these roles, there will be richer opportunities to analyze the economic significance of the existence of individual species. Hitherto, a common way to put an economic value on species has been to explore people's preferences for the existence of species (Nunes et al., 2003). While this indeed reflects that people value species' existence from an aesthetic and ethical perspective, species' functional roles are taken into account only to the extent that people are aware of it. The intricate nature of these functional roles suggests that such awareness is low. However, increased knowledge of how single species performs key functions in ecosystems makes it not only possible to increase the awareness among the general public but also creates new opportunities to value species' provision of ecosystem services such as seed dispersal, pollination or insect pest control. If it is known how such services serve as inputs into the production of goods in, for example, agriculture and forestry, production function approaches can be used for estimating the economic value of a changed provision of the services. For example, natural insect pest control services could be valued by the estimation of yield losses in agriculture or forestry in cases of absence of natural enemies, as proposed by Östman et al. (2003). Another way to illustrate the economic significance of the services is to measure the cost of replacing them by man-made substitutes; for example, replacing pollination services performed by native bees by way of human means.

Applying production function and replacement cost approaches for estimating the economic value of ecosystem services provided by individual species generally require detailed ecological knowledge of the species. In this paper, we show how such knowledge allows an estimation of the costs of replacing a specific seed dispersal service performed by the Eurasian jay (*Garrulus glandarius*). Our case is the seed dispersal capacity necessary for the regeneration of natural oak forest stands in the Stockholm National Urban Park (NUP) – a large city-park in close adjacency to Stockholm, the capital of Sweden. Our primary objective is to estimate the number of seed-dispersed oaks in the park that results from jays and to determine the costs of replacing this service through human means. What we want to accomplish by this case study is not any exact cost estimates, but rather to illustrate how ecological and economic knowledge can be combined in order to indicate the extent of an economic value of an ecosystem service that is likely to be unknown to most people (including policy makers).

The paper is organized as follows. The next section provides a descriptive background of the setting and the ecological complex in which the seed dispersal service takes place. Section 3 presents economic valuation approaches, in particular the replacement cost method, and the ecological–economic analysis resulting in replacement cost estimates. In Section 4, we conclude by discussing ways of interpreting these results as well as discuss cases and conditions when the replacement cost method may be applied in measuring economic values related to biodiversity.

2. Oak forests and the National Urban Park of Stockholm

Of central concern in this article is the process of natural oak forest regeneration in the National Urban Park of Stockholm (NUP) - a 2700-ha area located adjacent to Stockholm city (Fig. 1). Oaks have played a central role in the historical development of the cultural landscapes of this park for a considerable time. The first written regulations concerning oak harvesting date back to the year 1347 when oaks were widely valued as a source for hard wood and for acorn production (Herdin, 2002). Before this date, farmers that managed lands within the present-day park landscape deliberately eliminated oak seedlings from their property to make way for more arable lands. At the end of the 1600s, when large parts of the park were turned into royal hunting grounds, the ruling elite deliberately favoured oak trees, mainly due to its high demand as materials for naval shipbuilding (Fogelfors and Hansson, 1997). In 1680, the Royal Djurgården Administration (RDA) was established to manage lands in the park and the royal hunting grounds.[1] The management objective was based on romantic ideals, with the foremost objective to enhance the scenic beauty of natural lands, favouring stands of broadleaved trees, particularly oaks (Barthel et al., 2005). With these ideals the Swedish kings created several English landscape parks in the 1700s, and planted broadleaved and pine forests (including exotic tree species) on partly overgrazed hunting

[1] RDA is still managing most of the lands in the present-day park.