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# Economic valuation of habitat defragmentation: A study of the Veluwe, the Netherlands

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## ABSTRACT

This paper offers an economic value assessment of a nature protection programme in the Veluwe, the Netherlands. This programme involves two defragmentation scenarios: the first scenario connects the central part of the Veluwe with river forelands in a north-eastern direction (i.e. the meadows of the IJssel river), while the second scenario is focussed on defragmentation in a south-western direction (i.e. the meadows of the Rhine river). The valuation is based on a questionnaire that was administered during face-to-face interviews in the area and through the Internet. We employ a contingent valuation approach to assess the respondents' willingness to pay for the realisation of the defragmentation scenarios. It appears that the mean willingness to pay (WTP) for the two defragmentation scenarios is € 162.2 (lognormal distribution) per respondent. Because the Veluwe is considered a nature park of national importance, we performed an aggregation of individual WTP estimates over Dutch households. With the resulting aggregate estimates we can compare the total costs and benefits of the two scenarios for habitat defragmentation in the Veluwe. In addition, we test whether respondents value the two scenarios equally. We also check whether the methods of data collection (face-to-face interviews and Internet questionnaires) have distinct influences on the stated WTP responses.

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## 1. Introduction

This paper presents an economic valuation of a nature protection programme targeted at the alleviation of the negative impacts of habitat fragmentation in a nature area in the Netherlands, namely the Veluwe-region. Based on various scientific references, Foppen (2001, p. 21) defines fragmentation as "... the splitting up of suitable habitat in a landscape from a single coherent unit into smaller, isolated patches of habitat in a surrounding inhospitable landscape, resulting from habitat loss

and degradation."<sup>1</sup> The impact of habitat fragmentation on the loss of biodiversity is now widely recognised, and a variety of mitigation measures have been developed (see, for example, van der Grift and Pouwels, 2006). These measures have been heavily

<sup>1</sup> This is only one definition from many. Fahrig (2003) shows that the literature on habitat fragmentation is huge, leading to a myriad of definitions. Although Fahrig suggests that the term habitat fragmentation should be limited to the breaking apart of habitat, independent of habitat loss, the definition we use here does not distinguish between habitat loss and fragmentation per se. The reason is that Fahrig herself points out that most (ecological) researchers do not make this distinction and, moreover, we believe that such a distinction would not much affect the outcomes of our economic analysis.

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examined by ecologists. In this article, we will focus on some of the economic aspects, namely the benefits, of habitat defragmentation. Thus rather than determining ecological values, this article assesses economic values of defragmentation measures.

The valuation study was set up in order to provide a basis for policy recommendations for nature protection. It was designed with the purpose of application to the management of the Veluwe, and is intended to clarify some policy alternatives for the design and implementation of nature policy programmes. As such, the main objective of this paper is to determine the willingness to pay for two defragmentation scenarios, which are aimed at mitigating the adverse impacts of fragmentation of the area. Since most of the benefits from such protection scenarios are non-market goods, a survey was constructed as a measure instrument for assessing the individual's valuation of these two defragmentation scenarios. The survey comprised a questionnaire which was conducted in two different ways: through the Internet, and by face-to-face interviews in the Veluwe-area. In addition to addressing the question whether respondents value the two scenarios equally, we also examined whether these two ways of data collection influences the WTP responses.

The organisation of this paper is as follows. Section 2 provides a short background to the study area, including a description of its present situation, its historical development, and the problem it faces. Section 3 describes the questionnaire used, with special attention given to the questionnaire design and survey administration. The survey revolves around two defragmentation scenarios, which are also presented in this section. Section 4 presents the descriptive statistics of the survey responses, such as number of respondents and response patterns on various questions. Although in the original valuation study results are derived using both a travel cost model and a contingent valuation method, we focus in the present paper only on the contingent valuation method. The reason for this is that the travel cost model is only capable of estimating use values, while the contingent valuation method captures both use and non-use values (see, for example, Carson et al., 2001). Section 5 discusses and analyses the valuation results derived from the survey, and tests some hypotheses concerning possible differences between (i) the willingness to pay for the two defragmentation scenarios and (ii) the methods of data collection. Finally, Section 6 presents the conclusions.

## 2. Study area

The Veluwe is the largest forested and natural area in the lowlands of north-western Europe. It is located in the province of Gelderland, in the eastern part of the Netherlands (see Fig. 1). The central part of the Veluwe is a ridge of hills and forms a part of the sand region, in which the fine periglacial sands deposited during the last Ice Age (the Weichselien, 100,000 – 10,000 years ago) play a predominant role (Vos and Zonneveld, 1993).

For centuries, the Veluwe was a wild and desolate area with only red deer, wild boar, roe deer and wolves. People did not live in the Veluwe but entered the area every now and then for hunting. When agriculture began on the slopes of the hills, it

gradually caused an ecological disaster. Primeval forests were cut down in order to obtain areas of open grassland for farm animals – especially sheep – to graze on, but also to gain charcoal for the extraction of iron. The widespread clearance of the land ultimately resulted in an overexploitation of the area, with large-scale sand-drifts on soils vulnerable to erosion. Already in the 11th century, the villages of the Veluwe were threatened by large amounts of sand. Together with heathlands, which are also to be found in the Veluwe, these sand-drifts are nowadays considered valuable natural ecosystems.

From an ecological point of view, the area is extremely important because of its size, equaling approximately 1,000 square kilometres, and its ecological quality. The Veluwe is rich in animals species, including wild boar, red deer, roe deer, several species of snakes, pine marten, foxes, badgers, sand lizard, more frog, silver-spotted skipper and raven. The exotic mouflon, a species of wild sheep, has been successfully introduced into the area. Moreover, the area is characterised by a unique variety of forest (almost 75%), heathlands and sand-drifts (20%), and country seats and cultivated landscapes (5%).<sup>2</sup> Due to this variety, approximately 500 different kinds of plants have been recorded in the area. The wide variety of scenery and wildlife is further increased by the transition zone, with its complexity of abiotic conditions, between the elevated central part of the Veluwe and the plain areas of the outer marches. The sandy, central part of the area is dry and low in nutrients, whereas the soil of the border areas – consisting of brooks and areas with high ground water levels – typically contains large amounts of nutrients. Most of these border areas are, however, in agricultural use and therefore, ecological values remain underdeveloped.

Because of its nature, its landscape and its cultural history, the Veluwe-region is attractive to many people as a place to live and work. Together with the beaches along the North Sea coast, it is one of the most popular tourist sites within the Netherlands. Each year, millions of day-trippers and holiday-makers visit the area. The total turnover due to recreation and tourism is estimated at 1 billion euros per year. The tourist sector offers employment to more than 22,000 people, which is about 5% of the economically active population in the Veluwe (Provincie Gelderland, 2000). Because the Veluwe offers a combination of quietness, space and nature, the province of Gelderland has turned out to be an attractive location for the establishment of several industries.

Due to game-averting fences, infrastructure, economic activities (such as agriculture), camping sites and bungalows, and military sites, the Veluwe consists of a patchwork of habitat fragments.<sup>3</sup> Although habitat fragmentation does not always have a negative effect on biodiversity (for example, Fahrig, 2003) and the genetic impacts of connectivity are not

<sup>2</sup> Due to government intervention, aimed at curbing the sand-drifts, most of the current forest was planted at the end of the 19th century on sand-blown areas. By and large, the stands consist of Scots pine and are generally homogeneous. There are some deciduous stands as well, which consist mainly of oak and beech.

<sup>3</sup> Across the Veluwe, there are 1,200 kilometres of provincial roads ('provinciale wegen'), 107 kilometres of national motorways, and 60 kilometres of railways.

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