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The sources of preference heterogeneity for nature restoration scenarios

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Abstract

Due to the steady reduction of nature sites in urbanised regions, nature restoration projects are now a focal point of public interest. Policy-makers are required to balance public preferences for nature sites, with the high costs of nature restoration projects. Landscape preferences are, in general, positively correlated with ecological preferences. However this relationship is far from straightforward. Past studies show that different factors, such as personal, site-specific and spatial characteristics, influence preferences, while at the same time, little is known about the relative importance of these factors. This article proposes a conceptual approach for gaining insights into preference heterogeneity, in the context of stated preference environmental valuation studies. We conduct a choice experiment at the Drongengoed (Belgium); an afforested heathland with a diversified mosaic of natural habitats. The experiment determines public preferences towards nature restoration scenarios and illustrates the public's willingness-to-pay for a change from the current state to a scenario with less coniferous trees, higher biodiversity and good maintaining of accessibility. Area-specific and socio-demographic characteristics are controlled for and affect the preferences for certain types of nature restoration scenarios. Preference heterogeneity is also observed for most of the choice attributes, suggesting that more sophisticated modelling methods are needed.

Key Words: choice experiment; nature; restoration; ecosystem services; preference heterogeneity

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1. Introduction

The unceasing activity of our modern society is increasingly putting pressure on the natural environment (World Resources Institute, 2007). Natural habitats are under threat from intensified agriculture, accelerating urbanisation, pollution and tourism. Between one-third and one-half of the land surface has been transformed by various human activities (Vitousek et al., 1997) and about 60% of the world ecosystem services (ES) have been degraded (MEA, 2005). We are facing the challenge of managing trade-offs between satisfying human needs and maintaining the capacity of the natural ecosystems to provide goods and services in the long term (Foley et al., 2005). Valuing the services that humans get from the environment becomes important to give a counterweight to the process of nature degradation and to ensure future human well-being (TEEB, 2010; MEA, 2005).

There is an ongoing challenge to optimise natural resource management decisions, for example in terms of nature conservation, to sustainably deliver ES (Maynard et al., 2010; Christie et al., 2006). For that purpose, new policy and economic mechanisms are deployed to protect nature and consequent ES provision (Goldstein et al., 2012; Biénabe & Hearne, 2006). In the past few years, several nature restoration projects were implemented through the EU Birds and Habitats Directives and Natura 2000, a network of protected areas throughout the EU. Considerable funds are allocated with the aim of protecting biodiversity in Europe. Several studies focus on the ecological achievements of these nature restoration projects and assume a positive relationship between ecological quality and public preferences (Clewell & Aronson, 2006; Bowles & Whelan, 1994).

This relationship is however far from straightforward (van Marwijk et al., 2011). Past studies show that personal characteristics could underpin attitude and consequent willingness-to-pay (WTP) for landscape characteristics (e.g. Kniivilä, 2006; Brouwer & Spaninks, 1999). In addition, site-specific features are also important (Englin & Mendelsohn, 1991). Firstly, ecosystem characteristics like biodiversity level, habitat types and environmental quality are essential (Sevenant & Antrop, 2010; Willis et al., 2003). For example, a contingent study in Finland indicates that 67% of respondents have a positive attitude to nature conservation through implementing the Natura 2000 program because of the importance they attach to flora and fauna, and biotope conservation (Pouta et al., 2000). Secondly, infrastructure, encompassing for instance site accessibility and recreational facilities, is also a determinant factor in shaping the attractiveness of natural sites (e.g. for forest, Colson et al., 2010; for water, Shrestha et al., 2002).

ES valuation is also dependent on spatial factors (Schaafsma et al., 2012; Hanley et al., 2003). The WTP for landscape characteristics tends to decline as the geographical distance between an individual and the nature site under valuation increases (Loomis, 2000). This so-called distance-decay effect can be further complicated by the availability of substitutes within a certain range (i.e. substitution effect). However, few contingent studies address this spatial effect which might result in biased WTP estimations (Schaafsma et al., 2012; Cameron, 2006; Hailu et al., 2000).

To design effective nature restoration and conservation policies, not only ecological factors should be taken into account but also stakeholder preferences should be incorporated (Martín-López et al., 2008; Li et al., 2004). However, there is no universal consensus on how to integrate various influential factors into contingent choice studies at the local level (Blamey et al., 2002; Hanley et al., 2001, 1998).

Integrating all influential factors is thus essential to improve our understanding of the characteristics that affect preferences for nature restoration and, in a later phase, to make value transfer more robust and practical (Turner et al., 2003). The question of transferability is omnipresent in the literature on environmental valuation (Bateman et al., 2011; Colombo et al., 2007). Still, it appears that transferring benefits or value functions across sites is only likely to work if a sufficient level of comparability exists between those sites. Various sources of heterogeneity, next to variability in site characteristics, influence preferences and must be understood. It is thus crucial to further investigate where preference heterogeneity originates from.

Therefore, this study aims to gain insights into public preferences for nature restoration and understand which specific characteristics lead to heterogeneous preferences. The next section of the paper presents a conceptual framework to classify the main sources of preference heterogeneity affecting the WTP for nature restoration. Section 3 introduces the materials and methods used during the data collection phase and Section 4 describes our modelling approach. The results of the estimated models and consequent marginal WTP are presented in Section 5. Section 6 discusses those results and Section 7 concludes the paper.

2. Conceptual framework: preference heterogeneity in nature valuation

Environmental valuation literature is vast and confusing. Authors diverge in opinions on how to collect the necessary information, what method to use to analyse the data and what are the most relevant variables to include in the model. These expert discussions distract the reader from the primary purpose of such studies: providing policy-makers with sensible estimates of non-market environmental benefits.

The large diversity of variables used in stated preference (SP) valuation studies does not simply stem from the diversity of starting assumptions. Instead, variables are often chosen because of practical constraints (e.g. time, budget, and available data) and overall fit of the empirical model.

Inspired by the enlightening work from Adamowicz et al. (2011) and Jones et al. (2010), we propose a generic approach where the characteristics affecting preferences for nature restoration are structured in three general groups (Figure 1): (i) on-site characteristics of the nature site, (ii) individual-related characteristics, and (iii) off-site spatial characteristics.

[Figure 1]

2.1 On-site characteristics of the nature site

When selecting environmental attributes for a choice experiment, one should favour attributes that are demand-relevant, policy-relevant and measurable (Blamey et al., 2002). Therefore, it is assumed that on-site characteristics of a nature area such as biodiversity, habitat composition, and accessibility consistently influence its economic value.

Biodiversity is a primary ecological characteristic of nature areas. It is the subject of numerous valuation studies (Meyerhoff et al., 2009; Xu et al., 2003). For instance, Ojea et al. (2010) confirm that nature conservation projects that contribute to enhance biodiversity result in higher forest value per hectare (i.e. more cultural, provisioning and regulating ES). In Scotland, people favour the restoration of native forests and the re-introduction of rare animal species because of the enhancement of biodiversity and the recreational opportunity. Their

WTP for such restoration projects ranges from £68 to £167/household/year (McMillan et al., 2001). In a similar case for Germany, Meyerhoff et al. (2009) obtain WTP values of €6.47–13.26/person/year for biodiversity enhancement in the context of a transition from classical to nature-oriented forestry.

Next to biodiversity, the mosaic of natural habitats that shapes the landscape also affects its valuation (Yapp et al., 2010; Rambonilaza & Dachary-Bernard, 2007). Garrod and Willis (1994) find a higher WTP for reserving broadleaved woodland (£2.323/person/year) than other habitat types (moorland and coniferous forest in that case) in the UK. Similarly, broadleaved forest is preferred over conifers in Ireland (Mill et al., 2007; Scarpa et al., 2000). On the contrary, McMillan and Duff (1998) find that the mean household WTP to restore native pinewood forests in Scotland ranges from £35 to £53/household/year across sites. This suggests that the attachment to unique or traditional habitats may also play a role in influencing preferences for a habitat type. For instance, a study on peatland conservation in Scotland shows a WTP of about £17/year to protect the unique peatland habitat from afforestation (Hanley & Craig, 1991).

Biodiversity and habitat composition are site characteristics affecting use and non-use values (e.g. existence, bequest). However, site characteristics that only affect use values, and outdoor recreation in particular, strongly influence nature valuation (Stenger et al., 2009; Strange et al., 2007). Most empirical studies reveal that users' WTP for the conservation of nature areas is higher than non-users' WTP (Hanley et al., 1998). WTP is particularly related to the accessibility of natural areas. Accessibility is determined by the number of footpaths, car parking, and outdoor recreational facilities (Watson et al., 2004). In Ireland, visitors are willing to pay about €148/year for the conservation of natural forests, when sufficient recreational facilities are present, but only €52/year for pine forests with limited public access (Mill et al., 2007). So, special attention must be paid to on-site characteristics that affect the recreational attractiveness of a nature area.

2.2 Individual-related characteristics

The decision making process of each individual is based on beliefs, norms or values that eventually result in different WTP (Pouta et al., 2002; Luzar & Cosse, 1998; Ajzen & Driver, 1992). Beliefs and behaviours are intimately linked to personal characteristics (income, age, gender, etc.). This explains why most valuation studies include attitudinal and socio-demographic variables. They control for individual heterogeneity, validate individual responses to WTP questions, and help limit biases when transferring values across populations and sites (Rosenberger et al., 2012; Turner et al., 2003; Turpie, 2003; Arrow et al., 1993).

Firstly, income is theoretically the most central variable in contingent valuation studies as it restricts the amount of money a person can possibly pay. Choice behaviour is thus expected to diverge in the case of higher costs. Moreover, the benefits of a nature restoration project on different income groups are critical determinants of public support (Broberg, 2010). Exploring income effects is also relevant for predicting future WTP and transferring benefits across regions, because of the spatiotemporal variation of income (Jacobsen & Hanley, 2009; Ready et al., 2002). We are also interested in exploring people's age (Mincer, 1974) and level of education (Blundell et al., 2005) because of the causal effect they may have on income.
Secondly, gender can shape attitude towards the environment (Stern et al., 1993). Male and female may behave differently and state different WTP. For example, Minati et al. (2008) observe that females are more likely to prefer the status quo in a contingent study of restoring an endangered species (*Nymphoides peltata*) in Japan. Yet, information about how the gender variable affects WTP for nature restoration remains scarce.

Thirdly, attitude towards nature is likely to play a role as a higher-order source of preference heterogeneity. Social psychological theories, such as the protection motivation theory (Menzel & Scarpa, 2005) or the theory of planned behaviour (Spash et al., 2009) can be employed to underpin the rationale of WTP responses. The empirical findings suggest that ethical and protective motivations are necessary ingredients of a contingent valuation survey as they provide additional insights on individual responses and improve the validity of contingent valuation results (Veisten, 2007). Evidence suggests that up to 25% of contingent valuation responses related to wildlife and ecosystems are motivated by ethical beliefs (Kotchen & Reiling, 2000).

Besides, nature-lovers may have a higher WTP for nature restoration than other people (Milon & Scrogin, 2006). If public attitudes are heterogeneous, interests may be conflicting when talking about nature area restoration. Therefore, understanding the attitude heterogeneity and the impact of individual characteristics on the WTP for nature restoration is critical in formulating well-balanced management policies (Ojea & Loureiro, 2007).

2.3 Off-site spatial characteristics

Off-site spatial characteristics refer to the geographical context of the nature area under valuation. Two spatial factors – distance and substitution – are particularly influential in ES valuation (Hanley et al., 2003; Pellegrini & Fotheringham, 2002). WTP tends to decline with the geographical distance between the respondent and the nature site. At a certain distance, people may be no longer willing to pay (Loomis, 2000). Significant distance-decay effects are reported in contingent valuation studies (Liekens et al., forthcoming; Schaafsma et al., 2012). Failure to account for the distance effects prevents value function transferability and can overestimate total WTP up to 600% (Bateman et al., 2006). Distance effects are thus critical when aggregating the mean WTP per household across an entire region to estimate the total benefits of a nature site (Loomis, 2000).

Ideally, one must also account for the substitution effect, i.e. the availability of substitutes within a certain spatial scale (Hanley et al., 2003). The larger the supply of substitutes, the lower the WTP for restoring one particular nature site (Loomis et al., 1994). Therefore, WTP estimates might be biased if potential substitutes are ignored (Boxall et al., 1996). In addition, the larger the spatial scale, the harder it is for the respondents to correctly estimate the availability of substitutes. Their perception of substitutes may vary markedly from the real situation (Rofle et al., 2002). This is why we are interested in exploring if the existence and perception of substitutes significantly affect the WTP for nature restoration.

3. Materials and Methods

3.1 Theoretical background

The choice experiment method is the SP technique used in this study. It was introduced by Louviere and Hensher (1982). It consists in a survey-based method for modelling preferences for goods, where goods are described in terms of attributes and the levels that these take

(Hanley et al., 2001). Choice experiments (CE) are preferred over contingent valuation methods (CVM) because CVM based on dichotomous questions usually lead to false responses (yea-saying) and CVM with open-ended questions are generally disliked for confusing respondents with hard mental tasks (Pearce & Özdemiroglu, 2002). We thus opt for a CE because of its advantage to give respondents many chances to express their preference for various scenarios.

McFadden's Random Utility Theory (1974) underpins those attribute-based methods: through their choices, people try to maximise their utility. Random utility theory states that a respondent's utility function comprises a deterministic, observable component and a random, unobservable component (Birol et al., 2006):

$$U_{ij} = V(Z_j, S_i) + \varepsilon(Z_j, S_i)\ , \qquad (1)$$

where U_{ij} represents the utility a respondent *i* derives from choosing alternative *j*. The term (*V*) represents the deterministic component of utility, derived from the attributes of each alternative (Z_j) and from socio-demographic and attitudinal parameters specific to each respondent (S_i). ε is independent from (*V*) and represents the random component (error term). The choice set *C* comprises several alternatives (nature restoration scenarios). Choosing one alternative over the others implies that the utility of the chosen alternative exceeds the utility derived from the other alternatives.

Classically, CE and recreation demand analyses were specified using the conditional logit (CL) model because of its relative simplicity (Hearne & Salinas, 2002; Hausman et al., 1995; Caulkins et al., 1986). The CL model assumes a linear relationship between utility and attribute parameters, and requires the error term to be identically and independently distributed (i.i.d.) according to a Weibull distribution (Mariel et al., 2011). When these conditions are met, the probability of choosing a particular alternative *j* takes the form of a logistic distribution (Birol et al., 2006):

$$P_{ij} = \frac{exp\left(V(Z_{ij}, S_i)\right)}{\sum_{h=1}^{C} exp\left(V(Z_{ih}, S_i)\right)}\ , \qquad (2)$$

The following conditional indirect utility function is generally estimated:

$$V_{ij} = \beta + \beta_1 Z_1 + \beta_2 Z_2 + \dots + \beta_n Z_n + \delta_1 S_1 + \delta_2 S_2 + \dots + \delta_l S_m\ , \qquad (3)$$

where β is the alternative specific constant (ASC). This term captures the utility attached to attributes not accounted for in the description of each alternative (see also section 4.1). The number of attributes of each nature restoration scenario is *n*. The number of socio-demographic and attitudinal parameters used to understand the choice of a nature restoration scenario is *m*. Note that these parameters are individual-specific and remain constant across choices. So they are simply interacted with the nature restoration scenario attributes. The coefficients β_1 to β_n and δ_1 to δ_l are respectively attached to the vector of attributes (*Z*) and to the vector of interaction terms (*S*).

CL models present however three restrictions (Train, 1986): (i) they assume homogeneous preferences (i.e. similar tastes) across respondents (Moore, 2008; DeShazo & Fermo, 2002); (ii) they respect the IIA (Independence of Irrelevant Alternatives) property, predicting that attribute changes in one alternative have proportional influence on the attributes of the other alternatives (Poirier & Fleuret, 2010); (iii) in situation with repeated choices over time, they assume no effect of past experience on choice preferences (Train, 1998).

A first way heterogeneity can be accounted for in CL models is by interacting the choice attributes with socio-economic variables or by estimating different models for different subsets of observations. To push it further, we use a generalisation of the standard logit model: the mixed logit (MXL). The main task with the MXL is to find variables and a mixing distribution that account for the other components of utility (e.g. socio-demographics), which correlate over alternatives or are heteroskedastic (Train, 2003). The random utility function of the MXL model takes the following form (Birol et al., 2006):

$$U_{ij} = V(Z_j(\beta + \eta_i), S_i) + \varepsilon(Z_j, S_i) \,, \qquad (4)$$

where the only difference here lies in the deterministic component (*V*). A random component η_i is attached to the attributes of each alternative to account for possible preference heterogeneity across respondents. Accounting for unobserved heterogeneity by adding the error terms ε and η allows equation (2) to be rewritten (Train, 1998):

$$P_{ij} = \frac{exp\big(V(Z_j(\beta+\eta_i), S_i)\big)}{\sum_{h=1}^{C} exp\big(V(Z_h(\beta+\eta_i), S_i)\big)} \qquad (5)$$

Logit models are used to estimate choice-specific information through maximum likelihood (Poirier & Fleuret, 2010). Parameter estimates are derived from the log-likelihood function associated with our logit model and accounting for three dimensions of information: individuals, choice sets and finally choice alternatives. By looking at the choices made by individuals when some attribute level changes and looking at the same time at the price associated with this particular scenario of change, we can derive marginal values for each attribute when moving from the "status quo" (or initial level) of the attribute to the final level of this attribute. This gives the marginal willingness-to-pay (WTP) (also called implicit price) of such a change in that attribute (Christie et al., 2004):

$$WTP = -\frac{\beta_{attribute}}{\beta_M}, \quad (6)$$

where β_M is the marginal utility of income (assumed to be equal to the negative of the coefficient of the monetary variable).

3.2 Study area and data collection

This study relies on a survey carried out in a nature area in Flanders (Belgium) named "Drongengoedbos", situated between Bruges and Ghent (Figure 2). With a total size of 860 ha, the Drongengoed region is the largest one-piece nature area in the province of East-Flanders. Most of this land was originally covered by moor and heather until it was turned to farmland in 1746. Due to hard clay soils, the major part of the site was not suitable for crops so most of it was afforested.

[Figure 2]

Nowadays the Drongengoed is publicly accessible for recreation. "Natuurpunt" (a Flemish NGO for nature conservation) is working on restoring this site to its original state. In Belgium, the last decade has witnessed a trend of converting coniferous forests to heathland or broadleaved forests to enhance biodiversity. Heathland is an ancient natural landscape that existed prior to the 19^{th} century in the North of Flanders. This unique habitat is one of the most threatened habitats in Belgium (Maes et al., 2003) and accommodates a number of endangered species. This restoration effort is partly attributed to a revival of the lost memory of an unspoilt landscape. As such, this study area is highly suitable to improve our understanding of preferences for different nature restoration scenarios.

Data are collected by designing a questionnaire structured in three parts: (i) general questions to know respondents' opinion on environmental issues, perception of nature and recreational habits; (ii) the choice experiment itself, (iii) general questions about socio-demographic characteristics and post-experiment control questions (e.g. "How would you judge the complexity of the choice cards?").

The survey questionnaire was sent out by Internet using a panel of more than 110,000 respondents (provided by the company iVOX) in June 2011 and ended Mid-August 2011. Out of 440 responses, 284 questionnaires were entirely filled in and kept for further analysis. We finally excluded 32 protest bids from the analysis to make the WTP estimates more robust. Protest bidders are responsible for a bias called “false zero bids”. The respondent does not consider the attributes of each scenario to make his choice. Instead, his attention is totally driven by the payment vehicle (here, a tax) that he does not agree with so he directly reports a zero WTP (Poirier & Fleuret, 2010).

3.3 Descriptive statistics

The use of a panel guarantees the random selection of individuals across the population. We observe minor differences, though (Table 1). Respondents are mainly males (55.8%) and on average 50 years old, which is a little bit higher than regional statistics for Flanders (Belgian Federal Government, 2012). The majority (51.6%) is educated up to high school level, is employed (54.4%) and presents a total household income that does not exceed €2,500/month. The respondents are thus more educated, less employed and have on average a lower net household income than the average for Flanders (3,515.2€/month).

[Table 1]

Additional details are obtained through the survey (see Table 2). Most of the respondents have already heard about the Drongengoed before, although 43.2% have never been there. The majority of the people (62.3%) think environmental actions are needed but only 22% declare to be a member of an “eco-friendly” NGO. Walking is from far away the most popular outdoor recreational activity, followed by cycling. Other activities are negligible. We observe that outdoor recreation in nature areas remains occasional in most cases (Figure 3).

[Table 2]

[Figure 3]

Respondents are then asked about the perception of their living environment. For 45.6% of them nature proximity was decisive when choosing their home location. The majority feels sufficiently surrounded by nature. By road, respondents are on average living 22 km away from the Drongengoedbos, although values range from 2.7 to 65.6 km.

At the end of the questionnaire, we also ask questions about use and non-use values[4]. The bequest value of nature appears important for almost everyone (92.5%), followed by the direct use value of nature as a relaxing place and by the simple existence of nature for its wildlife (non-use value). This confirms people value nature on the basis of use and non-use values and supports the use of a SP technique that allows considering both values.

3.4 The choice experiment

In the choice experiment part of the survey, respondents have to choose between three nature restoration scenarios, one being the status quo. These three alternatives are described using four attributes: change in habitat (increase in broadleaves or heathland), reduction of the coniferous forest size, biodiversity and accessibility. A cost attribute (six levels) is also included to conduct the WTP analysis (Table 3). The status quo refers to the current situation: 250 ha conifers, 310 ha broadleaves, 25 ha heathland and 275 ha other lands (pasture, arable land, peat, poplar). Heathland is thus much scarcer than broadleaf. Hence, a 50 ha decrease of coniferous trees resulting in a 50 ha increase in heathland represents a 200% increase of heathland compared to the current situation, while the same increase in broadleaves only represents a 16% increase.

[Table 3]

Currently, biodiversity is low (few species) and there are many footpaths within the area (good accessibility). For the status quo scenario, price remains zero: no need to pay to maintain the current situation. The payment vehicle used here is an annual tax exclusively designed for the restoration of the Drongengoed. Experience shows this is a commonly accepted option (Liekens et al., forthcoming).

The full factorial design of the experiment includes 144 (=2^3*3*6) different landscape scenarios. Only a restricted number is chosen to reduce bias due to cognitive burden. Using principles of D-efficient fractional factorial design (Mangham et al., 2009), only 24 cards are selected and divided in 4 blocks of 6 choice cards. Respondents are randomly allocated to one of the 4 blocks (see Figure 4).

[Figure 4]

[4] These values refer to the theory of Total Economic Value (TEV) introduced by Peterson & Swanson (1987) and taken up later by environmental economists (Pearce & Turner, 1990).

4. Empirical Model

Our empirical approach for looking at sources of preference heterogeneity consists in three progressive steps. Firstly, a conditional logit model is estimated (i). Then, preference heterogeneity is tackled by (ii) estimating a mixed logit model, and by (iii) including additional variables (e.g. socio-demographics) in interaction in the mixed logit model.

4.1 Model I: Conditional logit (CL)

All variables used in the model are summarised in Table 4. The attributes are dummy-coded for simplicity. That is, the intercept term captures both the utility of status per se and the utility of the reference levels to the dummy-coded variables (Bech & Gyrd-Hansen, 2005). Another option is to use “effects coding”. Effects codes are uncorrelated with the intercept, so the values of omitted levels for each attribute are calculable (Louviere et al., 2000).

[Table 4]

Two ASCs are added for the two non-status quo alternatives. ASCs capture variations in choices that cannot be explained by the attributes or by socio-demographic covariates included in the model. They reflect the effect of choosing one alternative over not choosing it (Álvarez-Farizo & Hanley, 2006). Here it means that the ASC conveys the change in utility coming from a “standard change” from the status quo: a 50 ha switch from coniferous tree cover to heathland, more common species and no reduction in the accessibility level. Each time one of the other variables is added to the model, this results in another configuration to be compared to that standard change. As alternatives are unlabelled the ASC parameters are expected to be equal within each model specification. Positive values would indicate that respondents prefer to move away from the status quo, while negative values would indicate conservative preferences (Pepermans, 2011).

Finally, recalling the large variability in habitat composition at the study site, we need to account for the different impact of a change in heathland proportionally to a change in broadleaf. This is why *Broadleaf* is interacted with the dummy variables *Size100* and *Size200*. Hensher & Greene (2003) recommend running a standard CL model before going for a MXL analysis; this to test the behaviour of the different variables and observe whether a more complex approach is needed. Model I depicts the utility function that an individual *i* gets from alternative *j* at choice situation t:

$$Model\ I:\ U_{ijt} = \sum_{k=1,2}\beta_k^C ASC_j + \beta^T Broadleaf_{ijt} + \beta^{S100} Size100_{ijt} + \beta^{S200} Size200_{ijt} + \beta^{S100*B} Size100_{ijt} * Broadleaf_{ijt} + \beta^{S200*B} Size200_{ijt} * Broadleaf_{ijt} + \beta^R Rare\ Species_{ijt} + \beta^{LA} Low\ Access_{ijt} + \beta^P Price_{ijt} + \varepsilon_{ijt} \quad (7)$$

4.2 Model II: Mixed logit (MXL)

The IIA assumption can be avoided by using a more complex model like the MXL (Kjær, 2005). The MXL enables the researcher to determine the possible sources of heterogeneity (Hensher et al., 2005). We follow the methodology developed by Hensher & Greene (2003) to select the attributes to be randomised. A Lagrange Multiplier Test is carried out on the variables of the CL model to assist in the establishment of candidate random parameters. All attributes but the price are tested and the null hypothesis of no random coefficients is rejected for the variables significantly different from zero. Only the interaction term between *Broadleaf* and *Size200* is kept fixed. We assume a normal distribution for the random coefficients because some respondents are expected to have positive preferences and some others negative preferences regarding the different attributes of the site (Carlsson et al., 2003). The following specification is estimated:

$$Model\ II:\ U_{ijt} = \sum_{k=1,2}\beta_k^C ASC_k + (\beta^B + \eta^B) Broadleaf_{ijt} + (\beta^S + \eta^S) Size100_{ijt} + (\beta^S + \eta^S) Size200_{ijt} + (\beta^{S100*B} + \eta^{S100*B}) Size100_{ijt} * Broadleaf_{ijt} + \beta^{S200*B} Size200_{ijt} * Broadleaf_{ijt} + (\beta^R + \eta^R) Rare\ Species_{ijt} + (\beta^A + \eta^A)\ Low\ Access_{ijt} + \beta^P Price_{ijt} + \varepsilon_{ijt} \quad (8)$$

4.3 Extended MXL model: interactions with additional variables

As another way to overcome a possible violation of the IIA property, we estimate an extended MXL model with the inclusion of interacted variables. Since the on-site characteristics are already integrated as attributes into the model, the focus is here on the influence of individual and spatial characteristics.

Individual-related variables

Following the conceptual framework presented earlier, several socio-demographic variables are added to the model: level of income, age, level of education, and gender. To control for attitudinal aspects, we test the effect of knowing the site ex ante (*Knowdrong*), and control for possible differences between the recreational preferences of users and non-users (*Actual* *user*). A variable is also added on the importance of nature proximity in deciding people's home location (*Homenat*). Finally, we add the variable *Ecofriendly*, a dummy on the current belonging to an NGO aiming at protecting the environment in whatever way. This variable accounts for people's sensitivity to environmental questions.

Off-site spatial variables

A distance component is added. The road distance (*Distkm*) separating each respondent's home address from the Drongengoed is chosen to avoid limitations coming from Euclidian (straight-line) distance calculations. This is calculated using Esri's ArcGIS 10 Geographic Information Systems (GIS) package with extension Network Analyst.

To get insights into the substitution question, we add a variable on the perceived nature proximity in a 5 km radius (*Natprox5km*). Nature is defined as any type of landscape existing independently of human activity, so comprising no industrial, residential or agricultural areas, i.e. forest/woodland, heathland, peatland, rivers and marshes[5]. *Natprox5km* is based on questions asked during the survey. People surrounded by nature are expected to be more reluctant towards a change in the Drongengoed area, since this includes a cost while they have sufficient alternatives in their neighbourhood. Nature has to be distinguished from "semi-natural" areas: all landscapes that typically look artificial because shaped by human activity (e.g. arable lands, meadows, parks). A second variable called *Seminatprox5km* is also defined to look into perception of semi-natural proximity in a 5 km radius.

5. Results

5.1 Model I (CL) estimation results

Results indicate that the ASC coefficients are significantly positive and stay positively significant when using effects coded variables, validating that dummy coding can be further used with no danger of misinterpretation. This can be interpreted as a relative preference for moving away from the status quo towards a habitat composition with less coniferous trees and more biodiversity. The parameters of the two ASCs are tested and cannot be considered significantly different (χ^2=0.75, p-value=0.387), which is in line with expectations. Because ASCs may capture a status quo bias and might therefore significantly differ from zero (Champ et al., 2003; Adamowicz et al., 1998) the model is re-estimated with an ASC for the

[5] Other potential land cover types are negligible in the present context.

status quo option. Since this ASC is negative and significant (β=-0.68***), we reject the presence of a status quo bias. Respondents would thus prefer to quit the status quo even if all attributes were held constant. Later on, WTP estimates are thus calculated using only one ASC (Table 5).

[Table 5]

As expected, the variable *Rare Species* is significantly positive, indicating that a landscape with common and rare species is significantly preferred over a landscape with common species. Respondents have a clear preference for highly accessible areas as indicated by the significantly negative coefficient of *No Access*. *Price* is negative and significant. Unsurprisingly, the utility people get from choosing a scenario is negatively affected by a cost increase in the proposed measure.

The interaction terms of *Broadleaf* with *Size100* and *Size200* indicate that the extent of the restoration project has a different impact depending on the habitat type. An increase in heathland from 50 ha to 100 ha has a different effect than a similar increase in broadleaves. An increase in broadleaves from 50 ha to 100 ha presents an estimated coefficient of 0.423 (-0.663+1.086) and this coefficient is significantly different from zero (χ^2=6.6, p=0.01**). Hence, *ceteris paribus*, respondents value a medium switch (100 ha) more than a smaller one (50 ha) towards broadleaves. However, the null hypothesis that a large switch (200 ha) of broadleaves is equally preferred as 50 ha of broadleaves cannot be rejected. So concerning broadleaves respondents seem to prefer medium changes.

The situation is different for heathland. A small (50 ha) increase in heathland is preferred over a medium (100 ha) or a large (200 ha) one (Table 5). Furthermore, additional estimations with a 100 ha increase of heathland in the intercept, reveal that an increase of heathland with 200 ha is slightly more preferred (10% significance) than a 100 ha increase of heathland[6]. So concerning heathland respondents seem to like extremes.

Next, we also want to know whether a restoration project that increases the proportion of broadleaves is preferred over a heathland restoration project. It appears to depend on the size of the converted area. Respondents prefer a 50 ha increase in heathland over a 50 ha increase in broadleaves. When the coniferous forest is decreased by 100 ha, then one has to look at the

[6] Estimation results are available upon request from the authors.

sum of the coefficient of the *Broadleaf* variable and the coefficient of the interaction term of *Broadleaf* and *Size100*. This sum equals 0.698 and is significantly different from zero. That is, respondents prefer a 100 ha increase in broadleaves over a 100 ha increase in heathland. When a 200 ha increase is considered, respondents are indifferent to habitat composition.

5.2 Model II (MXL) estimation results

According to a Hausman test, omitting each time one of the three scenarios (A, B and status quo), the IIA hypothesis is rejected for all three cases (Table 6). This confirms that mixing is needed (Hausman & McFadden, 1984).

[Table 6]

Model II estimates (Table 5) show significant standard deviations for all random parameters, except for the interaction of *Broadleaf* with *Size100* for which the hypothesis cannot be rejected. There are indeed heterogeneous preferences towards on-site characteristics. Model II presents a lower Akaike Information Criterion (AIC), which indicates a better fit than Model I. Indeed minimising AIC means finding the optimal model by maximising the information extracted from the data.

Model II produces similar results as Model I, although mean coefficient values are higher in absolute value. All random parameters have the same sign as in Model I and are statistically significant, except for *Rare Species*. Respondents are this time indifferent about the level of species richness but the large standard deviation attached to that variable implies a high variability of opinions (Carlsson et al., 2003). For *Rare Species*, 49.2% of the respondents have indeed the opposite opinion, explaining why the mean coefficient is not significant.
For *No Access*, 67.5% of the respondents dislike a future scenario with low accessibility. This confirms the CL findings but should again be warily interpreted considering the large preference heterogeneity.

Concerning changes in habitat composition, results are consistent with Model I. Nevertheless, the coefficient of the *Size200* variable is more negative than in Model I. The standard deviation is significant though, indicating that many respondents have an opposite preference. Additional estimates with the *Size100* variable in the intercept cannot confirm that a 200 ha increase in heathland is less preferred than a 100 ha increase. This indicates that respondents are indifferent between a medium and a large increase in heathland, but that a small increase

(50 ha) is more preferred. Hence, compared to Model I, the preference towards extreme switches in heathland (either 50 ha or 200 ha) disappears when accounting for preference heterogeneity. However, results for the *Size200* variable still indicate significant preference heterogeneity.

5.3 Extended MXL model: results

Next to on-site characteristics, individual-related characteristics and off-site spatial characteristics are expected to affect the WTP for nature restoration. To test these effects, we interact the site attributes with individual and spatial characteristics in the MXL model, as this model proves to fit the data better than the CL model (see Table 7) [7].

[Table 7]

5.3.1 Individual-related characteristics

As Liekens et al. (forthcoming), we confirm the influence of certain socio-demographic characteristics on preferences. Higher income people compared with the rest are, on average, more in favour of any type of nature restoration project. This is in line with our expectations as higher income people are less affected by the project costs. By isolating retired people (≥65 years old) from the rest, we observe that they positively value the alternatives to the current situation. This positive relationship between age and environmental awareness is confirmed in the literature (Aminrad et al., 2011) and may be due to retired people's higher time availability to enjoy nature. Their higher "generosity" may also come from the lower budget constraint faced when their children are no longer living in their house.

A reduction of accessibility to the site primarily affects the more educated respondents. This would suggest that these respondents recreate more often to the site, but this is not observed. More educated people may be simply showing more clearly their disagreement with what they understand to be an obvious reduction of utility.

Gender also affects the preference for nature restoration projects. The results indicate that men are significantly more reluctant towards a 100 ha switch to heathland than women. The similar finding is observed for high income respondents. A possible explanation could originate from risk aversion. A larger proportion of heathland may increase fire risk.

[7] A detailed overview of the estimation results of these significant interactions is available upon request from the authors.

Heathland fires proved to be particularly devastating in densely populated areas and the phenomenon is expected to worsen because of climate change (EOS, 2009; United Nations, 2005). In 2011, about two months before the survey, 450 ha of heathland got destroyed by fire in Flanders and several houses had to be evacuated. So, risk aversion could overshadow other arguments to prefer larger heathland restoration projects (e.g. nostalgia of the traditional landscape). Here, risk-averse people are males and higher income respondents.

Next, the results show that preferences regarding nature restoration do not differ between people who knew the site ex ante (*KnowDrong*) and people who did not. No significant difference is either found between direct users of the Drongengoed (*Actual user*) and non-users. By contrast, people for whom nature proximity was important when they chose their home location (*Homenat*) show a positive attitude towards any nature restoration scenario. This positive behaviour may originate from their higher background knowledge and general environmental awareness (Kuckartz & Grunenberg, 2003).

Finally, a strong positive relationship is found between the WTP for nature restoration and membership of an ecological NGO (*Ecofriendly*). People positive towards the environment get a higher utility from the proposed scenarios. These results confirm that attitude towards nature is central and must be taken into account.

5.3.2 Off-site spatial characteristics

Distance

To test for the presence of a distance-decay effect, the road distance separating each respondent from the site is interacted with each choice card attribute and does not appear significant. Quadratic and logarithmic transformations of distance are also tested with no success. Concu (2007) indicates that the distance-decay effect can also take more complex forms as it depends on available information, on substitutes, and on the type of nature being studied. In order to clarify where this spatial complexity could originate from, we looked at possible variations between urban and rural residents and examined several zones separately: each main city (Ghent, Bruges, Aalst), the seaside and the rest of the people. Unfortunately, none of these two approaches showed significant results.

Substitution

The existence of substitutes near people's home acts detrimentally on their WTP for nature restoration scenarios. *Natprox5km* is interacted with the choice card attributes to further explore the influence of this parameter. People satisfied with the amount of nature in their immediate environment show, *ceteris paribus*, a lower preference for improvements to the site. Perception of nature proximity is also tested for "semi-natural" areas (arable lands, meadows, etc.) within 5 km (*Seminatprox5km*) and shows similar results. So, people also consider semi-natural areas as possible substitutes for natural areas. This demonstrates the complexity of the substitution question. The proximity of green spaces provides close alternative recreational sites. It is thus logical to see the respondents less willing to pay for the restoration of the Drongengoed, a farther place they are less likely to visit.

We finally test the perception of nature proximity at a larger scale (30 km radius) but it does not appear significant. This is likely to be due to the cognitive burden imposed to the respondents in that question. Indeed, a 30 km radius represents a surface of more than 2,800 km^2, so about a tenth of Belgium.

5.4 Marginal WTP values based on the MXL model

Model II and Model II-interacted estimates are used to calculate WTP values (Table 8). Model II-interacted includes only the four interactions that show ≤1% significance for each of the two terms being interacted and for their sum (Table 7). In Model II, respondents are willing to pay €91.3 to move away from the status quo towards a situation with 50 ha more heathland and more common natural species. A similar switch towards more broadleaf would only be worth €60.3. The WTP would be €2.4 higher to move to a landscape with rare biodiversity rather than to a landscape with common biodiversity, but would be about €94 in total to move away from the current habitat type with low biodiversity towards a 50 ha increase in heathland with common and rare species richness. The respondents clearly value the accessibility of the area. Reducing the number of footpaths would induce a €36.3 drop in their WTP.

[Table 8]

Respondents would be willing to pay €65.5 to move to a landscape with a 100 ha increase of heathland compared to the current situation (Table 9). To move to 200 ha additional heathland compared to the current situation, they would be willing to pay €57.9. A larger switch seems thus less appreciated. We test for the presence of a significant difference of WTP for a switch from 100 ha to 200 ha of heathland and the WTP values do not diverge (χ^2=0.53, p=0.469). Yet, preferences for a 200 ha increase in heathland are very heterogeneous. This suggests a decreasing marginal utility function for an increase in heathland cover up to a certain extent (+100 ha or +400%), together with opinion divergences when considering larger changes (+200 ha or +800%). This can be attributed to the fact that after a certain threshold it becomes hard for respondents to think about all possible consequences of an increase in one habitat type.

[Table 9]

Respondents would be willing to pay €82.9 to modify the current habitat composition towards an additional 100 ha of broadleaves. A similar conversion to an additional 200 ha of broadleaves would only be worth €41.5. A test confirms that the WTP values differ significantly between a 100 ha and a 200 ha increase in broadleaves (χ^2=12.88, p=0.000). This suggests a reverse U-shaped WTP curve. That is, the WTP for broadleaves increases with the size of the restoration project up to an optimum (100 ha in this case) then falls down with larger project sizes. An explanation is to be found in the general preference for landscapes with a larger diversity of natural elements (Kaplan & Kaplan, 1989). The public perception of landscape diversity is however a complex matter as it conveys ecological, socio-economic and aesthetic aspects (Nijnik & Mather, 2008).

Comparing heathland with broadleaf, respondents would pay €31.0 less for broadleaf cover in the case of a 50 ha change. Putting in balance a 100 ha switch to broadleaves or to heathland, respondents would pay an additional €17.4 for broadleaf. Finally, respondents are willing to pay €16.4 less for a 200 ha switch to broadleaf than for a 200 ha switch heathland.

6. Discussion

This paper proposed to investigate the question of preference heterogeneity for nature restoration in peri-urban areas. Literature on nature restoration showed no systematic preferences regarding habitat types. Instead, the parameters influencing preferences seemed to be highly individual- and context-dependent. A relevant case study, the Drongengoed, was chosen in one of the most densely populated regions in Europe: Flanders. The habitat composition of this site – mainly a mixture of woodland and heathland – made it particularly well-suited to study how people value one habitat type over another.

We introduced a clear framework describing these different sources of preference heterogeneity to organise our research. We distinguished three main components influencing preferences for nature restoration: (i) on-site characteristics, (ii) individual-related characteristics, (iii) off-site spatial characteristics. Each source of preference heterogeneity was then further investigated.

First, we observed a positive reaction from people about nature restoration scenarios. People were willing to pay to move away from the current state of the Drongengoed towards a situation with more biodiversity, less coniferous trees (non-native habitat) and sufficient accessibility through the site. Restoring heathland by clearing coniferous trees was highly valued in the case of a small change (50 ha). The WTP was then declining with the increase in conversion size and showed high divergences of opinion for the largest change. Broadleaved forest restoration showed at the contrary that a medium change (100 ha) was preferred over other sizes. This suggests a reverse U-shaped marginal utility function: broadleaved forest is preferred up to a certain optimum then progressively loses its attractiveness.

The preference for heathland in small landscape changes can be explained by the original habitat distribution: the proportion of heathland is tiny (3%) compared to coniferous (29%) and broadleaf (35%). In the case of a progressive modification of the landscape, people see a 50 ha switch towards heathland as a priority over other habitat types. Because people value landscape diversity, they appreciate this option. Restoring patches of heathland create glades in the forest, bring light, increase biodiversity and make the forest appear more welcoming to recreationists.

However, our results show as well that large forest clearcuttings (200 ha) on public lands, even for nature restoration purposes, raises public opposition. This statement goes in line with previous studies (Bradley & Kearney, 2007; Ribe & Matteson, 2002) and confirms that the size of the clearcut and the ecological improvement justification affect people's perception (Bliss, 2000).

The marginal utility function for the heathland restoration scenario is thus declining but preferences diverge after a certain point (200 ha). We suggest several explanations: (i) people's cognitive burden (Payne et al., 1993): the complexity of the choice situation may induce a violation of rationality assumptions and lead to different decision strategies; (ii) some underpinning sources of preference heterogeneity (e.g. personal beliefs) may not be accounted for; (iii) the medium change option could be devaluated by the conflicting presence of two groups of respondents: some who prefer to restore smaller patches of heathland for various reasons (heathland fire risk, opposition to clearcuttings, etc.) and some others who want to restore as much heathland as possible, possibly because of sentimental attachment to that landscape. This last point was indeed not addressed here but is expected to play an important role, too (Jorgensen & Stedman, 2001; Bricker & Kerstetter, 2000).

Secondly, this study looked into the influence of individual-related characteristics on choice preferences. Out of the different socio-demographic characteristics that we tested, income, age, education and gender had an effect. The survey also showed different recreational habits and different levels of concern for the environment among the respondents. A model clustering the respondents according to common individual-related factors could have then been suited. Unfortunately, the relatively limited number of observations prevented us to opt for that type of analysis. This surely remains a valuable improvement, though.

For the attitudinal variables, knowing the site ex ante had no effect on WTP. No difference could be found either between actual users and non-users of the Drongengoed. Further research is needed to disentangle these use and non-use values. By contrast, we observed that the respondents belonging and donating to a NGO in relation with the environment were more willing to pay (+€75.5) for nature restoration than the other respondents, regardless of the habitat. This confirms the findings from Milon & Scrogin (2006). Similarly, the respondents who had purposely chosen their home location close to nature showed a higher WTP, too. Knowledge and experience about environmental matters seem to help elicit the potential utility gain attached to the nature-oriented scenarios.

WTP is context-dependent and affected by spatial effects. Unfortunately, the first parameter we tested was not significant. The road distance separating each respondent from the site was tested in various ways to elicit its influence on the WTP but no clear distance-decay effect could be found. A possible explanation is that our respondents are mostly spread along a Bruges-Ghent-Aalst axis (see Figure 2), which may disturb the distance-decay effect. Schaafsma et al. (2012) argue that *"the presence of directional variation in WTP stresses the importance of sampling in all directions from a study site in order to avoid biases in WTP and allow for reliable estimation of distance-decay"*.

We could have also used travel time instead of distance such as Jones et al. (2010) did. The intuition behind this is that people pay more attention to travel time than to road distance, when choosing their recreational destination. A further analysis should then better take that aspect into consideration. Ideally, a differentiation should also be made between the means of transport being used to get to the nature area (Kienast et al., 2012). Users living in the vicinity are indeed expected to walk or cycle to the nature area.

Alternatively, our second context-dependent parameter, substitution, was significant. To test for the possible effect of substitutes on preferences, several variables of neighbourhood perception were tested. The perceived level of greenness around people's home appeared negatively significant on their WTP. People satisfied with the level of greenness in their 5 km vicinity would pay on average €24.6 less than the others to move away from the current situation (Table 8). Similar results were found for the "semi-natural" areas in people's neighbourhood. These findings strongly support the assumption that nearby substitutes act detrimentally on the WTP for nature restoration at a site situated farther away (97.2% of the respondents live farther than 5 km away from the Drongengoed) and suggest that substitute should not be restricted to nature areas but also other types of lands.

7. Conclusion

This study proves that the division of the value function in three categories of inputs is particularly relevant. All choice card attributes except one appear highly significant, confirming the primary need for good site-specific characteristics. We sustain that taking personal characteristics (socio-demographics, knowledge, and attitude) into account is crucial when using SP methods for environmental valuation purposes. Spatial aspects, such as the substitution effect, also happen to be essential. All of these characteristics consequently require special attention to prevent further biases in future valuation studies.

In a peri-urban context, nature restoration projects must be designed in accordance with public preferences to be worth the investment. We provide policy-makers with relevant information to convert traditional, forestry-oriented woodlands to multi-purpose woodlands that fulfil people's expectations.

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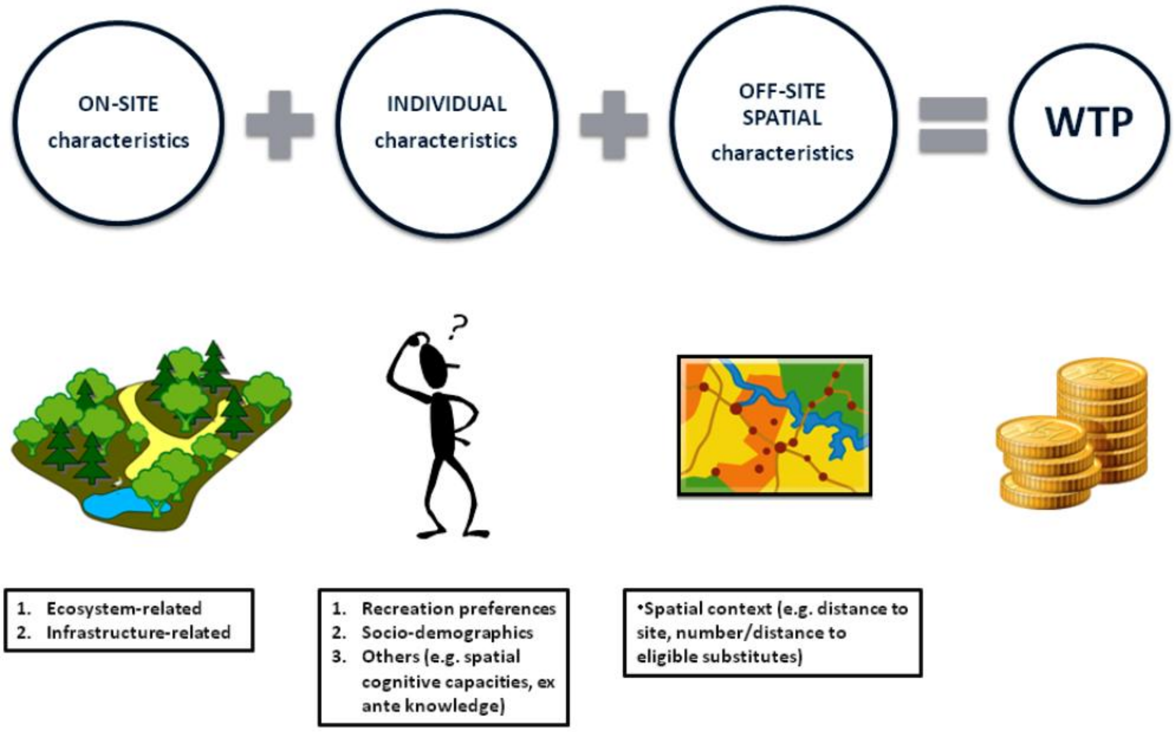

Figure 1. Conceptual framework

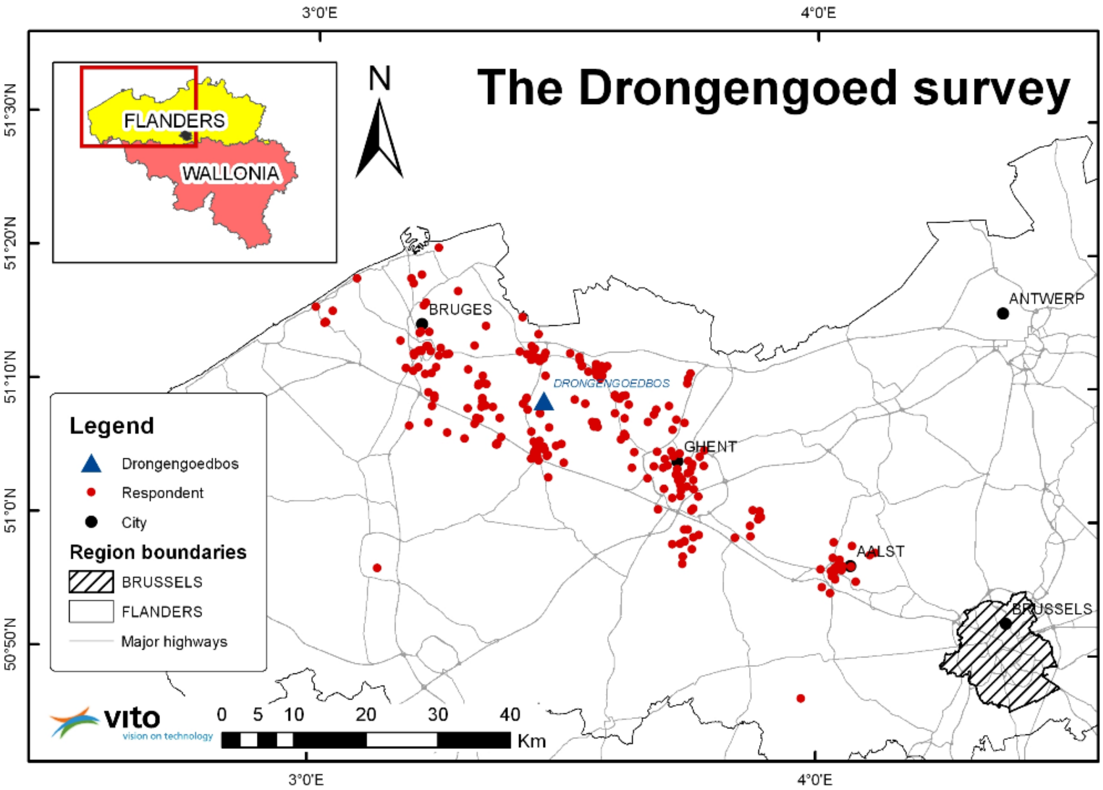

Figure 2. Locating the Drongengoedbos and the 284 respondents

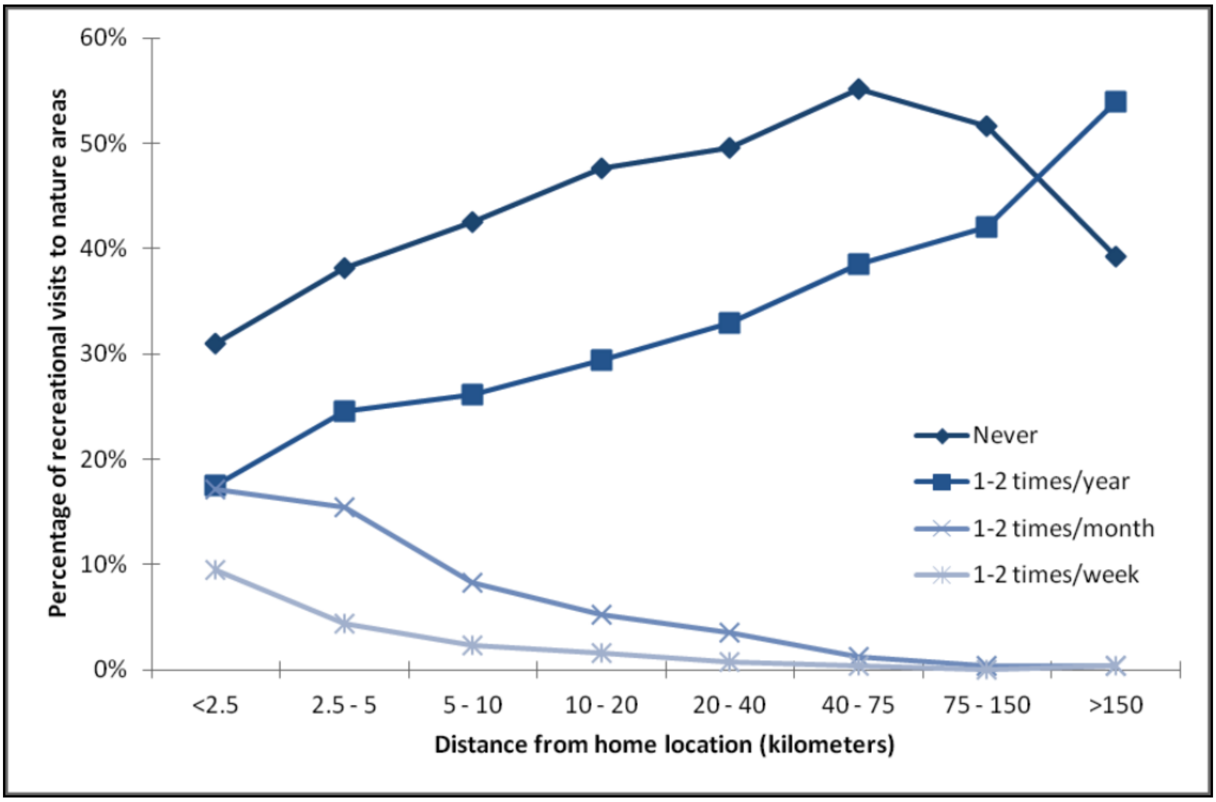

Figure 3. Effect of distance on the frequency of recreational visits to nature areas

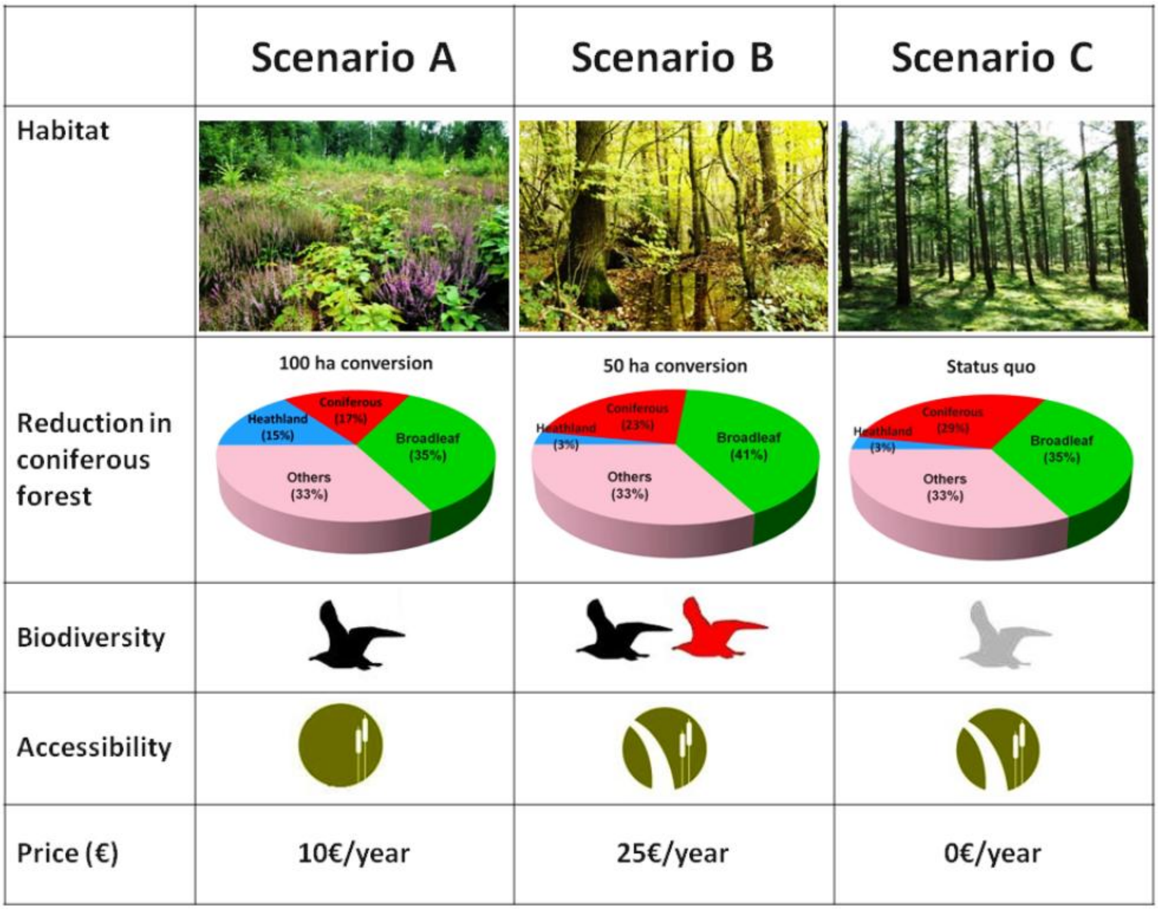

Figure 4. Example of choice card

Table 1. Descriptive statistics

Variable		Survey	Flanders census (Belgian Federal Government, 2012)
Gender	Male	55.8%	49.4%
	Female	44.2%	50.6%
Age (years)	18 – 29	13.3%	21.5%
	30 – 49	34.9%	34.3%
	50+	51.8%	44.2%
Household size (persons)	1	17.6%	12.0%
	2+	82.4%	88.0%
Level of education	High school degree or lower	51.6%	72.9%
	Bachelor degree or higher	48.4%	27.1%
Household net income	≤€2,500	58.9%	72.0%
	>€2,500	41.1%	28.0%
Job status	Employed	54.4%	66.2%
	Not employed	45.6%	33.8%
Member of an eco-friendly NGO		22.0%	N/A

Table 2. Additional survey questions

Question		Percentage
Knew the Drongengoed before (ex ante knowledge)		63.9%
Had already recreated at least once at the site		56.8%
Believe that active nature protection/management is needed		62.3%
Most preferred outdoor recreational activities*	Walking	92.9%
	Cycling	61.1%
	Relaxing	38.5%
	Nature/bird watching	32.1%
	Picnicking	24.6%
	Other	6.0%
Nature proximity was decisive when choosing home location		45.6%
Satisfied with nature density within 5km radius*		72.2%
Satisfied with nature density within 30km radius*		79.8%
Preserving the Drongengoed site is important because:		
Nature is necessary for future generations (Non-use value – Bequest)*		92.5%
Nature is a relaxing place (Use value – Direct)*		91.7%
Of the life it contains (fauna/flora) (Non-use – Existence)*		89.7%
I like the presence of nature in my neighbourhood (Use value – Indirect)*		86.9%
Of the positive effect of nature on people's health (Use value – Indirect)*		84.5%
Nature should be accessible to everyone (Non-use – Altruism)*		83.7%
Of ES provision (air/water cleaning, climate regulation...) (Use value – Indirect)*		81.3%
I might recreate there in the future (Use value – Option)*		69.0%
I recreate there (Use value – Direct)*		44.0%

*5+ score on a seven-point Likert scale

Table 3. Attributes and levels used in choices sets

Attributes	**Base level**	**Levels**	**Nr of levels**
Habitat	Coniferous forest	Switch to heathland	2
		Switch to broadleaved forest	
Biodiversity	Low	More species (common species)	2
		More species (common & rare species)	
Reduction in coniferous forest	0 ha	50 ha, 100 ha, 200 ha	3
Accessibility	Good	Good	2
		Poor	
Price (€)	0	10, 25, 50, 75, 125, 200	6

Table 4. Model variables

Attributes	Description
ASC	Alternative specific constant
Price	Cost of the different scenarios
On-site variables	
Broadleaf	Dummy. 1 if switch to broadleaf habitat, 0 if switch to heathland
Size100	Dummy. 1 if coniferous forest decreased by 100 ha, 0 if by 50 ha
Size200	Dummy. 1 if coniferous forest decreased by 200 ha, 0 if by 50 ha
Broadleaf*Size100	Interaction term between *Broadleaf* and *Size100*
Broadleaf*Size200	Interaction term between *Broadleaf* and *Size200*
Rare species	Dummy. 1 if more species, including rare ones, 0 if more common species
No access	Dummy. 1 if poor accessibility to the area, 0 if good accessibility
Individual-related variables	
High income	Dummy. 1 if income >€3,500
Age	Respondent's age (in years)
Level of education	Dummy. 1 if Bachelor or higher degree, 0 if High school degree or lower
Gender	Dummy. 1 if male
Knowdrong	Dummy. 1 if ex ante knowledge of the study site
Actual user	Dummy. 1 if respondent has already visited the site
Homenat	Dummy. 1 if nature proximity was crucial for choosing home location
Ecofriendly	Dummy. 1 if member of an "eco-friendly" NGO (e.g. WWF)
Off-site spatial variables	
Distkm	Road distance (in km) between respondent's home and the site
Natprox5km	Dummy. 1 if individual feels sufficiently surrounded by nature in his 5 km vicinity
Seminatprox5km	Dummy. 1 if individual feels sufficiently surrounded by "semi-natural" areas (arable lands, meadows, etc.) in his 5 km vicinity

Table 5. Parameter estimates of preferences for nature restoration scenarios based on two different logit models

	Step 1	Step 2		
	Model I (CL)	**Model II (MXL)**		
		Mean	Std. Dev.	Prob. Rev. Sign
Design variables				
ASC	1.024***	2.834***		
	(0.167)	(0.280)		
Price	-0.0132***	-0.0311***		
	(0.00118)	(0.00241)		
Rare species	0.369***	0.0744	3.523***	49.2%
	(0.0950)	(0.267)	(0.375)	
No Access	-0.427***	-1.128***	2.481***	32.5%
	(0.0929)	(0.248)	(0.258)	
Broadleaf	-0.388***	-0.964***	2.410***	34.5%
	(0.143)	(0.299)	(0.316)	
Size100	-0.663***	-0.800***	0.716**	13.1%
	(0.107)	(0.213)	(0.339)	
Size200	-0.391***	-1.036***	1.975***	30.0%
	(0.136)	(0.297)	(0.332)	
Size100*Broadleaf	1.086***	1.502***	1.041	7.5%
	(0.204)	(0.393)	(0.760)	
Size200*Broadleaf	0.175	0.455		
	(0.187)	(0.389)		
Summary statistics				
Log-likelihood	-1,464.3	-1,208.5		
AIC	2,946.6	2,447.0		
BIC	3,004.4	2,543.3		
Observations	4,536	4,536		
Sample size	252	252		

Table 6. Hausman test for IIA hypothesis

Sample	χ^2 statistics	Significance level
Without scenario A	15.24	0.085*
Without scenario B	35.35	0.000***
Without status quo	66.43	0.000***

Table 7. Summary of the choice modelling results for Model II using interaction terms

Interaction term of			Impact of interaction term on indirect utility	
Individual-related characteristic	&	Site attribute	Joint significance (χ^2)[a]	Sign
High income*		ASC***	46.21***	Positive
High income*		Size 100***	7.87***	Negative
Old (dummy. 1 = age ≥ 65) ***[b]		**ASC*****	**69.29*****	**Positive**
Level of education*		No Access**	20.24***	Negative
Gender (1=male)*		Size100*	14.51***	Negative
Knowdrong		None	N/A	N/A
Actual user		None	N/A	N/A
Homenat**		ASC***	65.52***	Positive
Ecofriendly *** [b]		**ASC*****	**62.82*****	**Positive**
Off-site spatial characteristic	&	Site attribute	Joint significance (χ^2)[a]	Sign
Distkm		None	N/A	N/A
*Natprox5km**** [b]		**ASC*****	**63.80*****	**Negative**
Seminatprox5km ***[b]		**ASC*****	**67.46*****	**Negative**

[a] Only interaction terms with a 1% (***) significance level are reported
[b] Interaction terms in bold are kept for further WTP calculations

Table 8. Willingness to pay estimates with Krinsky-Robb 95% intervals

	Model II (MXL)			Model II – Interacted		
Design variables	WTP	Lower limit	Upper limit	WTP	Lower limit	Upper limit
ASC	91.3	77.0	105.1	112.3	86.2	137.7
Rare species	2.4	-13.6	18.1	3.0	-12.8	18.1
No Access	-36.3	-52.4	-20.3	-35.1	-50.1	-20.0
Broadleaf	-31.0	-49.5	-12.7	-28.4	-47.1	-10.7
Size100	-25.8	-40.2	-12.0	-23.9	-38.4	-10.6
Size200	-33.4	-52.9	-14.6	-28.8	-46.9	-10.2
Size100*Broadleaf	48.4	25.1	74.4	45.9	22.9	72.0
Size200*Broadleaf	14.6	-9.5	39.3	12.4	-12.3	37.4
Additional variables interacted						
Old*ASC				60.5	39.0	84.5
Ecofriendly*ASC				75.5	53.6	97.0
Natprox5km*ASC				-24.6	-47.5	-3.1
Seminatprox5km* ASC				-43.0	-68.9	-18.1

Table 9. Average WTP per type of habitat change

	From the current situation to 50 ha (Small change)	From the current situation to 100 ha (Medium change)	From the current situation to 200 ha (Large change)
Heathland	€91.3	€65.5	€57.9
Broadleaf	€60.3	€82.9	€41.5