Forest Policy and Economics 163 (2024) 103201

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Psychological distances to climate change and public preferences for biodiversity-augmenting attributes in family-owned production forests

Do-hun Kim [a,*], Hanne K. Sjølie [b], Francisco X. Aguilar [a,b]

[a] Department of Forest Economics, Swedish University of Agricultural Sciences (SLU), 90736 Umeå, Sweden

[b] Department of Forestry and Wildlife Management, Inland Norway University of Applied Sciences, P.O. Box, 2480 Koppang, Norway

ARTICLE INFO

Keywords:
Wood production
Forest biodiversity
Discrete choice experiment
Psychological distances to climate change
Integrated choice and latent variable model

ABSTRACT

Understanding public perceptions on how management can help adapt forests to climate change is fundamental to the design of socially-acceptable policies. A binary discrete choice experiment in Norway and Sweden was conducted to elicit public preferences for biodiversity-augmenting changes in three forest management attributes (set-aside, proportion of uneven-aged tree stands, and number and type of tree species) compared to typical *status quo* conditions in family-owned production forests. Importantly, how self-constructed psychological (spatial, social, temporal and hypothetical) distances to climate change were associated with management preferences was investigated. Following integrated choice and latent variable modeling approaches to account for their latency, our econometric results show that closer psychological distances to climate change were associated with increased support for biodiversity-augmenting changes in management attributes from *status quo* conditions of family-owned production forests. On average, the Norwegian public preferred larger set-asides and introducing one more broadleaved species, while the Swedish public favored changes in all attributes. The highest utility was derived from increasing set-aside areas from the *status quo* (5%) to 10% and 20% in both countries with respective average WTP of about 10 to 11 EUR/month in Norway, and approximately 10 to 14 EUR/month in Sweden. Findings point to universal acceptability of increasing set-aside areas in both nations, and public approval for uneven-aged and mixed forest management in Sweden.

1. Introduction

Management has an integral role in supporting the capacity of forest ecosystems to mitigate and adapt to climate change. Land management strategies that increase the storage of carbon on land, and utilization that supports long-term carbon fixed in wood products, are recognized for their potential to reduce net greenhouse-gas emissions (Behr et al., 2015; Geng et al., 2017; IPCC, 2023). Public policy can enhance the forest sector's capacity to mitigate and adapt to climate change impacts by promoting, among others, silvicultural practices that reduce the intensity of timber harvesting and promote diversity in age and species composition, and in adopting cascade-use principles along the wood product value-chain (FAO, 2018; Verkerk et al., 2022).

The 'New EU Forest Strategy for 2030' aims to adapt Europe's forests to the new conditions, weather extremes and high uncertainty brought about by climate change (European Comission, 2021). The Strategy stresses biodiversity conservation goals over the supply of products sourced from European forests. Among other considerations, the Strategy maintains that the possible loss of forest carbon sinks are unsurmountable to the benefits of additional carbon fixed in forest products, and silvicultural practices such as clear-cutting should only be used exceptionally (European Commission, 2021). However, reducing timber harvest to enhance forest carbon stocks and biodiversity may decrease wood product supply and its substitution potential with non-renewable or carbon-intensive products. It could plausibly lead to long-term decline in biome carbon storage due to lower investments in forest management (Duncker et al., 2012; IPCC, 2019). Such trade-offs may impair the social welfare of some stakeholders, particularly those

Abbreviations: AIC, Akaike information criterion; AVE, Average variance extracted; BIC, Bayesian information criterion; CFA, Confirmatory factor analysis; CR, Composite reliability; DCE, Discrete choice experiment; HTMT, Hetrotrait-Monotrait discriminant validity; Hyp-P, Hypothetical proximity; ICLV, Integrated choice and latent variable model; MWTP, Marginal willingness-to-pay; Ov-P, Overall proximity to climate change; PD, Psychological distances; RE, Random-effects binary logit; SpSo-P, Spatial and social proximity; Tem-P, Temporal proximity; TemHyp-P, Temporal and hypothetical proximity; WTP, Willingness-to-pay..

* Corresponding author.
E-mail address: dohun.kim@slu.se (D.-h. Kim).

https://doi.org/10.1016/j.forpol.2024.103201
Received 5 October 2023; Received in revised form 11 March 2024; Accepted 13 March 2024
Available online 26 March 2024

dependent on active forest management activities, timber harvest and industrial processing (Howe et al., 2014). The European forest industry and forest owners have criticized the Strategy for being excessively centralized and misinformed of the importance of wood products in achieving carbon neutrality (Gordeeva et al., 2022; EUSTAFOR, 2021).

Motivated by this policy background and the fundamental role of understanding public preferences in the design of socially-acceptable forest management (Eriksson et al., 2013), we implemented a discrete choice experiment to elicit public preferences and willingness-to-pay (WTP) for biodiversity-augmenting forest management considering climate change beliefs. We surveyed the adult populations of Norway and Sweden, two Nordic European countries with a high share of family-owned forested area where production-oriented management practices are common. We focused on the general public as the largest stakeholder to forest management, anchored in longstanding Fennoscandic social and legal traditions (Bengtsson, 2004; Sheppard and Meitner, 2005). Both countries are endowed with boreal forests vulnerable to climate change, but also of considerable adaptation potential through alternative biodiversity-augmenting practices (Hof and Svahlin, 2016; Högberg et al., 2021; Reich et al., 2022). We inferred WTP for selected attributes using an increase in monthly taxes as an instrument that could channel resources to compensate landowners for likely losses in timber-related revenues. Specifically, we framed this compensation aimed at family-owned production forests as being the largest ownership class in both nations (Nordic Forest Research, 2020). Family-owned production forests account for 78% (5,453,236 ha) and 48% (11,374,000 ha) of production forests – defined as forested area with timber growth of more than $1m^3$/ha/year – in Norway and Sweden, respectively (Official statistics of Sweden, 2022; Statistics Norway, 2022).

This study generates empirical results to inform a current forest policy issue, and makes a direct contribution to current understanding of how psychological distances to climate change as comprehensive measures of one's climate beliefs are associated with stated forest management preferences. Climate beliefs are known determinants of support for climate policy (Bergquist et al., 2022; Bumann, 2021; Drews and van den Bergh, 2016), but these have been understudied when examining forest management preferences. It remains a major knowledge gap considering the high level of European concern for climate change and the pivotal roles of forest management in climate strategies (European Commission, 2020). Here, we employed psychological distances to climate change to comprehensively measure how climate beliefs econometrically explain stated choices (Spence et al., 2012; Trope and Liberman, 2010). To the best of our knowledge, this is the first study to investigate the association between psychological distances to climate change and stated preferences for forest management. Next, we describe the theories framing our study, and our empirical approach to answer the following research questions: (1) what are the public's preferences for selected attributes that constitute forest management strategies? (2) what are the statistical relationships between psychological distances to climate change and stated choice for forest management strategy?

2. Theoretical framework

2.1. Extended random utility

Random utility maximization offers a framework to study explanatory factors to stated preferences using discrete choice experiments. In an experimental setting, choices made by participants from mutually exclusive and exhaustive alternatives can help discern their underlying preferences (Train, 1986). Preferences are subjective and comparative evaluations of alternatives that can be expressed in a utility function under completeness and transitiveness axioms, where utility is a latent variable manifested in observed choices (Ben-Akiva et al., 1999; Varian, 1992). Random utility maximization posits that a rational utility-maximizing individual chooses an alternative that yields the highest utility among a set of given alternatives (McFadden, 1980).

Utility functions have been conventionally considered as invariant and specified in terms of observable characteristics, such as attributes of the alternatives and individuals' socio-demographic characteristics (McFadden, 2001). However, decision-making is a process highly dependent on a variety of factors, such as the context of decision-making situation and behavioral constructs of an individual including motivation, attitudes, perceptions, and beliefs (Ben-Akiva et al., 1999; McFadden, 2001). An individual's behavioral constructs have profound effects in the decision-making process (Ben-Akiva et al., 1999). Several extended frameworks of choice models explicitly include behavioral constructs as viable elements of utility function (see: e.g. Ben-Akiva et al., 2002; Morikawa et al., 2002). The incorporation of behavioral constructs in choice models can increase construct validity and explanatory power of the models (Faccioli et al., 2020; López-Mosquera and Sánchez, 2012; Shan et al., 2019).

Discrete choice experiments (DCEs) grounded on random utility maximization have been extensively used to elicit preferences for environmental goods and programs (Johnston et al., 2017). Yet, DCE studies in environmental domains infrequently incorporate behavioral constructs in their econometric models. Some studies reported evidences that environmental values and attitudes construct preferences (Aguilar et al., 2018; Börger and Hattam, 2017; Choi and Fielding, 2013; Faccioli et al., 2020; Hoyos et al., 2015; Milon and Scrogin, 2006; Ouvrard et al., 2019). Somewhat recently, factors behind theory of planned behavior (attitudes, subjective norms, perceived behavioral control) have been used as predictors to the intention to perform environmentally-minded behaviors (Ajzen, 1991; Börger and Hattam, 2017; Nocella et al., 2012; Ouvrard et al., 2019; Shan et al., 2019). However, there is a lack of agreement on how beliefs are associated with forest management preferences in the particular context of climate change adaptation and mitigation.

2.2. Psychological distances to climate change and preferences for forest management

Psychological distances (PDs) are built upon construal level theory which posits that PDs are formed at multiple levels of an individual's mental construals of particular events (Trope and Liberman, 2010). PDs refer to the extent to which an individual evaluates an event as nearby or far from one's self, place, and the moment where one is; an event is likely to be perceived as more psychologically distant when it is construed at higher levels (Trope and Liberman, 2010). PDs are comprised of four dimensions: *temporal* distance representing the extent an event is perceived as temporally near or far; *spatial* distance representing geographical distance to an event; *social* distance representing perceived distance of an event to social groups to which one belongs; and *hypothetical* distance referring to perceived probability that an event will happen (Liberman and Trope, 2014). These distances are not constant but subject to change by new information and events (Keller et al., 2022). Multiple dimensions of PDs to climate change can overlap and change simultaneously (Maiella et al., 2020; McDonald et al., 2015).

PDs to climate change are considered viable determinants of support for climate actions and their four dimensions can overlap and change simultaneously (Maiella et al., 2020; McDonald et al., 2015). It has been argued that closer PDs to climate change lead to increased support for climate action (Van Lange and Huckelba, 2021). Plausibly, closer PDs to climate change may lead to greater willingness to endorse mitigation and adaptation behaviors (Maiella et al., 2020; McDonald et al., 2015), pointing to their social acceptability. Several studies (Jones et al., 2017; Singh et al., 2017; Soliman et al., 2018; Spence et al., 2012) have reported that climate change being perceived as closer in at least one dimension is associated with stronger intentions to adopt pro-environmental behaviors, including increased support for climate policy. Raising awareness on the proximity of PDs to climate change can increase public engagement and support for adaptive policy (Lee et al., 2020; Scannell and Gifford, 2013; Van Lange and Huckelba, 2021). In the context of our study, discerned relationships between PDs to climate change and DCE choices reflect on the overall association between perceptions of climate change proximity and preferred forest management strategies.

3. Methods

Our methods included the development of a survey that incorporated a DCE following an orthogonal main-effects design. The DCE allowed us to elicit preferences for biodiversity-augmenting changes in selected forest management attributes, which were selected based on their prospect to adapt and mitigate climate change in the specific context of European Nordic forests of Norway and Sweden. The survey included a battery of questions to measure PDs to climate change. Socio-demographic information (e.g. gender, income, education level) was collected at the end of the survey. Self-reported survey data were gathered from a random sample of the adult population of Norway and Sweden and were analyzed using integrated choice and latent variable models.

3.1. Binary discrete choice experiment

The DCE was structured as a binary choice between two forest management profiles: one representing the *status quo* and another as an alternative strategy. We chose this relatively parsimonious design because it can increase response efficiency and consistency by relieving respondent fatigue. Our selection for a binary choice design also aimed at facilitating participants' evaluation of clear contrasts between the *status quo* and varying alternative strategies. Further, a binary DCE is incentive-compatible[1] (i.e. a truthful response to a question is the actual optimal strategy for a respondent) in the context of a public good, and its convergent-validity has been supported in empirical analyses (Carson and Groves, 2007; Weng et al., 2021).

In the survey, the DCE was preceded by descriptions of prevalent forest management practices denoting *status quo* conditions, and descriptive information on how management could advance climate mitigation and adaptation goals. For instance, we explained that net carbon emissions might be reduced by increased harvest as it can create forest structures that sequester carbon more efficiently and in more forest products; increased biodiversity could enhance resiliency of forests to climate disturbances. Explanations were accompanied by visual images to standardize knowledge. We also identified potential trade-offs when deviating from the *status quo* to alternative management attributes. For example, we explained that increasing set-aside areas from 5 to 10% may increase forest biodiversity, but may also decrease wood production, income to landowners, and tax revenues.

Three attributes described *status quo* and alternative forest conditions in the DCE: set-aside, tree age variation, tree species composition. Our attributes and levels – including those corresponding to biodiversity-increasing changes from the *status quo* – are outlined in Table 1. Base levels defined *status-quo* production-oriented management practices in Norway and Sweden. Alternative strategies had at least one attribute level that differed from the *status quo*. They represent scenarios for augmented forest biodiversity in comparison with the *status quo*, such as larger tree age class variability or species composition, but with plausible reduction in wood product supply.

Table 1
Attributes, descriptions and levels used in the design of the discrete choice experiment.

Attribute	Description	Levels
Set-aside	Areas that forest owners voluntarily decide not to harvest	• *5% (base)* • 10% • 20%
Tree age variation[†]	Age variation within a group of trees in a forest stand	• *90% even-aged stand (base), 10% uneven-aged stand* • 80% even-aged stand, 20% uneven-aged stand • 70% even-aged stand, 30% uneven-aged stand
Tree species composition	Type and number of dominant tree species in a forest stand	• *One conifer (base)* • Two conifers • One conifer and one broadleaved
Monthly tax	Tax paid to subsidize the implementation of a new forest management strategy	• *0 (base)*, 50, 100, 200, 350, 500 NOK(SEK)/Month[₸]

[†] 70% even-aged stand, 30% uneven-aged stand; 60% even-aged stand, 40% uneven-aged stand; 50% even-aged stand, 50% uneven-aged stand for the Norwegian survey considering its national context.
[₸] 1 NOK = 0.086 EUR (€); 1 SEK = 0.084 €.

The identification of attributes and selection of levels was done after reviewing the scientific literature on family-owned production forest management (Gundersen and Frivold, 2008), and validated after consultation with Norwegian and Swedish forestry experts. Set-aside was defined as an area that a forest owner decides not to harvest to maintain biodiversity and growth of old-aged trees. Setting aside 5% of the total forest area was defined as a base level as it is the minimum requirement to be granted forest certification which is ubiquitous in commercially-managed Norwegian and Swedish forests (FSC, 2019; PEFC, 2022); alternative levels were 10% and 20%. Tree age variation was defined as variation in ages within a forest stand and expressed as proportions of even-aged and uneven-aged stand. Commercial forests in Norway and Sweden are dominated by even-aged stands (Savilaakso et al., 2021). Base levels corresponded to 70% of all forest stands as even-aged in Norway, and 90% of all forest stands as even-aged in Sweden; alternative levels were commonly defined as increasing the proportion of uneven-aged forest by 10% and 20% from the base level. Tree composition was operationalized as types and number of dominant tree species in a forest stand. Following the prevalent monoculture of coniferous species (e.g., *Picea abies* – Norway spruce or *Pinus sylvestris* – Scots pine) in Norwegian and Swedish production forests (Felton et al., 2016), we set base level as one coniferous specie; alternative levels were defined as adding a coniferous or a broadleaved species to the base level.

A fourth attribute in the DCE captured WTP for changes in forest management attributes instrumentalized as an increase in monthly taxes. These revenues would be used to compensate family forest owners for costs and revenue losses associated with changes in forest management attributes. Respondents were informed that remaining at the *status quo* will not cause an increase in monthly taxes. This payment instrument was chosen as one likely to be perceived as real and binding is required, along with information on who pays and payment methods and amounts (Johnston et al., 2017). Hypothetical taxation ranged across six levels from 0 to 500 NOK/SEK per month.

An orthogonal main-effects experimental design was used to generate our binary choice sets (Kuhfeld, 2010). Our experimental design had a final statistical D-efficiency of 1.16 and contained 25 choice sets. We divided the DCE design into five blocks of five choice sets each to increase response efficiency without influencing expected utilities (Kuhfeld, 2010). A respondent was asked to answer only one complete block of five choice sets. We randomized the five blocks in an effort to

[1] Incentive-compatibility requires other conditions, including (1) the survey question is consequential, i.e. the respondent interpret the result of survey as actually influencing one's action and should care about the consequence of the action; (2) the payment instrument is coercive; (3) the choice sets in DCE are independent; (4) at most one policy can be implemented; (5) one-to-one correspondence between the alternative strategy and possible policy, i.e. the alternative strategy in a choice set exactly describes only one possible policy (Carson and Groves, 2007; Vossler et al., 2012).

collect same number of samples for all blocks. Our questionnaires including a block of DCE sets are available as **Supplementary Information**.

3.2. Measurement of psychological distances to climate change

Items measuring PDs to climate change were adapted from Jones et al. (2017) and Spence et al. (2012) (Table 2). Following Maiella et al. (2020) and McDonald et al. (2015), we measured all four dimensions to allow testing mutual influences. Respondents were asked to use a 1 to 7 Likert scale (1 = strongly disagree, 4 = Neither agree nor disagree, 7 = strongly agree) to express agreement to each statement.

3.3. Survey and data collection

The survey was developed in English and translated to Norwegian and Swedish by native-speakers with expertise in the forest sector. It was pre-tested with about 20 individuals resembling our target population. We distributed our survey after amending several questions and descriptions for clear layperson understanding following the pre-test. Our sample was comprised of Norwegian and Swedish residents at least 18 years old. Data collection was conducted online by the market research company Syno International (2022) using consumer panels between June and July 2022. Online surveys may be susceptible to over-representation of certain demographic groups, but allow collecting samples at a relatively lower cost and higher response rates than mail surveys (Barrios et al., 2011; Kwak and Radler, 2002). Previous DCE studies have successfully applied online consumer panels to elicit WTP estimates for forests and other natural resources (e.g. Aguilar et al., 2018; Giergiczny et al., 2015; Weller and Elsasser, 2018). Our survey had a final response rate of 46% for Norway and 53% for Sweden. 1420 Norwegians and 2889 Swedish were invited to the online survey, and 660 responses and 1517 responses were collected, respectively. Johnson and Orme (2010) suggests $(n \times t \times a)/c \geq 1000$ as a general guideline to determine the sample size for a main-effects DCE, where n is the sample size, t is the number of choice sets per respondent, a is the number of alternatives per set and c is the largest number of levels for an attribute. A sample size exceeding 600, thus, sufficed to statistically generalize findings to Norway and Sweden in case of our DCE design.

Table 2
Measurement items of psychological distances to climate change.

Dimensions	Variable	Items[†]
Spatial	Sp1	I believe climate change is likely to affect the local area where I live
	Sp2	I believe climate change is likely to affect the country where I live
	Sp3	I believe the effect of climate change is worse in other parts of world
Social	So1	Climate change will affect me and my family
	So2	Climate change will affect people whose income is similar to mine
	So3	Climate change will affect people whose income level is lower than mine
Temporal	Tem1	I believe climate change is happening now or will happen in my lifetime
	Tem2	I believe climate change will not happen in my lifetime, but sometime in future generations
	Tem3	I believe climate change is not likely to happen, and even if it does it might be in a remote future
Hypothetical	Hyp1	I am uncertain that climate change is really happening
	Hyp2	I am certain about the negative consequences of climate change
	Hyp3	I believe there is a substantial agreement among scientists that climate change is happening

[†] Self-reported items measured in 7-point scale (1 = Strongly disagree, 4 = Neither agree nor disagree, 7 = Strongly agree).

3.4. Econometric analysis

Survey data were analyzed using an integrated choice and latent variable (ICLV) approach to econometrically model how participants' choices were explained by DCE attribute levels underlying utility, and the association of PDs to climate change with the probability of choosing a particular alternative management strategy as latent explanatory factors. Our ICLV approach consisted of a measurement equation for latent PDs to climate change, a structural equation that explains latent PDs to climate change by observed socio-demographic characteristics, and a choice modeling equation that includes DCE attributes, latent PDs to climate change and observed socio-demographics as its components (Fig. 1).

An ICLV is a suitable method to implement an extended random utility maximization framework as it contains latent psychometric explanatory variables to choice (Ben-Akiva et al., 1999). Earlier studies have incorporated psychometric items directly into a latent utility function (Aguilar et al., 2018; Börger and Hattam, 2017; Shan et al., 2019), but this approach may be susceptible to inconsistent estimators, endogeneity, and/or inefficient estimators (Hoyos et al., 2015; Kim et al., 2014). ICLV avoids these issues when combining a latent variable model with discrete choice models and using a simultaneous estimation; the latent variable model allows identifying latent psychometric variables from sets of measurement items and capture the associations between latent psychometric variables and observed socio-demographic variables (Kim et al., 2014). Several empirical studies have applied ICLV to analyze discrete choices including latent psychometric variables (Alemu and Olsen, 2019; Groothuis et al., 2021; Soto et al., 2018).

Our ICLV estimation procedures are described in detail next. We implemented confirmatory factor analysis (CFA) on each country sample to compare our measurement of PDs to climate change with the conceptual four-dimensional structure, prior to ICLV estimations. CFA is an appropriate method to check the measurement of latent variables with strong prior notions (Hair et al., 2010). Standardized factor loadings>0.7, composite reliability>0.7, average variance extracted>0.5, heterotrait-monotrait discriminant validity<0.85 were used as fitness thresholds to evaluate our CFA solutions (Brown, 2015; Hair et al., 2010; Henseler et al., 2015).

CFA solutions guided our specification of ICLV measurement equation as follows:

$$I_{ik} = \gamma PD_i + \xi_i; \quad \xi_i \sim N(0,\ 1), \tag{1}$$

where I_{ik} denotes the observed response of individual i on k-th measurement item of PDs to climate change, PD_i denotes latent PDs to climate change, γ is a parameter vector to be estimated, and an error term ξ_i following a standard normal distribution. I_{ik} has ordered discrete values since PDs to climate change were measured using a 7-point Likert scale. Thus, we used an ordered probit link function in our measurement equations with threshold parameters $\tau_1 \dots \tau_6$:

$$I_k = \begin{cases} i_1 & -\infty < PD_i \leq \tau_1 \\ i_2 & \tau_1 < PD_i \leq \tau_2 \\ \vdots & \vdots \\ i_7 & \tau_6 < PD_i \leq -\infty, \end{cases} \tag{2}$$

where $i_1 < i_2 \dots < i_7$ denote observed discrete values for k-th measurement item in I_k.

The structural equation examined the associations between latent PDs to climate and socio-demographic variables. It is specified in a linear form:

$$PD_i = \rho Z_i + \varepsilon_i\,, \tag{3}$$

where Z_i is a vector of individual-specific socio-demographic variables, ρ is a parameter vector to be estimated, and ε_i an idiosyncratic error term.

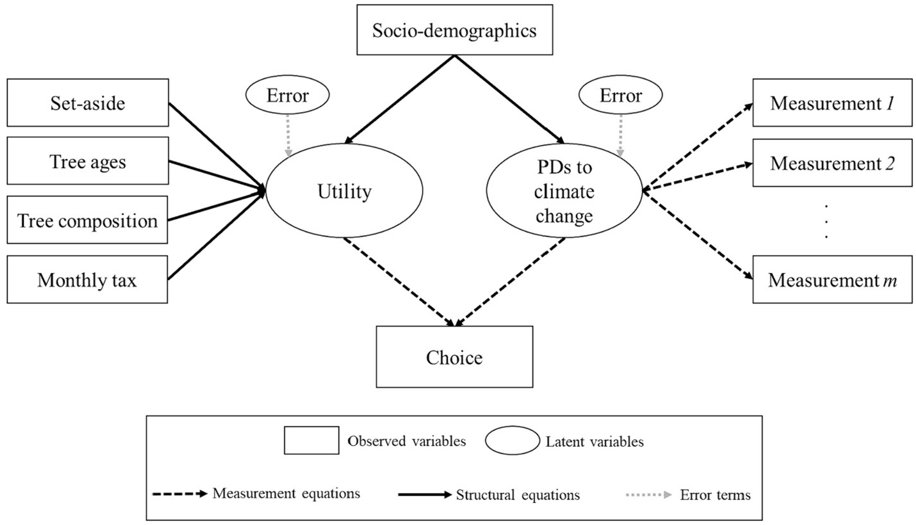

Fig. 1. Depiction of the integrated choice and latent variable model used in this research.

Our econometric modeling of the probability of the i^{th} individual choosing an alternative strategy ($Y = 1$) over the *status quo* ($Y = 0$) was expressed as a random-effects binary logit (RE), since a central premise of our DCE is that a respondent chooses an alternative strategy if it provided a higher utility than the *status quo*, otherwise the *status quo* was chosen. This can be expressed as:

$$Prob(Y_{ij} = 0, 1 | X_j, PD_i, Z_i) = \frac{exp(\omega\alpha + \beta X_j + \theta PD_i + \delta Z_i + v_i)}{1 + exp(\omega\alpha + \beta X_j + \theta PD_i + \delta Z_i + v_i)}, \quad (4)$$

where j refers to choice sets presented to the i^{th} participant, α denotes monthly tax attribute of alternative strategy at choice j, X_j denotes non-monetary DCE attributes vector of the alternative strategy at choice j, and ω, β, θ, and δ are parameters to be estimated.

Eq. 4 included an error component at the i^{th} level (v_i) that follows a normal distribution and is assumed to be uncorrelated with other explanatory variables (i.e. random-effects for every individual) (Train, 2009; Wooldridge, 2010). Use of random-effects is not common in the analysis of DCE data but justified in our case of binary discrete choice (Conaway, 1990; Kjaer, 2005). The inclusion of this idiosyncratic term is due to the panel structure of our data since every respondent answered five choice tasks. Random-effects is one way to control for unobserved individual-specific effects in panel models (Wooldridge, 2010). Several studies, largely within health economics, have empirically applied RE to analyze binary DCE data (Černauskas et al., 2018; Chavez et al., 2020; Tappenden et al., 2007). Indeed, RE can be considered as a simplified mixed logit where choice probability is the mixture of a logistic distribution and a normal distribution (specified for the error component v_i), with DCE parameters (β) fixed across individuals (Brownstone and Train, 1998; Greene and Hensher, 2007; Train, 2009). ICLV estimates eqs. 1 to 4 simultaneously using maximum likelihood. We estimated ICLVs for the Norwegian and Swedish sample separately, with standard errors clustered at i^{th} level to reflect on the multiple choices observed per respondent.

As a degree of robustness to our results regarding attribute preferences and WTP, we also ran a more parsimonious RE to our DCE responses with attributes and socio-demographic variables as its systematic components. This RE model that excluded PDs (partly due to empirical challenges in computational estimation) allowed us to discern whether DCE attribute coefficients were statistically different between countries. We implemented Chow-like test of equality of coefficients (Chow, 1960) after pooling Norwegian and Swedish data to test the null hypothesis (H_0):

$$\beta_P = \beta_N = \beta_S, \quad (5)$$

where β_P is a coefficient vector from the pooled data, β_N is a coefficient vector from the Norwegian data, β_S is a coefficient vector from the Swedish data, and alternative hypothesis (H_1) being $\beta_P \neq \beta_N \neq \beta_S$.

Post ICLV and RE estimations, we calculated marginal willingness-to-pay (MWTP) to quantify the perceived utility for DCE attributes (Juutinen et al., 2014). It can be used to assess trade-offs an individual makes in his or her choice between the attribute levels (Boxall et al., 1996). MWTPs were obtained as marginal rate of substitutions between non-monetary attributes and monthly tax attribute:

$$MWTP_m = -\left(\frac{\widehat{\beta_m}}{\widehat{\omega}}\right) \ \forall m \in M. \quad (6)$$

where $M = \{$*set-aside, tree age variation, tree composition*$\}$ and m are its elements, $\widehat{\beta_m}$ and $\widehat{\omega}$ denotes estimated coefficients for non-monetary DCE attributes and the monthly tax attribute from eq. 4, respectively. All estimations were conducted in Stata MP 18.0.

4. Results

4.1. Descriptive statistics

Table 3 shows descriptive statistics of our sample which can considered as an adequate representation of the adult population in both countries. Our sample had nearly equal gender representation with a slightly higher proportion of males. The average respondent age was about 45 in both countries. Some 42% of Norwegian and 38% of Swedish respondents self-reported having a bachelor's or higher academic degree. These values correspond with those reported in official statistics at EU level with minor deviations. Tests reveal that the gender proportions in both country samples are not significantly different from the values reported in official EU statistics, but average ages are slightly lower. Official EU statistics in 2022 reports that proportion of male and female was 50.5% and 49.5% in Norway and 50.3% and 49.7% in Sweden; average age of adults over 18 years old were 48.6 for Norway and 49.7 for Sweden, and 42.2% of adults (18–69 years) in Norway and 41.4% in Sweden have tertiary education (Eurostat, 2022).

4.2. Confirmatory factor analysis

We obtained the same three-latent variables solution for both countries after omitting items with low internal consistency. Our solution had sufficiently acceptable fitness thresholds except for a slightly lower factor loading of Hyp3 than the threshold in the Swedish sample

Table 3
Descriptive statistics of socio-demographic profiles of respondents by country.

	Norway ($n = 660$)	**Sweden** ($n = 1517$)
Gender† (%)		
Male	50.76	49.97
Female	48.79	49.51
Not reported	0.45	0.53
Age†‡ (years)	44.94***	45.83***
	(6.23)	(16.30)
Annual household income₸ (%)		
< 400,000 NOK (< 300,000 SEK)	30.15	27.16
400,000– 700,000 NOK (300,000– 600,000 SEK)	35.15	41.73
700,000– 1.2 million NOK (600,000– 900,000 SEK)	26.21	20.76
> 1.2 million NOK (> 900,000 SEK)	6.67	9.49
Not reported	1.82	0.86
Education⁑ (%)		
Elementary	6.36	6.53
Secondary	34.09	36.39
Post-secondary	16.21	18.52
Bachelor's degree or equivalent	29.09	27.09
Master's degree or equivalent	12.73	10.55
Ph.D. or equivalent	1.06	0.66
Not reported	0.45	0.26

† Binomial test or two-sided t-test of equal means (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$) between country sample and corresponding values reported in official EU statistics.

‡ Standard deviations in parentheses.

₸ Income criteria for Swedish sample in parentheses.

⁑ University education of 3 and 4 years considered Bachelor level in Sweden. University education of 5 years is considered Master level.

(Table 4). Sp1, Sp2 and So1, So2 were loaded on the first latent variable; this can be interpreted as spatial and social proximity to climate change (SpSo-P). Tem3R and Hyp1R (reverse-coded Tem3 and Hyp1) were loaded on the second latent variable; this represents temporal and hypothetical proximity to climate change (TemHyp-P). Reverse-coding of Tem3 and Hyp1 was to ensure that the second latent variable could be interpreted in terms of proximity as other latent variables. Hyp2 and Hyp3 were loaded on the third latent variable; this represents hypothetical proximity to climate change (Hyp-P).

4.3. Integrated choice and latent variable model

4.3.1. Measurement and structural equations

Table 5 shows coefficients, standard errors and p-values of our measurement and structural equations of latent PDs to climate change. All measurement items for SpSo-P were positive and strongly significant in both countries ($p < 0.001$), indicating that SpSo-P can be interpreted as spatial and social proximity. Different from our CFA solutions, only Tem3R was used to measure TemHyp-P due to non-convergence of the models when Hyp1R was included. Tem3R has a positive and significant coefficient in both country samples ($p < 0.05$). This indicates that the interpretation of TemHyp-P in our ICLVs is actually limited to temporal proximity (henceforth referred to as Tem-P). Regarding Hyp-P, Hyp2 was significant in both country samples but Hyp3 was significant only in the Swedish sample ($p < 0.001$). This indicates Hyp-P can be interpreted as hypothetical proximity with a stronger connotation in the Swedish sample. We also estimated an ICLV where all the items comprising SpSo-P, Tem-P and Hyp-P were loaded onto a single latent variable (Ov-P), since multiple dimensions may jointly change overall perceived distance to climate change (Maiella et al., 2020; McDonald et al., 2015). All loaded items were positive and significant in both countries ($p < 0.001$), indicating that Ov-P may be interpreted as overall proximity (encompassing spatial, social, temporal and hypothetical dimensions) to climate change.

Structural models show that latent PDs to climate change are explained by observed individual socio-demographic characteristics. Spatial and social proximity was positively associated with education ($p < 0.05$) but had an inverse relationship with age in the Norwegian sample ($p < 0.001$); in the Swedish sample, being male was the sole and negative predictor ($p < 0.001$). Temporal proximity had a significant and positive relationship with age in both countries ($p < 0.05$); in Sweden, being male had an inverse relationship but education and age were positively related ($p < 0.05$). Hypothetical proximity was positively correlated with education in the Norwegian sample ($p < 0.001$); in the Swedish sample, being male had a negative relationship ($p < 0.05$), while education had a positive association ($p < 0.001$). Overall proximity was positively associated with education ($p < 0.05$) and had a

Table 4
Standardized factor loadings, composite reliability, average variance extracted and heterotrait-monotrait discriminant validity of latent variables in the measurement model of PDs to climate change, by country.

Latent variables	Items	Standardized factor loadings	CR	AVE	HTMT		
					SpSo-P	TemHyp-R	Hyp-P
Norway (n = 660)							
SpSo-P	Sp1	0.833***	0.882	0.654		0.189	0.382
	Sp2	0.843***					
	So1	0.829***					
	So2	0.722***					
TemHyp-P	Tem3R	0.774***	0.819	0.701	0.189		0.456
	Hyp1R	0.896***					
Hyp-P	Hyp2	0.775***	0.715	0.558	0.382	0.456	
	Hyp3	0.718***					
Sweden (n = 1517)							
SpSo-P	Sp1	0.884***	0.915	0.732		0.239	0.382
	Sp2	0.901***					
	So1	0.860***					
	So2	0.772***					
TemHyp-P	Tem3R	0.898***	0.799	0.678	0.239		0.479
	Hyp1R	0.742***					
Hyp-P	Hyp2	0.853***	0.717	0.578	0.382	0.479	
	Hyp3	0.655***					

SpSo-P: spatial and social proximity; TemHyp-P: temporal and hypothetical proximity; Hyp-P: hypothetical proximity.
CR: composite reliability; AVE: average variance extracted; HTMT: Heterotrait-monotrait discriminant validity.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 5
Measurement and structural equations of integrated choice and latent variable models by country.

	Norway (n = 657)				Sweden (n = 1509)			
	SpSo-P	Tem-P	Hyp-P	Ov-P	SpSo-P	Tem-P	Hyp-P	Ov-P
Measurement component								
Sp1	1.715***			1.661***	2.171***			2.054***
	(0.180)			(0.158)	(0.152)			(0.129)
Sp2	1.753***			1.904***	2.355***			2.436***
	(0.163)			(0.161)	(0.147)			(0.153)
So1	1.785***			1.625***	1.887***			1.856***
	(0.183)			(0.147)	(0.110)			(0.102)
So2	1.158***			1.141***	1.359***			1.349***
	(0.117)			(0.112)	(0.080)			(0.078)
Tem3R		1.483***		0.295***		0.563**		0.486***
		(0.073)		(0.064)		(0.165)		(0.044)
Hyp2			0.864***	0.927***			2.656***	1.121***
			(0.142)	(0.081)			(0.559)	(0.066)
Hyp3			2.661	0.775***			0.882***	0.734***
			(1.728)	(0.076)			(0.069)	(0.050)
Structural component								
Gender	−0.086	0.067	0.039	−0.069	−0.219***	−0.320*	−0.132*	−0.216***
(Male)	(0.084)	(0.099)	(0.100)	(0.083)	(0.054)	(0.132)	(0.057)	(0.054)
Education†	0.173*	0.136	0.336***	0.202*	0.059	0.331*	0.208***	0.086
	(0.088)	(0.104)	(0.090)	(0.088)	(0.056)	(0.138)	(0.060)	(0.056)
Age	−0.010***	0.006*	−0.005	−0.010***	0.001	0.017**	0.003	0.001
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)
Income‡	0.088	0.107	−0.028	0.074	0.037	−0.068	−0.001	0.029
	(0.092)	(0.111)	(0.094)	(0.091)	(0.058)	(0.124)	(0.063)	(0.058)

SpSo-P: spatial and social proximity; Tem-P: temporal proximity; Hyp-P: hypothetical proximity; Ov-P: overall proximity to climate change, a combined measure of SpSO-P, Tem-P, and Hyp-P.
Standard errors in parentheses.
† Below bachelor or equivalent = 0; Equal or above bachelor or equivalent = 1.
‡ Norway: <700,000NOK/year = 0, ≥700,000NOK/year = 1; Sweden: <600,000SEK/year = 0; ≥600,000SEK/year = 1.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

negative relationship with age ($p < 0.001$) in the Norwegian sample, while had an inverse relationship with being male ($p < 0.001$) in the Swedish sample.

4.3.2. Choice models

Table 6 shows coefficients, standard errors clustered at the i^{th} respondent level, p-values, and goodness-of-fit indicators (Log-likelihood, Akaike information criterion, Bayesian information criterion) of choice component of our four ICLVs and RE. ICLV 1 included SpSo-P, ICLV 2 included Tem-P, ICLV 3 included Hyp-P, ICLV 4 included Ov-P as a latent variable, respectively. In all ICLVs, variances of the error term of latent PDs to climate change were constrained at one to identify the model (Groothuis et al., 2021; Vij and Walker, 2016). RE included DCE attributes and socio-demographic variables as its components but latent PDs to climate change were excluded. Strong statistical significance of random-effects in all models support controlling for unobserved individual-level effects, and points to evidence of unobserved heterogeneity at the respondent level. Much higher absolute values of goodness-of-fit indicators of ICLVs than REs reflect on the greater complexity of ICLVs.

We found significant effects of latent PDs to climate change on the stated choice across all ICLVs. Overall, our results indicate positive relationships between psychological proximity to climate change and preference for biodiversity-augmenting changes in forest management. In the Norwegian sample, all types of climate proximity were associated with higher probability to choose an alternative strategy compared to the *status quo* ($p < 0.001$). Similar patterns were found in the Swedish sample, with temporal proximity not as strongly significant as the Norwegian case ($p < 0.05$).

Positive and significant coefficients of DCE attributes levels suggest a higher utility compared to the *status quo* levels (e.g. baseline set-aside: 5%), and negative and significant coefficient of monthly tax attribute shows disutility associated with higher taxation payments. Size, sign, and significance of coefficients of DCE attributes were not considerably different between ICLVs and REs except for ICLV 2 in the Swedish sample. Norwegian respondents attached higher utility for increasing set aside areas to 10% and 20% ($p < 0.001$) and preferred introducing one more broadleaved species (ICLV 1, 2, 4, and RE, $p < 0.05$); but they were indifferent to changes in other attributes in all ICLVs. Swedish respondents showed higher utility for changes in all of the forest management attributes, irrespective of model specifications. While we point to some differences in mean values, we cannot conclude that DCE preferences were statistically different between the two samples. Results from a Chow-like test of equality of coefficients revealed that DCE coefficients were not statistically different ($\chi^2 = 15.34$, *degree of freedom* $= 11$, $p = 0.168$) between countries.

We also found significant effects of socio-demographic variables on stated choice. In the Norwegian sample, education had a positive and significant association with probability to choose an alternative strategy in ICLV 1 and 2, and RE ($p < 0.05$); age was negatively associated in ICLV 2 and 3, and RE ($p < 0.05$). In the Swedish sample, education had a positive relationship with stated choice for alternative strategy in ICLV 1, 3, 4 and RE ($p < 0.01$); age did not have a significant effect in any of the ICLVs. Gender and income were not significant in any of ICLVs and REs in both countries.

4.4. Marginal willingness to pay (MWTP)

Table 7 shows MWTP point estimates, standard errors and p-values across estimated models, by country. There were no large differences in estimated MWTP values between models. The public in both countries commonly had the highest MWTP for increasing set aside to 20% of total

Table 6
Results from random-effects model and choice equation part of integrated choice and latent variable models by country.

	Norway					Sweden				
	ICLV 1	ICLV 2	ICLV 3	ICLV 4	RE	ICLV 1	ICLV 2	ICLV 3	ICLV 4	RE
AttributesŦ										
Set aside	0.456***	0.453***	0.460***	0.456***	0.449***	0.503***	0.684***	0.499***	0.501***	0.497***
10%	(0.120)	(0.123)	(0.122)	(0.121)	(0.120)	(0.076)	(0.173)	(0.076)	(0.076)	(−0.075)
Set aside	0.487***	0.485***	0.485***	0.487***	0.472***	0.702***	0.943***	0.694***	0.701***	0.684***
20%	(0.133)	(0.134)	(0.133)	(0.133)	(0.132)	(0.088)	(0.220)	(0.088)	(0.088)	(−0.087)
+Uneven-aged	0.032	0.029	0.033	0.033	0.025	0.321***	0.404**	0.308***	0.319***	0.304***
10%	(0.127)	(0.129)	(0.128)	(0.127)	(0.127)	(0.089)	(0.132)	(0.089)	(0.089)	(−0.088)
+Uneven-aged	−0.122	−0.128	−0.119	−0.121	−0.125	0.256**	0.320*	0.245**	0.253**	0.246**
20%	(0.124)	(0.126)	(0.125)	(0.124)	(0.124)	(0.085)	(0.124)	(0.085)	(0.085)	(−0.085)
One more	0.185	0.186	0.181	0.185	0.18	0.393***	0.531**	0.394***	0.394***	0.383***
Conifer	(0.126)	(0.128)	(0.127)	(0.126)	(0.126)	(0.088)	(0.158)	(0.089)	(0.088)	(−0.088)
One more	0.274*	0.282*	0.269	0.274*	0.271*	0.327***	0.448**	0.330***	0.328***	0.319***
Broadleaved	(0.137)	(0.139)	(0.138)	(0.137)	(0.136)	(0.090)	(0.149)	(0.090)	(0.090)	(−0.089)
Monthly tax	−0.004***	−0.004***	−0.004***	−0.004***	−0.004***	−0.004***	−0.006***	−0.004***	−0.004***	−0.004***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.001)	(<0.001)	(<0.001)	(<0.001)
Socio-demographics										
Gender:	0.159	0.083	0.092	0.154	0.115	0.109	0.524	0.047	0.115	−0.035
Male	(0.193)	(0.198)	(0.195)	(0.193)	(−0.196)	(0.120)	(0.412)	(0.121)	(0.119)	(−0.122)
Education†	0.407*	0.446*	0.316	0.381	0.515*	0.430**	0.054	0.345**	0.410**	0.471***
	(0.200)	(0.203)	(0.204)	(0.201)	(−0.201)	(0.125)	(0.328)	(0.128)	(0.125)	(−0.129)
Age	−0.010	−0.019**	−0.013*	−0.010	−0.015*	−0.001	−0.031	−0.002	−0.001	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(−0.006)	(0.004)	(0.021)	(0.004)	(0.004)	(−0.004)
Income‡	0.035	0.029	0.102	0.039	0.088	−0.007	0.152	0.017	−0.002	0.011
	(0.207)	(0.214)	(0.208)	(0.206)	(−0.212)	(0.132)	(0.263)	(0.133)	(0.131)	(−0.136)
Random-	4.360***	4.576***	4.390***	4.317***	4.582***	3.719***	6.993*	3.810***	3.670***	4.041***
effectsǂ	(0.522)	(0.556)	(0.531)	(0.518)	(0.543)	(0.295)	(3.077)	(0.303)	(0.292)	(0.315)
Constant	0.158	0.143	0.167	0.160	0.138	−0.308	−0.384	−0.299	−0.308	−0.294
	(0.319)	(0.324)	(0.320)	(0.319)	(−0.317)	(0.217)	(0.301)	(0.218)	(0.217)	(−0.215)
Latent variables										
SpSo-P	0.553***					0.660***				
	(0.114)					(0.070)				
Tem-P		0.542***					1.810*			
		(0.132)					(0.744)			
Hyp-P			0.587***					0.629***		
			(0.128)					(0.076)		
Ov-P				0.596***					0.694***	
				(0.116)					(0.071)	
Obs.	3285	3285	3285	3285	3285	7545	7545	7545	7545	7545
n	657	657	657	657	657	1509	1509	1509	1509	1509
Log-likelihood	−21,211.612	−7785.978	−12,692.706	−37,391.121	−1815.550	−46,523.000	−17,634.454	−28,378.942	−81,593.609	−4297.257
AIC	42,515.223	15,621.955	25,449.412	74,916.200	3657.100	93,137.998	35,318.908	56,821.883	163,321.2	8620.513
BIC	42,795.691	15,774.383	25,644.520	75,324.700	3736.363	93,456.715	35,492.124	57,043.600	163,785.4	8710.586

SpSo-P: Spatial and social proximity; Tem-P: Temporal proximity; Hyp-P: hypothetical proximity. Ov-P: overall proximity to climate change, a combined measure of SpSO-P, Tem-P, and Hyp-P.
Standard errors clustered at individual-level in parentheses.
AIC: Akaike information criterion; BIC: Bayesian information criterion.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
Ŧ Reference level: set-aside 5%; 70% uneven-aged and 30% uneven-aged for Norway (90% uneven- aged and 10% even-aged for Sweden); one conifer.
† Below bachelor's degree or equivalent = 0; Equal or above bachelor's degree or equivalent = 1.
‡ Norway: <700,000NOK/year = 0, ≥700,000NOK/year = 1; Sweden: <600,000SEK/year = 0; ≥600,000SEK/year = 1.
ǂ Variance of the estimated random effects.

Table 7
Marginal willingness-to-pay estimates for selected forest management attributes, by model and country.

Models	Forest management attributes					
	Set aside 10%	Set aside 20%	+Uneven-aged 10%	+Uneven-aged 20%	One more conifer	One more broadleaved
Norway						
RE	9.74***	10.24***	0.54	−2.70	3.91	5.88*
	(2.67)	(2.93)	(2.75)	(2.72)	(2.73)	(2.97)
ICLV 1	9.84***	10.50***	0.69	−2.64	3.99	5.91*
	(2.67)	(2.93)	(2.74)	(2.71)	(2.72)	(2.97)
ICLV 2	9.65***	10.33***	0.63	−2.73	3.97	6.01*
	(2.68)	(2.92)	(2.74)	(2.72)	(2.73)	(2.97)
ICLV 3	9.89***	10.43***	0.70	−2.55	3.88	5.79
	(2.68)	(2.93)	(2.75)	(2.72)	(2.73)	(2.98)
ICLV 4	9.85***	10.52***	0.72	−2.62	4.00	5.92*
	(2.67)	(2.93)	(2.74)	(2.71)	(2.72)	(2.97)
Sweden						
RE	9.82***	13.49***	6.00***	4.86**	7.56***	6.29***
	(1.50)	(1.74)	(1.67)	(1.67)	(1.72)	(1.76)
ICLV 1	9.83***	13.73***	6.27***	5.01**	7.68***	6.39***
	(1.50)	(1.74)	(1.66)	(1.66)	(1.72)	(1.76)
ICLV 2	9.81***	13.54***	5.79**	4.59**	7.62***	6.43***
	(1.52)	(1.74)	(1.67)	(1.67)	(1.72)	(1.76)
ICLV 3	9.73***	13.52***	6.01***	4.77**	7.68***	6.43***
	(1.50)	(1.74)	(1.66)	(1.66)	(1.72)	(1.76)
ICLV 4	9.80***	13.71***	6.25***	4.96**	7.70***	6.42***
	(1.50)	(1.74)	(1.66)	(1.66)	(1.72)	(1.76)

Unit: Euro/month; 1 Euro (€) = 0.086 NOK = 0.084 SEK.
Standard errors in parantheses.
Estimates were obtained by δ-method.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

forest area from the *status quo* of 5%. MWTP for increasing set aside area to 10% and 20% were 9.65– 9.89€/month and 10.24– 10.52€/month among Norwegian respondents, and 9.73– 9.83€/month and 13.49– 13.73€/month among Swedish respondents, respectively. MWTP of Norwegian respondents for adopting one more broadleaved species was 5.88– 6.01€/month, but the estimate was not significant in ICLV 3. MWTP for adjusting the proportion of uneven-aged stands were only statistically significant ($p < 0.01$) in the Swedish sample. On average, Swedish respondents were willing to pay 5.79– 6.27€/month and 4.77– 5.01€/month to increase the proportion of uneven-aged tree stands by 10% and 20%, respectively; and 7.56– 7.70€/month and 6.29– 6.43€/month for adding one more coniferous species and one more broadleaved species, respectively. We cannot say mean Norwegian and Swedish public's MWTPs were statistically different since Chow-like test of equality of coefficients were not significant (section **4.3,** *Integrated choice and latent variable model*).

5. Discussion

5.1. Public preferences and marginal willingness-to-pay for selected forest management attributes

Our results show that both Norwegian and Swedish public seemed willing to accept less intensive area management practices that could increase biodiversity. Both the Norwegian and Swedish public showed the strongest preference for increasing set-aside areas compared to prevalent *status quo* levels. This may reflect on common public perceptions in Nordic countries (Gundersen and Frivold, 2008) toward reducing the footprint of forest operations (e.g. tailoring the size of clear cuts without infringing public accessibility and visual enjoyment of forest structures).

Average MWTP values for set-aside attributes showed that increasing it to 10% provided a similar gain in utility and the higher category (i.e. increasing set-aside to 20%) elicited a higher degree of utility to Norwegians and Swedish participants (Table 7). In the Swedish sample, increasing set-aside area provided the highest utility among all attributes, followed by adjusting tree species composition and proportion of uneven-aged tree stands. This might suggest that the Swedish public places greater importance on species diversity than diversification of stand age structures. This finding seems congruent with those of Nordén et al. (2017), which reported that Swedish citizens were more willing to pay to diversify tree species than for changing forest stand age and structures through a DCE.

5.2. Measurement and structural equations for psychological distances to climate change

Our data provides a three-dimensional structure of psychological distances to climate change (Table 4). While such a structure is not identical to the conceptual four-dimensional structure of PDs to climate change (Liberman and Trope, 2014), it does not necessarily deviate from the conceptual structure since a degree of direct correlation among the dimensions of PDs to climate change exists (Spence et al., 2012). The loading of all the items constructing PDs to climate change onto a single latent variable (Ov-P, **Tables 5** and **6**) supports the argument that these multiple dimensions appear to be intertwined (Keller et al., 2022).

Associations found between socio-demographic characteristics and PDs to climate change seem country-specific. While we found no significant relationship between age and hypothetical proximity, Milfont et al. (2014) found an inverse association after surveying New Zealanders. The significant and negative association between being male and hypothetical proximity to climate change found by Milfont et al. (2014) was also found in our Swedish sample (Table 5, Hyp-P).

5.3. Psychological distances to climate change and stated choice for forest management strategies

Our results showed that all dimensions of psychological proximity to climate change were correlated with greater support for biodiversity-augmenting changes in forest management in both nations (Table 6). We contextualized our choice tasks in terms of climate strategy in forest management by explicitly explaining to participants that the forest management profiles in our DCE aimed to address climate change. Previous studies conducted in different contexts suggest that psychological proximity to climate change was positively associated with increased support for climate policy (Singh et al., 2017; Spence et al., 2012). Results from past studies and our own DCE point to how the public in both Norway and Sweden might deem biodiversity-augmenting changes in forest management as a more acceptable climate strategy than the *status quo*. Nevertheless, we offer a point of caution that our findings do not equate public preference for biodiversity-augmenting attributes to endorsement for particular climate strategies.

Our findings come from the analyses of cross-sectional data from a survey conducted in the summer of 2022. Nevertheless, PDs to climate change are not constant but subject to change due to new information and events (Keller et al., 2022). Some empirical studies (e.g. Demski et al., 2017; Zanocco et al., 2018) have reported that exposure to extreme weather events has increased perceived proximity to climate change based on samples from the UK and the US, while others studies conducted in Germany and France did not find such statistically significant relationship (Gärtner and Schoen, 2021; Guillard et al., 2019). Given the increasing likelihood of more frequent and impactful climate-induced events (Stott, 2016), and our own empirical estimates denoting the association between dimensions of PDs to climate change and preferences for forest management contextualized as addressing climate change, we posit that biodiversity-increasing changes in forest management attributes will have greater public support in the future.

5.4. Policy recommendations

Among selected attributes and based on corresponding average MWTP estimates, forest management practices expanding set-asides garner a wider public approval than the *status quo* in both countries. Increased adoption of silvicultural methods such as continuous-cover-forestry (Kim et al., 2021; Lundmark et al., 2016) might receive a wider public support in Sweden as the Swedish public showed statistically discernible support for the promotion of mixed species and uneven-aged stand structures. Feasibility of implementing such biodiversity-supporting changes needs to be thoroughly investigated for their net costs and potential socio-ecological barriers that might be spatially variable to some extent. Besides, implementation of these changes should be made at forest owners' volition and be likely combined with technical and financial support.

We note that respondents may have negative connotations to *status-quo* forest management even though our DCE described that production-oriented management and wood products could contribute to climate mitigation. Yet, the latter role of forest management and wood product supply is often neglected by the public and may lead to negative evaluations (Ranacher et al., 2017, 2020). This point might also be reflected in past syntax of public preferences for Nordic forest attributes and management practices (Gundersen and Frivold, 2008). Wood product-oriented management and value-added systems are ingrained in Nordic economies and have a particular role to play in rural regional economies. Communication efforts to inform the public of carbon storage and substitution effects of wood products could help increase public perception and the acceptability of a sector deemed integral to the bioeconomy goals in Nordic nations (Lindner et al., 2017). Nonetheless, we point to any communication effort with caution as scientific evidence, risk and uncertainty on the role of forest products in climate mitigation need to be fully presented, and the interpretation of public messages can be highly sensitive to socio-economic conditions (Johnston and Radeloff, 2019).

We found no evidence that DCE coefficients and MWTP estimates were statistically different between the Norwegian and Swedish samples. But our results do not necessarily imply that preferences for forest management are homogeneous across both countries, nor that the lack of statistical evidence of differences might support a pan-European over national-level forest management approaches - as seems intended by the New EU Forest Strategy (Edwards and Kleinschmit, 2013; Gordeeva et al., 2022; Onida, 2020). While public opinion is an essential input for forest management policy, country-specific contexts such as wood production level and a broad set of other natural and socio-economic conditions are of central considerations. As noted by the European Council, a one-size-fits-all approach without taking country-specific contexts into account can be counterproductive to achieving climate mitigation and adaptation through forest management (European Council, 2021).

5.5. Limitations and future research

Our study is not without caveats. Our empirical measurement for PDs to climate change might be susceptible to measurement errors owing to complexity of the concept and questionnaires in two different languages. For example, omission of Hyp1 in measurement equations in ICLVs compared to CFA in both samples may imply measurement errors in this item in both countries. Measurement error is a common challenge in multilingual survey with self-reported psychometric questions. We also acknowledge that, among others, the precision of our MWTPs is constrained to the specific framing and design of the DCE which are common issues for all empirical applications of DCE (Rakotonarivo et al., 2016; Weng et al., 2021). Hence, we only referred to signs and relative size of our estimated MWTPs when drawing policy recommendations.

We recommend future studies to investigate unobserved heterogeneity in perceived changes in utility arising from the implementation of alternative forest management attributes. Accounting for unobserved heterogeneity provide consistent WTP estimates and distributional effects of resource management decisions (Boxall and Adamowicz, 2002). Behavioral constructs other than PDs to climate change, such as environmental attitudes, have been associated with heterogeneous levels of utility in forest and peatland management (Faccioli et al., 2020; Meldrum, 2015). Similar efforts in the context of climate change and forest management could guide to a more effective and legitimate climate-oriented national forest management.

Several country-specific factors including forest history, wood production levels and public interest on climate change and biodiversity may construct public preferences for forest management in different ways. Hence, future studies are advised to investigate public preferences and their explanatory variables in multiple European countries with different forest and socio-economic conditions and compare similarities and differences with robust methods. Such an effort could manifest Europeans' perception on climate-oriented forest management and provide scholarly inputs on ongoing policy discussions on priority between national-level and European-level forest management.

6. Conclusion

Our study elicited public preferences for biodiversity-augmenting management attributes in family-owned production forests of Norway and Sweden. Forest management was described with three selected attributes: set-aside, tree age variation, tree species composition. Particularly, we investigated how psychological distances to climate change were associated with preferences using integrated choice and latent variable approach. Norwegian respondents showed higher utility for increasing set aside areas to 10% and 20% and introducing one more broadleaved specie. Swedish respondents preferred increase in all attributes. However, there was no evidence that preferences were statistically different between countries.

Psychological proximity to climate change was positively associated with the probability to choose biodiversity-augmenting alternative strategies. Everything else constant, respondents with closer social, temporal and hypothetical distances were more likely to choose alternative strategies. Temporal remoteness was inversely correlated with stated choice for alternative strategies. Our results show that, on average, the Norwegian and Swedish public both seemed to be willing to accept larger set-asides that could increase biodiversity. Our findings suggest that psychological proximity to climate change correlates with greater support for biodiversity-augmenting changes in management of family-owned production forests.

Our findings that greater psychological proximity to climate change was associated with preference for biodiversity-increasing changes may imply that demand for biodiversity in family-owned production forests might increase with exacerbating climate change impacts. Expanding set-aside areas will likely receive a wider public approval in both countries. Communication efforts to inform public of carbon storage and substitution effects of wood-based products could help increase the public's perception and acceptability of wood production as an integral bioeconomy transition in Nordic countries. The indistinguishability of preferences between both countries does not necessarily support a one-size-fits-all European forest policy approach; country-specific forest and socio-economic conditions should be considered when crafting national forest management decisions. Future studies are recommended to investigate unobserved preferential heterogeneity associated with behavioral constructs other than PDs to climate change, and compare similarities and differences in preferences and their explanatory variables among European countries with different forest and socio-economic conditions.

Author statement

This manuscript or a very similar manuscript has not been published, nor is under consideration by any other journal.

CRediT authorship contribution statement

Do-hun Kim: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Hanne K. Sjølie:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition. **Francisco X. Aguilar:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data used in this manuscript are available online at the Harvard Dataverse (https://doi.org/10.7910/DVN/ZFNXFR).

Acknowledgements

This research was partly funded by the Swedish University of Agricultural Sciences' Forest Damage Center and Inland Norway University of Applied Sciences. The findings and opinions presented in the manuscript are the authors' and may not reflect those of the funder. Any errors are the responsibility of the authors. We thank Adan L. Martinez-Cruz for his valuable comments to an earlier version of the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.forpol.2024.103201.

References

Aguilar, F.X., Obeng, E.A., Cai, Z., 2018. Water quality improvements elicit consistent willingness-to-pay for the enhancement of forested watershed ecosystem services. Ecosyst. Serv. 30, 158–171. https://doi.org/10.1016/j.ecoser.2018.02.012.

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Alemu, M.H., Olsen, S.B., 2019. Linking Consumers' food choice motives to their preferences for insect-based food products: an application of integrated choice and latent variable model in an African context. J. Agric. Econ. 70 (1), 241–258. https://doi.org/10.1111/1477-9552.12285.

Barrios, M., Villarroya, A., Borrego, Á., Ollé, C., 2011. Response rates and data quality in web and mail surveys administered to PhD holders. Soc. Sci. Comput. Rev. 29 (2), 208–220. https://doi.org/10.1177/0894439310368031.

Behr, C., Russell, D.A., Locatelli, B., Pramova, E., Alumai, G.J., 2015. *How Forests Enhance Resilience to Climate Change: What We Know about Forests and Adaptation* (p. 48). Program on Forests (PROFOR). https://www.profor.info/sites/profor.info/files/How%20Forests%20Enhance%20Resilience%20to%20Climate%20Change%20What%20we%20know%20about%20how%20forests%20can%20contribute%20to%20adaptation_0.pdf.

Ben-Akiva, M., Mcfadden, D., Rling, T.G., Gopinath, D., Walker, J., Bolduc, D., Rsch-Supan, A.B., Delquieâ, P., Larichev, O., Morikawa, T., Polydoropoulou, A., Rao, V., 1999. Extended framework for modeling choice behavior. Mark. Lett. 10 (3), 187–203.

Ben-Akiva, M., Mcfadden, D., Train, K., Walker, J., Bhat, C., Bierlaire, M., Bolduc, D., Boersch-Supan, A., Brownstone, D., Bunch, D.S., Daly, A., De Palma, A., Gopinath, D., Karlstrom, A., Munizaga, M.A., 2002. Hybrid choice models: Progress and challenges. Mark. Lett. 13 (3), 163–175. https://doi.org/10.1023/A:1020254301302.

Bengtsson, B., 2004. Allemansrätten – Vad säger lagen? (Naturvårdsverket).

Bergquist, M., Nilsson, A., Harring, N., Jagers, S.C., 2022. Meta-analyses of fifteen determinants of public opinion about climate change taxes and laws. *Nature*. Climate Change 12(3), Article 3. https://doi.org/10.1038/s41558-022-01297-6.

Börger, T., Hattam, C., 2017. Motivations matter: Behavioural determinants of preferences for remote and unfamiliar environmental goods. Ecol. Econ. 131, 64–74. https://doi.org/10.1016/j.ecolecon.2016.08.021.

Boxall, P.C., Adamowicz, W.L., 2002. Understanding heterogeneous preferences in random utility models: A latent class approach. Environ. Resour. Econ. 23, 421–446. https://doi.org/10.1023/A:1021351721619.

Boxall, P.C., Adamowicz, W.L., Swait, J., Williams, M., Louviere, J., 1996. A comparison of stated preference methods for environmental valuation. Ecol. Econ. 18 (3), 243–253. https://doi.org/10.1016/0921-8009(96)00039-0.

Brown, T.A., 2015. *Confirmatory Factor Analysis for Applied Research* (Second Edition). The Guilford Press.

Brownstone, D., Train, K., 1998. Forecasting new product penetration with flexible substitution patterns. J. Econ. 89 (1–2), 109–129. https://doi.org/10.1016/S0304-4076(98)00057-8.

Bumann, S., 2021. What are the determinants of public support for climate policies? A review of the empirical literature. Rev. Econ. 72 (3), 213–228. https://doi.org/10.1515/roe-2021-0046.

Carson, R.T., Groves, T., 2007. Incentive and informational properties of preference questions. Environ. Resour. Econ. 37 (1), 181–210. https://doi.org/10.1007/s10640-007-9124-5.

Černauskas, V., Angeli, F., Jaiswal, A.K., Pavlova, M., 2018. Underlying determinants of health provider choice in urban slums: results from a discrete choice experiment in Ahmedabad, India. BMC Health Serv. Res. 18 (1), 473. https://doi.org/10.1186/s12913-018-3264-x.

Chavez, D.E., Palma, M.A., Nayga, R.M., Mjelde, J.W., 2020. Product availability in discrete choice experiments with private goods. J. Choice Model. 36, 100225 https://doi.org/10.1016/j.jocm.2020.100225.

Choi, A.S., Fielding, K.S., 2013. Environmental attitudes as WTP predictors: A case study involving endangered species. Ecol. Econ. 89, 24–32. https://doi.org/10.1016/j.ecolecon.2013.01.027.

Chow, G.C., 1960. Tests of equality between sets of coefficients in two linear regressions. Econometrica 28 (3), 591–605. https://doi.org/10.2307/1910133.

Comission, European, 2021. *New EU Forest Strategy for 2030*. https://eur-lex.europa.eu/resource.html?uri=cellar: 0d918e07-e610-11eb-a1a5-01aa75ed71a1.0001.02/DOC_1&format=PDF.

Conaway, M.R., 1990. A random effects model for binary data. Biometrics 46 (2), 317–328. https://doi.org/10.2307/2531437.

Demski, C., Capstick, S., Pidgeon, N., Sposato, R.G., Spence, A., 2017. Experience of extreme weather affects climate change mitigation and adaptation responses. Clim. Chang. 140 (2), 149–164. https://doi.org/10.1007/s10584-016-1837-4.

Drews, S., van den Bergh, J.C.J.M., 2016. What explains public support for climate policies? A review of empirical and experimental studies. Clim. Pol. 16 (7), 855–876. https://doi.org/10.1080/14693062.2015.1058240.

Duncker, P.S., Raulund-Rasmussen, K., Gundersen, P., Katzensteiner, K., De Jong, J., Ravn, H.P., Smith, M., Eckmüllner, O., Spiecker, H., 2012. How Forest management affects ecosystem services, including timber production and economic return: synergies and trade-offs. Ecol. Soc. 17 (4) https://www.jstor.org/stable/26269223.

Edwards, P., Kleinschmit, D., 2013. Towards a European forest policy—conflicting courses. Forest Policy Econ. 33, 87–93. https://doi.org/10.1016/j.forpol.2012.06.002.

Eriksson, L., Nordlund, A.M., Westin, K., 2013. The general public's support for forest policy in Sweden: A value belief approach. J. Environ. Plan. Manag. 56 (6), 850–867. https://doi.org/10.1080/09640568.2012.708324.

European Commission, 2020. Special Eurobarometer 501: attitude of European citizens toward the environment. Eur. Comm. https://doi.org/10.2779/902489.

European Council, 2021. Draft Council Conclusions on The New EU Forest Strategy for 2030. https://data.consilium.europa.eu/doc/document/ST-13537-2021-INIT/en/pdf.

Eurostat, 2022. At least upper secondary educational attainment, age group 25–64 by sex (online data code: TPS00065). https://ec.europa.eu/eurostat/databrowser/view/tps00065/default/table?lang=en.

Faccioli, M., Czajkowski, M., Glenk, K., Martin-Ortega, J., 2020. Environmental attitudes and place identity as determinants of preferences for ecosystem services. Ecol. Econ. 174, 106600 https://doi.org/10.1016/j.ecolecon.2020.106600.

FAO (Ed.), 2018. Climate change for forest policy-makers: An approach for integrating climate change into national forest policy in support of sustainable forest management: version 2.0. Food and Agriculture Organization of the United Nations.

Felton, A., Nilsson, U., Sonesson, J., Felton, A.M., Roberge, J.-M., Ranius, T., Ahlström, M., Bergh, J., Björkman, C., Boberg, J., Drössler, L., Fahlvik, N., Gong, P., Holmström, E., Keskitalo, E.C.H., Klapwijk, M.J., Laudon, H., Lundmark, T., Niklasson, M., Wallertz, K., 2016. Replacing monocultures with mixed-species stands: ecosystem service implications of two production forest alternatives in Sweden. Ambio 45 (2), 124–139. https://doi.org/10.1007/s13280-015-0749-2.

FSC, 2019. The FSC National Forest Stewardship Standard of Sweden. Forest Stewardship Council (FSC).

Gärtner, L., Schoen, H., 2021. Experiencing climate change: revisiting the role of local weather in affecting climate change awareness and related policy preferences. Clim. Chang. 167 (3), 31. https://doi.org/10.1007/s10584-021-03176-z.

Geng, A., Yang, H., Chen, J., Hong, Y., 2017. Review of carbon storage function of harvested wood products and the potential of wood substitution in greenhouse gas mitigation. Forest Policy Econ. 85, 192–200. https://doi.org/10.1016/j.forpol.2017.08.007.

Giergiczny, M., Czajkowski, M., Żylicz, T., Angelstam, P., 2015. Choice experiment assessment of public preferences for forest structural attributes. Ecol. Econ. 119, 8–23. https://doi.org/10.1016/j.ecolecon.2015.07.032.

Gordeeva, E., Weber, N., Wolfslehner, B., 2022. The new EU Forest strategy for 2030—an analysis of major interests. Forests 13 (9). https://doi.org/10.3390/f13091503 article 9.

Greene, W.H., Hensher, D.A., 2007. Heteroscedastic control for random coefficients and error components in mixed logit. Transport. Res. Part E: Logist. Transp. Rev. 43 (5), 610–623. https://doi.org/10.1016/j.tre.2006.02.001.

Groothuis, P.A., Mohr, T.M., Whitehead, J.C., Cockerill, K., Anderson, W.P., Gu, C., 2021. Measuring the direct and indirect effect of scientific information on valuing storm water management programs with a hybrid choice model. Water Resour. Res. 57 (5) https://doi.org/10.1029/2020WR027552 e2020WR027552.

Guillard, M., Navarro, O., Fleury-Bahi, G., 2019. Flooding experience and assessment of climate change: Implication of psychological distance, risk perception and place attachment / Experiencia de inundaciones y evaluación del cambio climático: implicaciones de la distancia psicológica, la percepción de riesgo y el apego al lugar. PsyEcology 10 (3), 287–312. https://doi.org/10.1080/21711976.2019.1622347.

Gundersen, V.S., Frivold, L.H., 2008. Public preferences for forest structures: A review of quantitative surveys from Finland, Norway and Sweden. Urban For. Urban Green. 7 (4), 241–258. https://doi.org/10.1016/j.ufug.2008.05.001.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2010. Multivariate data analysis, 7th ed. Prentice Hall.

Henseler, J., Ringle, C.M., Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. J. Acad. Mark. Sci. 43 (1), 115–135. https://doi.org/10.1007/s11747-014-0403-8.

Hof, A.R., Svahlin, A., 2016. The potential effect of climate change on the geographical distribution of insect pest species in the Swedish boreal forest. Scand. J. For. Res. 31 (1), 29–39. https://doi.org/10.1080/02827581.2015.1052751.

Högberg, P., Ceder, L.A., Astrup, R., Binkley, D., Bright, R., Dalsgaard, L., Egnell, G., Filipchuk, A., Genet, H., Ilintsev, A., Kurz, W.A., Laganière, J., Lemprière, T., Lundblad, M., Lundmark, T., Mäkipää, R., Malysheva, N., Mohr, C.W., Nordin, A., Kraxner, F., 2021. Sustainable Boreal Forest Management – Challenges and Opportunities for Climate Change Mitigation (Swedish Forest Agency).

Howe, C., Suich, H., Vira, B., Mace, G.M., 2014. Creating win-wins from trade-offs? Ecosystem services for human well-being: A meta-analysis of ecosystem service trade-offs and synergies in the real world. Glob. Environ. Chang. 28, 263–275. https://doi.org/10.1016/j.gloenvcha.2014.07.005.

Hoyos, D., Mariel, P., Hess, S., 2015. Incorporating environmental attitudes in discrete choice models: an exploration of the utility of the awareness of consequences scale. Sci. Total Environ. 505, 1100–1111. https://doi.org/10.1016/j.scitotenv.2014.10.066.

IPCC, 2019. Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems.

IPCC, 2023. Climate change 2023: Synthesis report. A report of the intergovernmental panel on climate change. Contribution of working groups I. In: II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC.

Johnson, R.F., Orme, B., 2010. Sample Size Issues for Conjoint Analysis. *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research*, vol. LLC. Research Publishers, Madison, pp. 57–66.

Johnston, C.M.T., Radeloff, V.C., 2019. Global mitigation potential of carbon stored in harvested wood products. Proc. Natl. Acad. Sci. 116 (29), 14526–14531. https://doi.org/10.1073/pnas.1904231116.

Johnston, R.J., Boyle, K.J., Adamowicz, W., (Vic), Bennett, J., Brouwer, R., Cameron, T. A., Hanemann, W. M., Hanley, N., Ryan, M., Scarpa, R., Tourangeau, R., & Vossler, C. A., 2017. Contemporary guidance for stated preference studies. J. Assoc. Environ. Resour. Econ. 4 (2), 319–405. https://doi.org/10.1086/691697.

Jones, C., Hine, D.W., Marks, A.D.G., 2017. The future is now: reducing psychological distance to increase public engagement with climate change. Risk Anal. 37 (2), 331–341. https://doi.org/10.1111/risa.12601.

Juutinen, A., Kosenius, A.-K., Ovaskainen, V., 2014. Estimating the benefits of recreation-oriented management in state-owned commercial forests in Finland: A choice experiment. J. For. Econ. 20 (4), 396–412. https://doi.org/10.1016/j.jfe.2014.10.003.

Keller, E., Marsh, J.E., Richardson, B.H., Ball, L.J., 2022. A systematic review of the psychological distance of climate change: towards the development of an evidence-based construct. J. Environ. Psychol. 81, 101822 https://doi.org/10.1016/j.jenvp.2022.101822.

Kim, J., Rasouli, S., Timmermans, H., 2014. Hybrid choice models: principles and recent Progress incorporating social influence and nonlinear utility functions. Procedia Environ. Sci. 22, 20–34. https://doi.org/10.1016/j.proenv.2014.11.003.

Kim, S., Axelsson, E.P., Girona, M.M., Senior, J.K., 2021. Continuous-cover forestry maintains soil fungal communities in Norway spruce dominated boreal forests. For. Ecol. Manag. 480, 118659 https://doi.org/10.1016/j.foreco.2020.118659.

Kjaer, T., 2005. A Review of the Discrete Choice Experiment—With Emphasis on its Application in Health Care. Syddansk Universitet.

Kuhfeld, W.F., 2010. Experimental design: efficiency, coding, and choice designs. Exp. Des. 189.

Kwak, N., Radler, B., 2002. A comparison between mail and web surveys: response pattern, respondent profile, and data quality. *Journal of of®cial.* Statistics 18, 257–273.

Lee, P.-S., Sung, Y.-H., Wu, C.-C., Ho, L.-C., Chiou, W.-B., 2020. Using episodic future thinking to pre-experience climate change increases pro-environmental behavior. Environ. Behav. 52 (1), 60–81. https://doi.org/10.1177/0013916518790590.

Liberman, N., Trope, Y., 2014. Traversing psychological distance. Trends Cogn. Sci. 18 (7), 364–369. https://doi.org/10.1016/j.tics.2014.03.001.

Lindner, M., Hanewinkel, M., Nabuurs, G.J., 2017. How can forest-based bioeconomy contribute to climate change adaptation and mitigation. In: Towards a Sustainable European Forest-Based Bioeconomy: Assessment and the Way Forward. European Forest Institute, pp. 77–85.

López-Mosquera, N., Sánchez, M., 2012. Theory of planned behavior and the value-belief-norm theory explaining willingness to pay for a suburban park. J. Environ. Manag. 113, 251–262. https://doi.org/10.1016/j.jenvman.2012.08.029.

Lundmark, T., Bergh, J., Nordin, A., Fahlvik, N., Poudel, B.C., 2016. Comparison of carbon balances between continuous-cover and clear-cut forestry in Sweden. Ambio 45 (2), 203–213. https://doi.org/10.1007/s13280-015-0756-3.

Maiella, R., La Malva, P., Marchetti, D., Pomarico, E., Di Crosta, A., Palumbo, R., Cetara, L., Di Domenico, A., Verrocchio, M.C., 2020. The psychological distance and climate change: A systematic review on the mitigation and adaptation behaviors. Front. Psychol. 11 https://doi.org/10.3389/fpsyg.2020.568899.

McDonald, R.I., Chai, H.Y., Newell, B.R., 2015. Personal experience and the 'psychological distance' of climate change: an integrative review. J. Environ. Psychol. 44, 109–118. https://doi.org/10.1016/j.jenvp.2015.10.003.

McFadden, D., 1980. Econometric models for probabilistic choice among products. J. Bus. 53 (3), S13–S29.

McFadden, D., 2001. Economic choices. Am. Econ. Rev. 91 (3), 351–378.

Meldrum, J.R., 2015. Comparing different attitude statements in latent class models of stated preferences for managing an invasive forest pathogen. Ecol. Econ. 120, 13–22. https://doi.org/10.1016/j.ecolecon.2015.09.024.

Milfont, T.L., Evans, L., Sibley, C.G., Ries, J., Cunningham, A., 2014. Proximity to coast is linked to climate change belief. PLoS One 9 (7), e103180. https://doi.org/10.1371/journal.pone.0103180.

Milon, J.W., Scrogin, D., 2006. Latent preferences and valuation of wetland ecosystem restoration. Ecol. Econ. 56 (2), 162–175. https://doi.org/10.1016/j.ecolecon.2005.01.009.

Morikawa, T., Ben-Akiva, M., McFadden, D., 2002. Discrete choice models incorporating revealed preferences and psychometric data. In: Advances in Econometrics, vol. 16. Emerald Group Publishing Limited, pp. 29–55.

Nocella, G., Boecker, A., Hubbard, L., Scarpa, R., 2012. Eliciting consumer preferences for certified animal-friendly foods: can elements of the theory of planned behavior improve choice experiment analysis? Psychol. Mark. 29 (11), 850–868. https://doi.org/10.1002/mar.20569.

Nordén, A., Coria, J., Jönsson, A.M., Lagergren, F., Lehsten, V., 2017. Divergence in stakeholders' preferences: evidence from a choice experiment on forest landscapes preferences in Sweden. Ecol. Econ. 132, 179–195. https://doi.org/10.1016/j.ecolecon.2016.09.032.

Nordic Forest Research, 2020. Nordic Forest statistics 2020 – resources, industry, trade, conservation, and climate. https://nordicforestresearch.org/wp-content/uploads/2021/03/Nordisk-skogsstatistik-3.pdf.

Official statistics of Sweden, 2022. 1. Declared productive forest land (1,000 hectares) by Region, Ownership class and Year. PxWeb. https://pxweb.skogsstyrelsen.se/pxweb/en/Skogsstyrelsens%20statistikdatabas/Skogsstyrelsens%20statistikdatabas_Fastighets-%20och%20agarstruktur/PX01.px/table/tableViewLayout2/.

Onida, M., 2020. Forest and forestry policy between the EU and its member states. Elni Rev. 16–24 https://doi.org/10.46850/elni.2020.004.

Ouvrard, B., Abildtrup, J., Bostedt, G., Stenger, A., 2019. Determinants of forest owners attitudes towards wood ash recycling in Sweden—can the nutrient cycle be closed? Ecol. Econ. 164, 106293 https://doi.org/10.1016/j.ecolecon.2019.04.005.

PEFC, 2022. PEFC N 02:2022 Norwegian PEFC Forest standard. Programme for Endorsement of Forest Certification (PEFC).

Rakotonarivo, O.S., Schaafsma, M., Hockley, N., 2016. A systematic review of the reliability and validity of discrete choice experiments in valuing non-market environmental goods. J. Environ. Manag. 183, 98–109. https://doi.org/10.1016/j.jenvman.2016.08.032.
Ranacher, L., Stern, T., Schwarzbauer, P., 2017. Do wood products protect the climate? Public perception of the forest-based sector's contribution to climate change mitigation. Austr. J. Forest Sci. 134 (3), 281–297.
Ranacher, L., Sedmik, A., Schwarzbauer, P., European Forest Institute, 2020. *Public perceptions of forestry and the forest-based bioeconomy in the European Union* (knowledge to action) [knowledge to action]. European Forest Institute. https://doi.org/10.36333/k2a03.
Reich, P.B., Bermudez, R., Montgomery, R.A., Rich, R.L., Rice, K.E., Hobbie, S.E., Stefanski, A., 2022. Even modest climate change may lead to major transitions in boreal forests. Nature 608 (7923). https://doi.org/10.1038/s41586-022-05076-3. Article 7923.
Savilaakso, S., Johansson, A., Häkkilä, M., Uusitalo, A., Sandgren, T., Mönkkönen, M., Puttonen, P., 2021. What are the effects of even-aged and uneven-aged forest management on boreal forest biodiversity in Fennoscandia and European Russia? A systematic review. Environ. Evid. 10 (1), 1. https://doi.org/10.1186/s13750-020-00215-7.
Scannell, L., Gifford, R., 2013. Personally relevant climate change: the role of place attachment and local versus global message framing in engagement. Environ. Behav. 45 (1), 60–85. https://doi.org/10.1177/0013916511421196.
Shan, J., Li, J., Xu, Z., 2019. Estimating ecological damage caused by green tides in the Yellow Sea: A choice experiment approach incorporating extended theory of planned behavior. Ocean Coast. Manag. 181, 104901 https://doi.org/10.1016/j.ocecoaman.2019.104901.
Sheppard, S.R.J., Meitner, M., 2005. Using multi-criteria analysis and visualisation for sustainable forest management planning with stakeholder groups. For. Ecol. Manag. 207 (1–2), 171–187. https://doi.org/10.1016/j.foreco.2004.10.032.
Singh, A.S., Zwickle, A., Bruskotter, J.T., Wilson, R., 2017. The perceived psychological distance of climate change impacts and its influence on support for adaptation policy. Environ. Sci. Pol. 73, 93–99. https://doi.org/10.1016/j.envsci.2017.04.011.
Soliman, M., Alisat, S., Bashir, N.Y., Wilson, A.E., 2018. Wrinkles in time and drops in the bucket: circumventing temporal and social barriers to pro-environmental behavior. SAGE Open 8 (2). https://doi.org/10.1177/2158244018774826, 215824401877482.
Soto, J.J., Márquez, L., Macea, L.F., 2018. Accounting for attitudes on parking choice: an integrated choice and latent variable approach. Transp. Res. A Policy Pract. 111, 65–77. https://doi.org/10.1016/j.tra.2018.03.003.
Spence, A., Poortinga, W., Pidgeon, N., 2012. The psychological distance of climate change. Risk Anal. 32 (6), 957–972. https://doi.org/10.1111/j.1539-6924.2011.01695.x.
Statistics Norway, 2022. 10613: Forest Properties and Productive Forest Area, by Tenure Status, Contents and Year. Statbank Norway, SSB. https://www.ssb.no/en/system/.
Stott, P., 2016. How climate change affects extreme weather events. Science 352 (6293), 1517–1518. https://doi.org/10.1126/science.aaf7271.
Tappenden, P., Brazier, J., Ratcliffe, J., Chilcott, J., 2007. A stated preference binary choice experiment to explore NICE decision making. PharmacoEconomics 25 (8), 685–693. https://doi.org/10.2165/00019053-200725080-00006.
Train, K., 1986. Qualitative Choice Analysis: Theory, Econometrics, and an Application to Automobile Demand, vol. 10. MIT press.
Train, K.E., 2009. Discrete Choice Methods with Simulation. Cambridge University Press.
Trope, Y., Liberman, N., 2010. Construal-level theory of psychological distance. Psychol. Rev. 117 (2), 440–463. https://doi.org/10.1037/a0018963.
Van Lange, P.A.M., Huckelba, A.L., 2021. Psychological distance: how to make climate change less abstract and closer to the self. Curr. Opin. Psychol. 42, 49–53. https://doi.org/10.1016/j.copsyc.2021.03.011.
Varian, H.R., 1992. Microeconomic analysis, 3th ed. Norton.
Verkerk, P.J., Delacote, P., Hurmekoski, E., Kunttu, J., Matthews, R., Mäkipää, R., Mosley, F., Perugini, L., Reyer, C.P.O., Roe, S., Trømborg, E., European Forest Institute, Colling, R., 2022. *Forest-based climate change mitigation and adaptation in Europe* (from science to policy) [from science to policy]. European Forest Institute. https://doi.org/10.36333/fs14.
Vij, A., Walker, J.L., 2016. How, when and why integrated choice and latent variable models are latently useful. Transp. Res. B Methodol. 90, 192–217. https://doi.org/10.1016/j.trb.2016.04.021.
Vossler, C.A., Doyon, M., Rondeau, D., 2012. Truth in consequentiality: theory and field evidence on discrete choice experiments. Am. Econ.J.Microecon. 4 (4), 145–171.
Weller, P., Elsasser, P., 2018. Preferences for forest structural attributes in Germany – evidence from a choice experiment. Forest Policy Econ. 93, 1–9. https://doi.org/10.1016/j.forpol.2018.04.013.
Weng, W., Morrison, M.D., Boyle, K.J., Boxall, P.C., Rose, J., 2021. Effects of the number of alternatives in public good discrete choice experiments. Ecol. Econ. 182, 106904 https://doi.org/10.1016/j.ecolecon.2020.106904.
Wooldridge, J.M., 2010. Econometric Analysis of Cross Section and Panel Data. MIT press.
Zanocco, C., Boudet, H., Nilson, R., Satein, H., Whitley, H., Flora, J., 2018. Place, proximity, and perceived harm: extreme weather events and views about climate change. Clim. Chang. 149 (3), 349–365. https://doi.org/10.1007/s10584-018-2251-x.
2021 EUSTAFOR., 2021. *Joint Statement: Draft new EU Forest Strategy: Time to really consider the opinion of EU forest and forest-based sector*. https://eustafor.eu/uploads/Joint-Statement_Draft-new-EU-Forest-Strategy-time-to-really-consider-the-opinion-of-EU-forest-and-forest-based-sector-003.pdf.