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ORIGINAL RESEARCH

Forest Owners' Willingness to Implement Measures to Safeguard Biodiversity: Values, Attitudes, Ecological Worldview and Forest Ownership Objectives

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Abstract

The effective implementation and development of conservation schemes to which participation of forest owners is voluntary, requires an understanding of forest owners' views on measures to safeguard forest biodiversity. The Forest Biodiversity Program for Southern Finland is currently the most important instrument of voluntary forest conservation in Finland. The aim of this study is to explore what kind of methods the forest owners are willing to implement to safeguard biodiversity in their own forests and to identify forest owner groups based on these views. The aim is also to compare forest owners' values, attitudes, endorsement of an ecological worldview and objectives for forest ownership as well as the background characteristics in these groups. The data were collected in 2015, by a nationwide mail survey sent to 3000 Finnish family forest owners (n = 1035). Five forest owner types were identified: *Conservationists, Moderate conservationists, Compensation oriented, Promoters of biodiversity through forest management* and *Uninterested*. Previous experience of implementation of voluntary measures to safeguard biodiversity and positive attitudes towards conservation were important in explaining the willingness to adopt conservation measures. The results can be utilized in developing voluntary conservation programs and in targeting advisory services related to biodiversity protection to different forest owner groups more accurately. The results support the need for flexible voluntary conservation programs, including a large variety of mechanisms to protect nature values in family owned forests.

Keywords Family forest owners · New ecological paradigm NEP · Schwartz's value types · Voluntary conservation measures

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Introduction

Measures to safeguard biodiversity have become more diverse in recent decades (Mayer and Tikka 2006; Kauneckis 2009; Hanley et al. 2012). Nature values in forests can be enhanced by e.g. regulatory mechanisms, incentive-based voluntary measures and by taking nature values better into account in forest management practices in commercially managed forests (e.g. leaving more retention trees in forest fellings). The Forest Biodiversity Program for Southern Finland (METSO) is currently the most important instrument of voluntary forest conservation in Finland (Anonymous 2014). Voluntary conservation mechanisms have been used also in Norway (Mitani and Lindhjem 2015), in Sweden through the Komet program (Widman 2016), in the United States through schemes such as the Conservation Reserve Program (Hellerstein 2017) and in Australia through e.g. tender programs (Whitten et al. 2013; Comerford 2014; Rolfe et al. 2017).

The need to safeguard biodiversity is widely recognized at global and national levels. The EU Biodiversity Strategy (European Commission 2011) set the goal of halting the loss of biodiversity and ecosystem services in the EU by 2020. In Finland the main goal of the METSO Program is to stop the decline of forest biodiversity (Anonymous 2014). Forest owners can voluntarily offer a forest site to be protected in the METSO Program either with a fixed-term contract or permanently and receive monetary compensation. Protected sites are left outside of forestry activities, and nature values of the site can be enhanced by nature management. Nature management projects are also implemented through METSO. The projects are planned by the Forest Centre and usually cover parts of the lands of several forest owners. Nature management includes restoring and preserving valuable natural features in forests using e.g. controlled burnings, restoration of streams, springs and mires. Participation in nature management projects is voluntary for forest owners and does not entail costs for the owner. The authorities evaluate the suitability of the sites offered to be protected in METSO and negotiate with the owner about the conservation method and the delineation of the site, and if both parties agree, they enter into a contract. A total of about 14,000 fixed-term and permanent contracts and land purchases have been concluded under the METSO Program from 2008 to 2019. In the METSO Program cooperation between landowners and authorities in the implementation of the measures is an important aspect (Anonymous 2014).

Forest conservation efforts are particularly needed in southern Finland where the share of protected forests is considerably lower than in northern Finland (OSF 2019) and the share of threatened habitat types is higher (Kontula and Raunio 2018). Private forest owners own 73% of the forestry land in Southern Finland (Ihalainen and Vaahtera 2018). Participation in the METSO Program is completely voluntary to forest owners. Therefore their acceptance of the conservation measures used is crucial to successful implementation of the program. However, a voluntary forest conservation program must have clear ecological goals and criteria that are based on ecological knowledge and research to be able to achieve the desired effects on biodiversity. The site selection criteria (Syrjänen et al. 2016) define the valuable forest habitats in Finland that can be protected through the METSO Program. Recreational

or cultural values can also be taken into consideration if they support biodiversity conservation. The sites protected in METSO generally have high ecological values (Siitonen et al. 2012).

Forest owners have been found to prefer less restrictive methods and appreciate flexibility and sovereignty in decision making as well as financial compensation for conservation (Horne 2006; Horne et al. 2009; Kumela and Koskela 2006; Sorice et al. 2013). According to Schirmer's et al. (2012) study concerning reversing scattered tree decline on private grazing land in Australia it is important that landholders are provided multiple options of instruments and choices for management practices. Flexibility of conservation mechanisms have been found to be important also to Tasmanian landowners by Van Putten et al. (2011).

It is important to know what kinds of measures forest owners are willing to use to safeguard biodiversity in order to develop voluntary conservation schemes that better match the varying views of forest owners. Identifying forest owner groups based on their willingness to implement different conservation measures and recognizing the background characteristics of the owners with different views can facilitate targeting advisory services and information sharing related to biodiversity protection more accurately. Understanding forest owners value priorities and their level of endorsement of an ecological worldview is essential for identifying to what extent the willingness to protect biodiversity is value-driven. Therefore the study aims to:

1. Clarify what kinds of measures forest owners are willing to use to safeguard biodiversity in their own forests and to identify forest owner groups based on these preferences, and
2. Describe the differences among these groups concerning values, the endorsement of an ecological worldview, objectives of forest ownership, attitudes towards conservation and the background features of forest owners.

Theoretical Framework

The study is theoretically based on Schwartz's value theory (1992, 1994, 2006), the new ecological paradigm (NEP) scale which measures the endorsement of an ecological worldview (Dunlap and Van Liere 1978; Dunlap et al. 2000; Dunlap 2008), and the studies on forest owners' objectives for forest ownership Karppinen (1998, 2000).

In Schwartz's value theory (Schwartz and Bilsky 1987, 1990; Schwartz 1992, 1994) values are defined as beliefs referred to desirable end states and behaviors. Values go beyond specific situations and are used as criteria for behavior and events. Values are ordered according to their relative importance, and relative importance guides action (Schwartz 2006). Schwartz's value theory (1994, 2006) identifies ten value types and their defining goals: benevolence, tradition, conformity, security, power, achievement, hedonism, stimulation, self-direction and universalism. These value types are distinguished from each other by the motivation they express (Schwartz 1992, 1994, 2006). The defining goal of *universalism* value type includes

protection of nature and it is the most interesting value type in the context of this study. It concerns the welfare of those in the entire society and world and for nature, and thus differs from benevolence, which focuses on the welfare of the people in the in-group. The indicators of universalism include unity with nature, a world of beauty, social justice and protecting the environment. The defining goal of universalism can be derived from the needs of survival that arise when individuals and groups become aware that failure to accept and treat different people fairly leads to serious controversy. Likewise, the inability to safeguard the natural environment causes the devastation of the resources that the society is dependent on (Schwartz 1992).

According to the Schwartz's value theory (1992, 1994), the circular structure of values forms a continuum of related motivations, with dynamic relations among the value types. The value types next to each other are compatible and harmonious, and those on opposite sides are conflicting. The values are organized along two bipolar dimensions, `openness to change–conservation´ and `self-transcendence–self-enhancement´. The dimension `openness to change–conservation´ reflects the contradiction between the values that stress readiness for change and independence in actions and emotions, and the values that underlie resistance to change, commitment, preservation of the past and self-restriction. The dimension `self-transcendence–self-enhancement´ highlights the conflict between the values that emphasize the concern for the welfare and interests of others and the values that stress one's own interests, success and control over others (Schwartz 1992, 1994). Schultz and Zelezny (1999) and Schultz et al. (2005) applied Schwartz's value theory to explore the relationship between values and environmental attitudes. Schwartz's value theory was applied by Eriksson et al. (2013) to study the legitimacy of the forest policy in Sweden among the public. Nordlund and Westin (2011) studied forest owners' forest values and forest management attitudes and Karppinen and Korhonen (2013) explored forest owners' value priorities compared to the general public.

Values and attitudes differ in a number of ways. Attitudes represent several beliefs focused on a certain object (Rokeach 1973), and they are our likes and dislikes towards objects, situations or other aspects (Bem 1970). According to Rokeach (1972), an attitude is quite strong organization of beliefs on something which is why one prefers to respond to certain situations in a certain type of a manner.

The new ecological paradigm (NEP) scale measures respondents' endorsement of an ecological worldview (Dunlap and Van Liere 1978; Dunlap et al. 2000; Dunlap 2008; Hawcroft and Milfont 2010). Originally the scale was termed the New Environmental Paradigm, and it was designed to measure the change among a population from the endorsement of the dominant social paradigm (DSP) that supports the prominent anthropocentric system of beliefs, towards endorsing a more environmentally conscious view (Dunlap and Van Liere 1978). The NEP scale has been revised twice, and the latest version is termed the new ecological paradigm (Dunlap et al. 2000). The scale includes 15 statements, of which eight reflect the endorsement of the new, more ecologically conscious paradigm (NEP), and seven of the statements represent support of the dominant social paradigm. Xiao and Buhrmann (2017) studied the structure and coherence of an emerging ecological worldview as measured by the NEP scale and discovered that both are consistent and stable over time. Schultz and Zelezny (1999) studied the relationship between values and

environmental attitudes and found that the value of universalism was a strong positive predictor, whereas the values of power and tradition were negative predictors of a stronger endorsement of ecological worldview.

Finnish forest owners have a wide range of objectives for forest ownership (Karppinen 1998, 2000). Karppinen (1998) used a set of statements describing monetary, recreational, emotional and aesthetic considerations, and identified three objective-dimensions: (1) non-timber objectives, (2) economic security and asset motives, and (3) sales income and self-employment opportunities. Karppinen (1998) identified four forest owner groups: multi-objective owners, recreationists, self-employed owners and investors. The same or an updated version of the objective statements has been used by Favada et al. (2009), Hujala et al. (2013), Kuuluvainen et al. (2014) and Häyrinen et al. (2015). Favada et al. (2009) and Hujala et al. (2013) identified the same four groups as Karppinen (1998) and, in addition, discovered a fifth group, called indifferent owners. Häyrinen et al. (2015) found four dimensions of objectives: the sense of economic security, recreation and leisure time, forestry as a source of income, and aesthetics and conservation of forests.

Forest Owner Survey Data and Analysis Methods

Data Description

The data were collected in autumn 2015 using a nationwide mail survey of a random sample of 3000 family forest owners who owned at least five hectares of forestry land (including productive and less productive forests) in Finland. The sample was selected from the Finnish Forest Centre's forest owner register. The sample included individuals owning forestry land, people owning forestry land together with the spouse, private partnerships and forest estates owned jointly by heirs. A total of 1035 respondents returned the questionnaire after two reminders, and the response rate was 35 percent. The respondents were also given the choice to reply online; 14 percent opted to do so.

A random selection of 46 recipients who had not replied to the questionnaire were interviewed by telephone. The non-respondents differed from the respondents to some extent. The non-respondents were more often farmers or female, and their forest holdings were slightly larger and more frequently owned jointly by heirs. They also less often supported the increase of the level of safeguarding nature values in private forests than the mail respondents, and the share of "cannot tell" replies to that question was higher (Table 1). The most common reasons for not answering the questionnaire were lack of time or interest or the complexity of the questionnaire.

Compared to the nationwide Finnish Forest Owner Surveys 2010 (Leppänen 2010; Hänninen et al. 2011) and 2020 (Karppinen 2020), the characteristics of the respondents of the study were somewhat similar. The respondents in 2015 were more often female and the share of jointly owned forest holdings was greater. The share of farmers and forestry entrepreneurs was smaller in 2015 compared to Finnish Forest Owner Survey 2010.

Table 1 Description of the background characteristics of the respondents and non-respondents in the survey 2015, and the respondents of the Finnish Forest Owner Survey 2010 (Hänninen et al. 2011) and 2020 (Karppinen et al. 2020), (modified from Juutinen et al. 2020)

	Respondents	Non respondents	Finnish Forest Owner Survey	
	n = 1035	n = 46	2010 n = 6318	2020 n = 6542
Average age, years	61	57	60	62
Average size of forest holding (forest land), ha	43	51	35	48*
Gender, %				
Female	37	49	25	25
Male	63	51	75	75
Occupation, %				
Wage earner	32	24	30	37
Farmer or forestry entrepreneur	9	24	16	9
Entrepreneur	6	2	7	6
Pensioner	50	44	45	47
Other (student, unemployed etc.)	3	7	2	2
Place of residence, %				
Rural	52	57	56	**
Population centre	17	17	19	**
City (> 20 000 habitants)	32	26	26	**
Place of residence, %				
Permanently on the holding	40	***	42	35
Elsewhere in the same municipality as the holding	21	***	22	27
Outside the municipality where the holding is located	39	***	35	37
Type of ownership, %				
Family (individual or with spouse)	66	59	76	72
Private partnerships	22	22	12	17
Estate owned jointly by heirs	13	20	11	11
Opinion on the level of safeguarding biodiversity in private forests, %				
Should be increased	19	7		
Present level appropriate	62	50		
Too high	11	16		
Cannot tell	9	27		

*Includes productive and less productive forests and thus the figure is not directly comparable to the other surveys

**Different classification

***Not included in non-respondent questionnaire

Variables

Forest owners were asked to express their willingness to implement seven different measures to safeguard biodiversity in their own forests using a five-point Likert scale ranging from not interested at all to very interested. The measures included fixed-term and permanent conservation options (forestry prohibited) with and without compensation, selling the land to the state for conservation purposes, areas to be set aside, and nature values being specifically taken into account in forest management practices.

Forest owners' value types were assessed using the Short Schwartz's Value Survey (SSVS) (Lindeman and Verkasalo 2005). This survey does not use separate value indicators, but measures the support for the ten value types directly. The value types and their definitions were presented in the questionnaire. The respondents assessed the importance of each of the ten value types in their own lives using a seven-point Likert scale (not important at all to very important). Although the SSVS is a condensed version of the original 56-variable measure battery of questions (Schwartz 1992), according to Lindeman and Verkasalo (2005) it has proven to have good reliability and high validity.

Forest owners' endorsement of an ecological worldview was estimated by using the NEP scale (Dunlap et al. 2000; Dunlap 2008). The respondents were asked to evaluate 15 statements describing the relationship between humans and nature, using a five-point Likert scale ranging from completely disagree to completely agree. The total NEP score was calculated for each respondent as the sum of all 15 statements of the scale ("Appendix 2"). Higher scores indicate a stronger endorsement of an ecological worldview. Seven of the NEP scale statements support the dominant social paradigm, which emphasizes human power over nature, and were coded in reverse order for the total sum score variable.

The objectives of forest ownership were examined using a set of 22 attitudinal statements (Karppinen 1998) ("Appendix 3"). Respondents were asked to evaluate their importance using a five-point Likert scale (insignificant to very important).

For multivariate analyses, missing values were imputed using multiple imputation (Berglund and Heeringa 2014) by generating an imputation regression model and performing it separately on each imputation. The imputation percentage was 1.1% among variables concerning measures to safeguard biodiversity. The imputed values were used to replace missing values in case if maximum of two values of seven in the observation were missing. If more than two values were missing, the respondent was excluded from that analysis. Imputation percentage was 0.4% among SSVS value type variables (imputed values used if max. three values were missing of ten), 0.5% among NEP scale items (imputed values used if max. four values were missing of 15) and 0.6% among forest ownership objective statements (imputed values used if max. three values were missing of 22). The effects of the imputation on the results were found to be negligible. The replacement of missing variables by imputing was considered appropriate as it provides more extensive data for multivariate analyses.

Forest owners' views towards conservation were examined by asking their opinion on the level of safeguarding nature values in Finnish private forests in general (it should be increased; the current level is appropriate; the current level is already

too high; cannot tell) and their attitude towards safeguarding biodiversity in their own forests in the next 5 years (seven-point Likert scale, negative to positive). The questionnaire contained questions concerning forest owner demographics including age, gender, place of residence and characteristics of the forest holding such as acreage and type of ownership. In addition to this, the level of knowledge of the METSO Program and prior experience in voluntary conservation were asked. The latter included voluntarily implementing measures to safeguard biodiversity in one's own forest, such as a fixed-term conservation contract, selling an area for conservation purposes, excluding a forest site from forestry activities or implementing management methods that take specifically nature values into account. Respondents were also asked to indicate whether they had carried out thinnings, fuelwood harvesting or final fellings or if they had applied certain forest management practices (e.g. planting, timber stand improvement) in their forest holding during a five-year period (2010–2014).

Analysis Methods

A factor analysis was used to identify the latent variables that cannot be directly observed but can be deduced from existing variables. The factors can be understood as hypothetical constructs that are extracted as wider concepts from measured variables (e.g. Thompson 2004; Tabachnick and Fidell 2007; Fabrigar and Wegener 2012). The maximum likelihood method (Tabachnick and Fidell 2007) was used to extract factors from sets of variables concerning forest owners' interest in implementing different measures to safeguard biodiversity and concerning forest ownership objectives.

An oblique Promax rotation was applied in the factor analysis concerning forest owners' interest in implementing different measures to safeguard biodiversity because considerable correlations were observed between the factors. Some correlation between factors can be expected, especially in studies in the social science field. If the factors are correlated, using an oblique rotation method instead of an orthogonal method can lead to more accurate results (Costello and Osborne 2005). As regards forest ownership objectives, considerable correlations between the factors was not detected, and an orthogonal Varimax rotation was used. Internal consistency of the factors was evaluated by means of Cronbach's alpha (Tavakol and Dennick 2011), and the sampling adequacy was assessed using the Kaiser-Mayer-Olkin measure. If the respondent had replied "cannot tell" to all statements concerning willingness to implement different measures to safeguard biodiversity or statements concerning the objectives of forest ownership, the respondent was removed from the factor analysis.

The factor scores were further used in K-means cluster analysis (e.g. Hartigan 1975) to classify forest owner groups based on their interest in implementing different conservation measures. Factor or principal component analysis and cluster analysis have been used in several forest owner typology studies (Karppinen 1998; Favada et al. 2009; Hujala et al. 2013; Ficko et al. 2019). Hypotheses related to the number and the content of the clusters were based on earlier research results

from Finnish forest owners (Horne 2006; Horne et al. 2009; Mäntymaa et al. 2009; Koskela 2011).

The relation between forest ownership objectives and the forest owner groups based on their willingness to implement different conservation measures was assessed by calculating the factor score means of objective factors of forest ownership and comparing them by these forest owner groups. The forest owner groups were further characterized by cross tabulating the clusters with background variables. The Pearson's χ^2 test was used to compare the percentage distributions (Field 2013), and a one-way analysis of variance (Tabachnick and Fidell 2007) was used to compare means. In cases where variances were not homogenous according to Levene's test, the Kruskal–Wallis test was used for mean comparisons. Forest owner value types were analyzed by calculating the means of the value scores. The means of the value scores of different forest owner groups were compared and presented on a radar graph.

A multinomial logistic regression analysis was used to study the differences between the identified forest owner groups. A multinomial logistic regression analysis is an extension of binary logistic regression and can be used for a dependent variable that is categorical with more than two categories. One category is chosen as a reference, and the model predicts the change in the odds of belonging in a certain category compared to the reference category (Hosmer and Lemeshow 2000; Field 2013). The variables included in the model were derived from the theoretical framework of the study: two value types (universalism and security), the total NEP sum score and forest ownership objective factor scores. The value type universalism was chosen to be included into the model because the defining goal of universalism include protection of nature (Schwartz 1992, 1994) and it belongs to the dimension `self-transcendence` in the Schwartz's value theory. The value type security emphasizes e.g. safety and stability of society and belongs to the dimension `conservation` in the Schwartz's value theory, and can thus be interpreted to be partly conflicting with universalism (Schwartz 1992, 1994). In addition, variables describing support for increasing the level of safeguarding nature values in private forests in general, prior experience of voluntarily implementing measures to safeguard biodiversity in one's own forests and the attitude towards conservation in one's own forests, gender, age and place of residence were included in the model. Analyses were conducted using SPSS 25.

Results

Willingness to Implement Measures to Safeguard Biodiversity: Typology

In general, the forest owners were more often willing to implement the measures that had less intensive impact on property rights or included compensation (Table 2). Two-fifths of the respondents were willing to specifically take nature values into account in forest management practices, and more than one-fourth indicated their willingness to implement a fixed-term conservation contract with compensation. One-fifth of the respondents indicated that they were interested in leaving

Table 2 Factor analysis of the statements concerning forest owners' interest in implementing measures to safeguard biodiversity in their own forests

Measures	Factors			
	Interested or very interested in implementing (%)	Safeguarding biodiversity as part of forest management	Compensation principle	No compensation
Leaving ecologically valuable site outside forestry activities without contract and compensation	20	0.819		
Nature values specifically taken into account in forest management	40	0.811		
Permanent conservation with compensation, land ownership remains	18		0.882	
Fixed-term contract, with compensation, no restrictions after the contract term	27		0.647	
Sale of the land to the state	17		0.544	
Permanent conservation without compensation, land ownership remains	7			0.981
Fixed-term contract without compensation, no restrictions after the contract term	8	0.390		0.439
Eigenvalues		3.540	1.120	0.772
Variance explained, %		51	16	11
Cronbach's alpha		0.773	0.727	0.801

The factor loadings and the percentages (%) of respondents who were interested or very interested in implementing the measure

Maximum likelihood, Promax rotation, loadings below 0.300 not included

Kaiser–Mayer–Olkin measure of sampling adequacy 0.795, Bartlett's test of sphericity $p = <0.001$, df = 21, n = 921

an ecologically valuable site outside forestry activities without both, contract and compensation. A bit less than one fifth were interested in implementing permanent protection of an area with compensation, or to sell land to the state for conservation purposes. The implementation of a fixed-term conservation contract without compensation was considered interesting by eight percent of forest owners, and implementation of permanent protection of an area without compensation was of interest to seven percent of forest owners.

The variables describing the willingness to implement different conservation measures were condensed into three dimensions by a factor analysis (Table 2). For the first factor, *Safeguarding biodiversity as part of forest management,* the measures in which biodiversity is enhanced without compensation or a binding contract had the highest loadings. Fixed-term conservation contracts without compensation were slightly cross-loaded to this factor. For the second factor, *Compensation principle,* the options that included compensation were emphasized. For the third factor, *No compensation,* permanent and fixed-term conservation of an area without compensation achieved the highest loadings.

The factor scores describing forest owners' willingness to apply different conservation measures were used as inputs for a K-means clustering analysis. Five clusters were identified: Conservationists, Moderate conservationists, Compensation oriented, Promoters of biodiversity through forest management and Uninterested (Table 3).

Conservationists (9% of forest owners) supported all types of conservation measures, including those without compensation. Conservationists were often in favor of the increase of the level of safeguarding biodiversity in private forests in general and had a positive attitude towards conservation in their own forests. About half of them had previous experience of voluntarily implementing measures to safeguard forest biodiversity. Forest owners in this group more often had higher level of education and more knowledge of the METSO Program than forest owners in the other groups, and the share of women was high ("Appendix 1"). *Moderate conservationists*

Table 3 Forest owner grouping based on their interest in implementing measures to safeguard biodiversity in their own forests. K-means clustering

Groups	n	Safeguarding biodiversity as part of forest management	Compensation principle	No compensation
		Mean of factor score		
Conservationists	82	1.385	1.416	2.234
Moderate conservationists	146	0.817	0.410	1.028
Compensation oriented	180	0.097	0.954	−0.334
Promoters of biodiversity through forest management	184	0.343	−0.409	−0.376
Uninterested	329	−0.953	−0.828	−0.614
F-value (df 916)		691.936	808.277	1173.155
Sig.		<0.001	<0.001	<0.001

(16%) were to various degrees in favor of all of the conservation measures but not as strongly as forest owners in the Conservationists group. The shares of women and of absentee ownerships were highest in this group. *Compensation oriented owners* (20%) were interested in implementing the conservation measures that included compensation, both fixed-term and permanent options. The share of men was high in this group. *Promoters of biodiversity through forest management* owners (20%) shared willingness to make an effort to safeguard and enhance biodiversity as part of forest management practices, by specifically taking nature values into account or leaving ecologically valuable sites outside forestry activities. The group was characterized by a high share of men, a relatively high level of education and a high frequency of prior experience with using voluntary conservation measures ("Appendix 1"). The owners in the *uninterested group* (36%) did not express willingness to implement the presented measures in their own forests. The group was characterized by older ages, a lower education levels and permanent residences on the forest holdings. Support for the increase of the level of safeguarding biodiversity in private forests was lower among the Uninterested, as well as the frequency of prior experience of voluntarily implementing measures to safeguard forest biodiversity in their own forests. The share of the owners that did not have knowledge of the METSO Program was highest in this group ("Appendix 1"). There were no significant differences between the groups in terms of the size of forest holdings or activeness in forest management practices or activeness in executing thinnings, fuelwood harvesting or final fellings.

Value Types

Based on the means of the value scores of the ten value types (Schwartz 1994), the forest owners considered security, benevolence, conformity and tradition the most important values. The forest owner groups had relatively similar value profiles (Fig. 1). The exception was Conservationists, who considered benevolence the most important value type, security the second most important and universality, which includes an emphasis on nature protection, the third most important value type. Power, stimulation and achievement were considered the three least important value types by all groups. The differences in the mean value scores between forest owner groups were statistically significant for the value types universalism (Kruskal–Wallis test, $p \leq 0.001$), security ($p = 0.002$), power ($p = 0.027$) and self-direction ($p = 0.03$).

Endorsement of an Ecological Worldview

Forest owners' endorsement of an ecological worldview was measured using the NEP scale (Dunlap et al. 2000). The statements of the scale that support an environmentally conscious worldview had in general higher mean scores than the statements that describe human power over nature ("Appendix 2"). The respondents agreed most strongly with the NEP scale (Dunlap et al. 2000, p. 433) statements: "*Despite our special abilities humans are still subject to the laws of nature*", "*Plants and animals have as much right as humans to exist*" and "*We are*

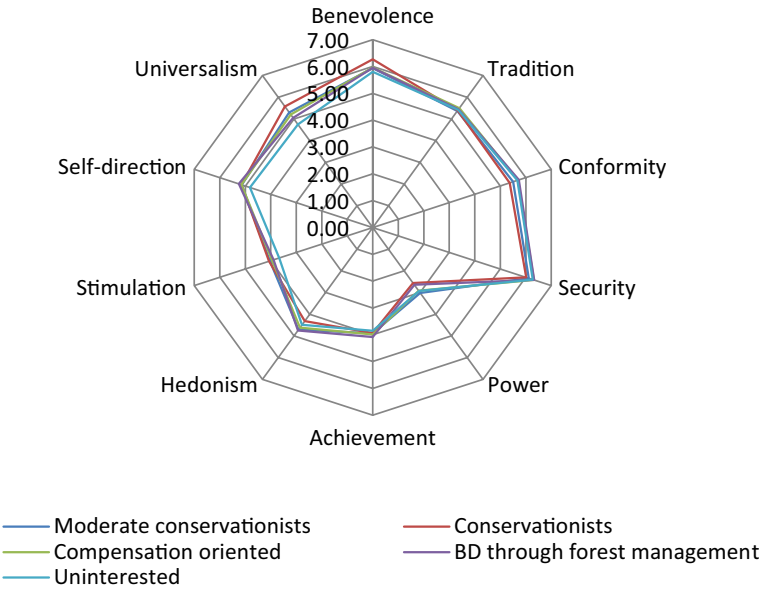

Fig. 1 Means of Schwartz's value type scores by forest owner group based on their interest in implementing measures to safeguard biodiversity in their own forests

approaching the limit of the number of people the earth can support". The total NEP sum score varied between 19 and 75 among respondents; the mean score was 53.7 (SD 8.46) and the median 53.0.

The total NEP sum score differed among the forest owner groups ($p < 0.001$) (Table 4). The highest mean score indicating support for an ecological worldview was among Conservationists and the lowest was among Uninterested owners. Both Conservationists and Uninterested owners differed significantly from the other groups.

Table 4 The mean total NEP (Dunlap et al. 2000) sum score by forest owner group based on their interest in implementing measures to safeguard biodiversity in their own forests (one-way ANOVA)

	n	Mean total NEP sum score (SD)	*p* value
Groups			< 0.001
Conservationists[a]	77	59.3 (6.89)[bcde]	
Moderate conservationists[b]	139	54.2 (7.36)[ae]	
Compensation oriented[c]	172	54.9 (8.48)[ae]	
Promoters of biodiversity through forest management[d]	175	54.3 (8.10)[ae]	
Uninterested[e]	289	50.7 (8.78)[abcd]	

The mean difference between groups is significant at the < 0.01 level, marked with [abcde]

Objectives of Forest Ownership

The objectives of forest ownership were examined using 22 attitudinal statements. The respondents most often considered the possibility to pick berries and mushrooms, the opportunity to do forest work and the possibility to harvest household timber as important or very important ("Appendix 3"). The objectives were reduced into two dimensions using factor analysis. The first factor was characterized by high loadings on variables dealing with monetary objectives, especially concerning economic security, and hence was labeled *Economic security and income*. Non-timber aspects, especially objectives related to recreation, aesthetics and the protection of biodiversity, were emphasized in the second factor, which was named *Recreation, conservation and aesthetics*. The mean factor scores of both factors differed between forest owner groups (Kruskal–Wallis test, first factor $p=0.004$, second factor $p<0.001$). The mean factor score for Economic security and income was slightly positive in the Uninterested and Moderate conservationists groups and negative in the other groups (Table 5). The mean factor score for Recreation, conservation and aesthetics was positive in all other groups except Uninterested and was highest for the Conservationists group.

Uninterested vs. Other Groups

A multinomial logistic regression model was estimated to describe the differences between the identified forest owner groups. The group Uninterested was used as the reference group in the model (Table 6). The inclusion of predictors significantly improved the fit of the model compared to the model including only the intercept $\chi^2_{44}=278.4$ ($p<0.001$). Goodness of fit was explored by conducting Pearson's χ^2 ($p=0.183$) and Nagelkerke Pseudo R-Square = 0.356. The model predicts 44.3 percent of the group memberships correctly.

Compared to Uninterested, a higher mean score of the Security value type, that emphasizes e.g. safety and stability, decreased the odds of belonging to the Conservationists and Moderate conservationists groups. The importance of the Universalism

Table 5 Mean factor scores for forest ownership objective factors by forest owner group based on their interest in implementing measures to safeguard biodiversity in their own forests (Kruskal–Wallis test)

	n	Factors	
		Economic security and income (SD)	Recreation, conservation and aesthetics (SD)
Groups			
Conservationists[a]	80	− 0.272 (0.953)[e]	0.454 (0.803)[bcde]
Moderate conservationists[b]	143	0.034 (0.826)	0.023 (0.812)[a]
Compensation oriented[c]	177	− 0.038 (0.888)	0.051 (0.920)[a]
Promoters of biodiversity through forest management[d]	183	− 0.111 (0.999)	0.081 (0.833)[a]
Uninterested[e]	312	0.141 (0.999)[a]	− 0.213 (1.053)[a]

The mean difference between groups is significant at the < 0.01 level, marked with [abcde]

Table 6 Multinomial logistic regression model on forest owner groups based on their interest in implementing measures to safeguard biodiversity in their own forests

Variables	Conservationists	Moderate conservationists	Compensation oriented	Promoters of biodiversity through forest management
	OR (95% CI)	OR(95% CI)	OR (95% CI)	OR (95% CI)
Continuous variables				
Value type *security*	0.578** (0.407, 0.820)	0.726* (0.543, 0.970)	0.872 (0.659, 1.153)	0.916 (0.694, 1.210)
Value type *universalism*	1.201 (0.917, 1.574)	1.017 (0.827, 1.251)	0.932 (0.777, 1.118)	0.936 (0.784, 1.119)
Total NEP sum score	1.061* (1.014, 1.110)	1.025 (0.991, 1.060)	1.040* (1.009, 1.072)	1.029 (0.998, 1.060)
Objective factor score economic security and income	0.697 (0.483, 1.006)	1.066 (0.798, 1.425)	0.995 (0.768, 1.290)	0.855 (0.664, 1.102)
Objective factor score recreation, conservation and aesthetics	1.700* (1.102, 2.625)	1.122 (0.831, 1.514)	1.234 (0.938, 1.624)	1.232 (0.938, 1.618)
Attitude towards safeguarding biodiversity in one's own forest[1]	2.479*** (1.717, 3.580)	1.705*** (1.366, 2.127)	1.558*** 1.296, 1.873	1.294** (1.095, 1.529)
Age, years	0.975 (0.949, 1.002)	0.978* (0.958, 0.999)	0.980* (0.962, 0.999)	0.973** (0.955, 0.991)
Dummy variables				
Opinion on the level of safeguarding biodiversity in private forests: Should be increased	4.123** (1.797, 9.456)	2.214* (1.056, 4.654)	1.713 (0.840, 3.492)	1.117 (0.527, 2.364)

Table 6 (continued)

Variables	Conservationists	Moderate conservationists	Compensation oriented	Promoters of biodiversity through forest management
	OR (95% CI)	OR(95% CI)	OR (95% CI)	OR (95% CI)
Prior experience in voluntary conservation[2]: Yes	3.390** (1.668, 6.887)	2.402** (1.342, 4.298)	2.181** (1.277, 3.725)	4.752*** (2.845, 7.935)
Gender: male	1.006 (0.510, 1.983)	0.976 (0.575, 1.657)	2.086** (1.257, 3.461)	1.634 (0.999, 2.670)
Place of residence: living on the forest holding	0.940 (0.460, 1.923)	0.449** (0.251, 0.804)	0.600* (0.363, 0.993)	0.635 (0.386, 1.043)

The reference category is Uninterested

Reference group: Uninterested (n = 215). OR = Odds Ratio. SE = Standard Error. 95% CI = Confidence Interval

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

n = 670

[1]Seven-point Likert scale (negative to positive)

[2]Voluntary implementation of at least one measure to safeguard biodiversity in one's own forest, such as entering into conservation contract, excluding a forest site or sites from forestry activities, or managing certain forest areas in a manner that specifically takes nature values into account

value type did not affect the odds of belonging to other groups compared to Uninterested. A higher NEP score increased the probability of belonging to Conservationists and Compensation oriented compared to Uninterested. The economic objectives of forest ownership did not have a significant effect, but the emphasis on the objectives related to recreation and conservation increased the likelihood of belonging to Conservationists compared to Uninterested. Support to increasing of the level of safeguarding biodiversity in private forests in general increased the likelihood of belonging to Conservationists and Moderate conservationists versus Uninterested. Prior experience of voluntarily implementing measures to safeguard forest biodiversity and a positive attitude towards conservation in one's own forest increased the probability of belonging to all other groups compared to Uninterested. Concerning demographics, male gender increased the odds of belonging to Compensation oriented, and absentee ownership increased the probability of belonging to Moderate conservationists or Compensation oriented compared to Uninterested. Younger age increased the odds of belonging to the Moderate conservationists, Compensation oriented or Promoters of biodiversity through forest management groups compared to Uninterested.

Discussion

In this study, the forest owners were divided into five types based on their willingness to implement measures to safeguard biodiversity in their forests: Conservationists and Moderate conservationists indicated a high willingness to implement a large variety of conservation measures. Compensation oriented and Promoters of biodiversity through forest management were interested in implementing conservation measures that fulfill certain conditions. The fifth group, Uninterested, did not indicate interest in implementing measures to safeguard biodiversity. In general, forest owners preferred the conservation measures that had a less intensive effect on ownership rights or that included compensation. Flexible conservation arrangements have also been found to receive more support among the other groups of landowners (Schirmer et al. 2012; Van Putten et al. 2011).

The study applied Schwartz's value theory (Schwartz 1992, 1994, 2006) and the new ecological paradigm scale (Dunlap and Van Liere 1978; Dunlap et al. 2000; Dunlap 2008). A positive attitude towards safeguarding nature values and previous experience with voluntary implementation of measures to protect biodiversity are strong explaining factors for the willingness to adopt conservation measures. Mäntymaa et al. (2009) found a positive attitude towards conservation to be related to forest owners' interest to participate in voluntary conservation program. According Uliczka (2004) positive attitude to conservation is linked to more frequent setting aside of forest areas for conservation during fellings. Rodriguez's et al. (2012) study showed that landowners' previous experience in participating in other programs has a positive relationship to landowners' interest in implementing contracts to protect endangered species habitats in North Carolina, U.S.

Conservationists are characterized by positive attitude towards conservation in their own forests. They support additional protection of forests in general, and often have prior experience with voluntarily implementing measures to safeguard

biodiversity. They also have knowledge of the METSO Program and emphasize the recreational objectives of forest ownership more than other forest owners. Conservationists have a higher total NEP score, which means that they support an environmentally conscious worldview more than the other forest owner groups. They could be potential participants of voluntary conservation programs and also willing to safeguard biodiversity through forest management.

Moderate conservationists are in principle interested in implementing conservation measures, but they are less committed than Conservationists. The share of owners living on the forest holding is relatively low in this group, which may indicate that forest-related issues are less familiar to them or that they are financially less dependent on their forests. Moderate Conservationists could be potential participants in voluntary conservation programs, but they probably would need encouragement and advice from forest or environmental advisors to do so. Forest advisors have a central role in introducing measures to enhance biodiversity to forest owners, as also found by Korhonen et al. (2013).

Compensation oriented forest owners are interested in implementing conservation measures that include financial compensation. But the Compensation oriented forest owners do not place stronger emphases on the economic objectives of forest ownership. Compensation oriented forest owners could be encouraged to participate in voluntary conservation by sharing information on conservation options that include compensation. The importance of compensation for forest owners in contract-based conservation has been found also by Horne (2006) and Horne et al. (2009). Boon et al. (2010) notes that in most cases offering financial compensation increase forest owners' willingness to set aside forest areas, but it is not the only motivating factor.

The Promoters of biodiversity through forest management group is characterized by the willingness to safeguard nature values as part of everyday forest management without contracts. Prior experience of voluntarily implementing measures to safeguard biodiversity is almost as frequent in this group as among Conservationists. It is important that these forest owners are provided with the information and necessary services to take biodiversity into account in forest planning and management.

The Uninterested group didn't indicate interest in implementing measures described in the questionnaire. However, among the Uninterested group the attitude towards safeguarding biodiversity in their own forests is at least to some extent positive. This may indicate that they could be motivated by some other conservation mechanisms which were not considered in the study. It is also possible that they think that the current restrictions and recommendations set by laws and certification systems are sufficient to protect biodiversity. Overall, the Uninterested have less knowledge of the options offered by the METSO Program than the forest owners in the other groups. It would be essential for forest owners to be aware of the conservation mechanisms available. Therefore, the different options to safeguard forest biodiversity should be brought up by forest authorities, forest extension officers and other forestry professionals whenever forest management decisions are made. A positive connection between obtaining forest management advice and participation in a cost-share program was found by Ma et al. (2012).

The observed structure of forest owners' value types followed Schwartz's value theory (1994): the radar chart shows that if the mean score of a value type is high,

the corresponding contradictory value type receives less support. Forest owners consider security, benevolence, conformity and tradition the most important value types. Similar result was found by Karppinen and Korhonen (2013) among Finnish forest owners. Forest owners emphasize security and tradition more than the general public (Puohiniemi 2006; Karppinen and Korhonen 2013).

A higher rating of the security value type is related to decreased probability of belonging to the Conservationists and Moderate conservationists groups compared to Uninterested. In the Schwartz's value theory (1992, 1994), the value universality is located in the high end of self-transcendence dimension, and security is located in the low end of conservation dimension. In this respect, universality and security can be interpreted as partly conflicting values. Although the mean score of the universalism value type differed among groups and was highest among Conservationists, the importance of universalism does not have a significant effect on the probability of belonging to the other groups compared to Uninterested in the model estimation.

The respondents agreed more often with the NEP scale (Dunlap et al. 2000) statements supporting an environmentally conscious worldview than the statements that describe human power over nature. The NEP sum score reflects the intensity of the willingness to implement conservation measures relatively well. The score was highest among Conservationists and lowest among Uninterested. A higher NEP score increased the likelihood of belonging to Conservationists or Compensation oriented owners compared to Uninterested. Comerford (2014) applied a shortened NEP scale to study landowners' participation to the Queensland's Vegetation Incentives Program in Australia and found that the participants had higher NEP scores that non-participants, and that participants had high levels of previous experience in participating other programs.

The study had some limitations which should be taken into account when interpreting the results. The interest of the respondent in the subject of the study can affect their willingness to reply, and the forest owners who have a positive attitude towards nature conservation might have been more likely to respond the survey more actively. The latter was also supported by the non-response analysis. Voluntary agreements through the METSO Program have been the prevailing practice in Finland for approximately a decade. Therefore, prior experience of voluntarily implementing conservation measures means in most cases leaving ecologically valuable sites outside forestry activities or specifically taking nature values into account in forest management. To some extent, the forest owners' indication of interest towards implementation of different conservation measures may have been hypothetical because the owners did not have to assess whether their forest sites fulfilled the METSO criteria.

Conclusions

The results suggest that willingness to implement measures to safeguard forest biodiversity seems to be at least partly value-driven. However, many forest owners consider specific contract terms, such as compensation, as a prerequisite for participation in a contract-based conservation scheme. That would make the implementation of conservation measures more vulnerable to possible changes in contract terms. On the other

hand, possibility to safeguard forest biodiversity without official agreements or contracts can be a prerequisite for some forest owners. In that case it is important that the best forest management practices enable and support these actions. The results of this study clearly support the need for flexible voluntary conservation schemes, including a large variety of mechanisms to protect biodiversity in family owned forests. Well-designed, research-based ecological criteria as well as monitoring of the ecological quality of the areas protected, are important factors in achieving the ecological objectives of the program. However, social aspects need to be incorporated into the design of the program. Forest owners acceptance for the measures implemented in the program as well as the administrative feasibility of the measures are critical to the successful implementation of the program. A continuous monitoring of forest owners' values, views, objectives and needs for different biodiversity-related services is important, as they may change through ongoing generational shifts in ownership of forests.

Nature conservation procedures, forest ownership structure, forest use and management practices and ecological factors vary widely from country to country. All these features affect to the generalizability of the results concerning forest owners willingness to safeguard biodiversity in their forests. The results of this study could be best applied in areas where family forestry is the dominant form of forest ownership, and voluntary incentive-based measures are available to safeguard biodiversity.

Forest extension officers and other forestry professionals play important roles in introducing options to enhance biodiversity to forest owners. In Finland, the number of farms and farm-forest owners has decreased, and the share of urban forest owners has slowly increased (Hänninen et al. 2011; Karppinen et al. 2020). This development may increase the proportion of forest owners who are less familiar with forest-related issues and are thus in need of more advisory services concerning safeguarding biodiversity. The use of digital services and applications is likely to increase in the future, which can facilitate counselling.

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Appendix 1

See Table 7.

Table 7 Characteristics of forest owners and their forest holdings in groups based on their interest in implementing measures to safeguard biodiversity in their own forests, crosstabulation. Pearson χ^2 (percentage distributions), one-way ANOVA/Kruskal–Wallis test (mean comparisons)

	Conservationists	Moderate conservationists	Compensation oriented	Promoters of biodiversity through forest management	Uninterested	*p* value
Age, years, mean	58	59	59	59	62	0.005
Gender, %						0.003
Female	44	47	28	32	36	
Male	56	53	72	68	64	
Education, %						0.020
No degree	11	15	17	13	24	
Vocational degree	34	42	41	37	42	
Polytechnic	32	26	28	30	23	
Academic	23	17	14	19	12	
Occupation, %						0.062
Wage earner	39	37	40	39	27	
Farm or forestry entrepreneur	6	6	9	10	12	
Other self-employed	5	7	4	6	8	
Pensioner	46	47	44	42	52	
Other	4	3	5	4	1	
Ownership type, %						0.064
Family (individual/with spouse)	57	58	63	70	71	
Private partnership	29	26	26	18	19	
Estate jointly owned by heirs	14	17	11	12	10	
Duration of ownership, years	20	20	20	19	23	0.014
Place of residence, %						0.045
Permanently on the holding	39	30	36	39	47	
Elsewhere in the same municipality as the holding	22	20	23	21	20	

Table 7 (continued)

	Conservationists	Moderate conservationists	Compensation oriented	Promoters of biodiversity through forest management	Uninterested	*p* value
Outside the municipality where the holding is located	39	50	42	40	34	
Prior experience in voluntary conservation, %*						
Yes	51	36	33	47	16	<0.001
No	49	64	67	53	84	
Opinion on the level of safeguarding biodiversity in private forests, %						<0.001
Should be increased	53	24	22	14	7	
Present level appropriate	39	63	62	71	64	
Too much	3	3	7	8	22	
Cannot tell	5	10	8	7	8	
Attitude towards safeguarding biodiversity in one's own forest, mean**	6.32	5.65	5.63	5.36	4.40	<0.001
Level of knowledge of the METSO Program						<0.001
High	21	10	13	13	12	
Moderate	53	62	55	59	47	
No knowledge	27	27	32	26	35	
Cannot tell	0	1	0	2	6	

*Voluntary implementation of at least one measure to safeguard biodiversity in one's own forest, such as entering into a conservation contract, setting aside some areas or specifically taking nature values into account in forest management practices

**Seven-point Likert scale (negative to positive), Kruskal–Wallis test

Appendix 2

See Table 8.

Table 8 Mean responses and standard deviations (in parentheses) of the NEP scale statements (Dunlap et al. 2000, p. 433) and percentages of agree or strongly agree responses for each statement

	M (SD)	%
"Despite our special abilities, humans are still subject to the laws of nature"	4.25 (0.85)	82
"Plants and animals have as much right as humans to exist"	4.11 (1.01)	78
"We are approaching the limit of the number of people the earth can support"	4.13 (0.91)	74
"The earth has plenty of natural resources if we just learn how to develop them"*	3.94 (0.89)	73
"When humans interfere with nature it often produces disastrous consequences"	3.91 (1.08)	73
"The balance of nature is very delicate and easily upset"	3.93 (1.02)	71
"Humans are severely abusing the environment"	3.68 (1.11)	63
"If things continue on their present course, we will soon experience a major ecological catastrophe"	3.64 (1.08)	57
"The earth is like a spaceship with very limited room and resources"	3.63 (1.01)	56
"Human ingenuity will insure that we do NOT make the earth unlivable"*	2.96 (1.08)	32
"Humans will eventually learn enough about how nature works to be able to control it"*	2.80 (1.08)	26
"Humans have the right to modify the natural environment to suit their needs"*	2.54 (1.11)	24
"Humans were meant to rule over the rest of nature"*	2.61 (1.19)	23
"The so-called "ecological crisis" facing humankind has been greatly exaggerated"*	2.62 (1.08)	20
"The balance of nature is strong enough to cope with the impacts of modern industrial nations"*	2.19 (1.01)	11

*NEP scale statements which support the dominant social paradigm (DSP) were reverse coded for the sum variable

Appendix 3

See Table 9.

Table 9 Factor analysis of the statements concerning objectives of forest ownership

Objective	%	Factors	
		Economic security and income	Recreation, conservation and aesthetics
Security against old age	46	0.854	
Security for unusual conditions	52	0.834	
Funding of investments	32	0.758	
Credibility	44	0.703	
Regular sales income	46	0.699	
Security against inflation	55	0.637	
Labor income and employment	27	0.636	
Investment	45	0.634	
Bequest motive	70	0.493	
Increase in economic value	24	0.373	
Personal outdoor recreation	79		0.798
Personal solitude and relaxation	79		0.746
Personal berry and mushroom picking	84		0.716
Personal residential environment	76		0.703
Aesthetic values	74		0.642
Protection of biodiversity	64		0.615
Nature conservation	44		0.545
Roots in the locality	68		0.486
Opportunity to do forestry work	83		0.433
Household timber	81		0.412
Intrinsic value of ownership	78		0.393
Personal opportunities for hunting	45		0.359
Eigenvalue		7.108	3.323
Variance explained, %		32	15
Cronbach's alpha		0.895	0.857

The factor loadings and the percentages (%) of respondents who considered the statement important or very important

Varimax rotation, maximum likelihood, loadings below 0.300 not included

Kaiser–Mayer–Olkin measure of sampling adequacy 0.909, Bartlett's test of sphericity $p < 0.001$, df = 231, n = 978

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