Methodological and Ideological Options

Using the generalised Q method in ecological economics: A better way to capture representative values and perspectives in ecosystem service management

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ARTICLE INFO

ABSTRACT

The Q-method identifies groups of people with similar or diverging perspectives and is increasingly used for analysing resource conflicts. However, it is uninformative on the prevalence of perspectives in the general population. The Norwegian government considers planting spruce climate forests on abandoned pastures, the habitat for many red listed species. We identify three prevailing stakeholder perspectives in the climate forest debate using the Q method; one pro climate forest and two against with differing motivations. Using the so-called scale creation method (Danielson, 2009) and a national survey, we measure the support of the general population for these perspectives and elicit their concern for ecosystem services. About half of the sample is pro climate forest. Opposition is greater in regions where spruce is uncommon and abandoned pastures are common. The impact of climate forests on biodiversity and landscapes is a concern. Conflicts would be dampened if climate forest policy took impacts on landscape aesthetics and biodiversity better into account. Our proposed generalised Q method combines two strengths: the depth of the Q method with the breadth of the general population survey. The method demonstrates a way forward in ecological economics to better capture representative values and perspectives in ecosystem service management and help design climate and environmental policies with greater acceptance.

1. Introduction

Over the last decades two-thirds of outfield pastures in Norway have been abandoned and are now longer used for grazing (Norwegian Environmental Agency (NEA), 2013). As a result, they slowly grow into natural forests consisting of tree species like birch (*Betula pubescens*), Scots Pine (*Pinus sylvestris*) and in some regions Norway Spruce (*Picea abies*). A pilot climate forest program (CFP) was initiated by the Norwegian Government in 2013 to test the planting of spruce on selected areas of abandoned pastures to sequester carbon more effectively. If scaled up to the national level – the original intention – the CFP would benefit forest owners who would receive government subsidies for planting as well as timber revenues. The CFP is controversial for at least three reasons. First, spruce planting potentially affects landscape aesthetics and, in some areas, also recreation benefits (Graesse, 2016; Dramstad et al., 2001). Planted stands of dense, monocultural climate

forest can be visually striking, especially in areas of the country where spruce is traditionally uncommon (e.g. in the west and the north of the country). Second, when in traditional use,[1] off-farm (outfield) pastures in the wilderness house many vascular plant species that have become endangered. Third, the net climate effect of spruce planting is not entirely known, e.g. due changes in albedo effects (Naudts et al., 2016) and below-ground carbon storage after forest planting (Hartley et al., 2012). The CFP pilot program has recently been evaluated and there is currently a heated debate among government and various stakeholders about whether to scale up (Norwegian Environment Agency (NEA) and Norwegian Agricultural Agency (NAA), 2019). An alternative use of the abandoned pastures to the CFP would be continued support for (traditional) grazing practices or alternatively, permit the areas to naturally reforest at no cost.

In situations of large preference heterogeneity and apparently deep-rooted conflicts among stakeholders, to find areas of common ground

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[1] In traditional use several domesticated animal species grazed the fields together, and no artificial fertiliser was applied.

and acceptable policy solutions, there is a need for a deeper understanding of the value plurality underlying the different positions and their relations to affected ecosystem services (ES) (Martin-Lopez et al., 2014; Bredin et al., 2015; Barry and Proops, 1999; Zabala et al., 2018). As argued by Spash (2013), standard economic analysis, including monetary valuation of costs and benefits, may not be the most suitable approach in such situations. Further, for ES with a strong cultural component, standard economic valuation and analysis may be particularly challenging (Díaz et al., 2018; Bredin et al., 2015; Barrena et al., 2014; Chan et al., 2012; Daniel et al., 2012; Iniesta-Arandia et al., 2014). Instead we follow recommendations by e.g. Barry and Proops (1999), Swedeen (2006) and Bredin et al., 2015 to analyse resource conflicts more in depth using the Q method, a tool for discourse analysis (Addams and Proops, 2000; Brown, 1980; Webler et al., 2009). The Q method provides the foundation for a systematic study of subjectivity in discourse analysis (Brown, 1993). It reveals perspectives in a debate using a by-person factor analysis to identify groups of people with similar perspectives. The method combines qualitative and quantitative methodological approaches by first exploring social discourses (patterns of attitudes held by different groups) qualitatively and using statistical tools to analyse the discourse. Applications of the Q method have increased significantly in areas of ecological economics, environmental management and conservation research in recent years (see e.g. review by Zabala et al., 2018), some also using the ES framework directly or indirectly (e.g. Sy et al., 2018; Bredin et al., 2015; Pike et al., 2015; Armatas et al., 2017; Hermelingmeier and Nicholas, 2017; Simpson et al., 2016; Barrena et al., 2014).

While the Q method can be useful in providing deeper insights into the range of opinions that exist about a topic within a certain sample of stakeholders, compared to general population surveys the Q method does not allow for generalisations about representativeness of different opinions within a larger population. This limited generalisability and validity has been an important criticism of the Q method's usefulness, especially for policy analysis (e.g. Ramlo, 2016; Danielson, 2009). To deal with this criticism and investigate the generalisability of the Q method, we follow the recent recommendation by Zabala et al.'s (2018: p1192) review "… to design a survey based on Q results to estimate the frequency of perspectives in a wider population." We build on the approach suggested by Danielson (2009) of combining the strengths of the Q method and the "R method" (i.e. the approach of standard population surveys),[2] asking four research questions: (1) What is the discourse, the main positions or perspectives (narratives), among stakeholders and experts in the Norwegian climate forest debate? (2) To what degree do these positions map to the opinions of the general population, and which spatial and respondent characteristics can explain people's grouping into main positions? (3) Which ES are emphasised by stakeholders, experts and the general population in the climate forest debate? (4) To what extent can applying the Q methodology in combination with a population survey contribute to our understanding of the resource conflict, the underlying values, ES trade-offs and potential policy solutions? This knowledge may be valuable when searching for common ground for the implementation of acceptable and feasible policy options, and as a basis for stakeholder participation (Cuppen et al., 2010; Niedziałkowski et al., 2018) and deliberative processes (Walton, 2013), the use of decision-support tools such as multi-criteria decision analysis (Swedeen, 2006), or even as basis for developing

attributes for carefully designed choice experiment valuation surveys (Armatas et al., 2014; Iversen et al., 2019).

To answer these questions, we first conduct a thorough qualitative process to identify the range of existing opinions and then apply the standard Q methodology using in-person interviews with stakeholders and experts across Norway to elicit their preferences for key arguments (statements) about the climate forest planting debate. We make the links between these different statements, the underlying values (monetary and non-monetary) and the full range of ES categories using the Common International Classification of Ecosystem Services (CICES).[3] We then use the so-called scale creation method (Danielson, 2009) to integrate our findings into a large, high-quality Internet panel survey questionnaire administered to a representative sample of the general Norwegian population. The results from the survey are then compared with the standard Q results to investigate whether the opinions and views found among stakeholders and experts regarding changes in the ES levels caused by climate forest planting can be extended to the general population. We ask specifically which ES are most salient for respondents.

This study is, to our knowledge, the first of its kind in ecological economics, and environmental management and conservation more generally, that makes the connection between Q and R to investigate generalisability of Q results and usefulness of combining the two methods.[4] We see the approach as a potentially constructive and promising way forward for the fast-growing field of Q research, and preference elicitation methods more generally, to become even more relevant in analysing values and perspectives in ES management.

2. Methods and data collection

2.1. Q methodology

A Q study typically involves several steps. The two most critical steps to secure a good quality study design include the selection of Q-statements (Q-set) and participants (P-set). The Q-set commonly derives from a so-called concourse of statements. This captures the broad (public) discourse on the topic under investigation and is usually obtained through reviewing scientific and popular literature, media coverage, and by conducting stakeholder interviews. A complete and unbiased concourse, including both positive and negative aspects, is crucial for the study to deliver meaningful results that can reveal the discourse in all its complexity. The Q-statements should be intelligible and allow for differing interpretations by the participants, the P-set.

2.2. Identification of participants for the Q study

The P-set should be selected to reflect the full diversity of opinions present in the concourse and consist of informed and involved stakeholders. In a Q study the P-set are the "observations" while the Q-set are the "variables", cf. Danielson (2009). Members of the P-set could for example belong to a relevant stakeholder organisation but could also include other stakeholders, e.g. well-informed individuals such as researchers, small-business owners and farmers. Stakeholders should ideally be selected through an explicit stakeholder analysis (Reed et al., 2009). The selected stakeholders in this study were chosen based on their participation in the public debate or because they represented conflicting land-use interests. Stakeholders were contacted for interview through email, phone and in-person. At the end of each interview,

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[2] According to Danielson (2009: 219–220): "… Q is a standard factor analysis turned on its side, with correlations computed between persons across a set of statements, rather than a standard ('R method') correlation between traits (such as ratings of statements) across a set of persons. This sideways correlation gives Q its key strength of allowing the participant to define her or his own subjectivity rather than treating her or his mind as an object to be measured. Yet R method offers advantages of its own, notably generalisability to a larger population of people and explanation of a perspective's relationship to other variables."

[3] http://cices.eu/.

[4] Following the work by Danielson (2009), there are a few studies that make more methodological or technical comparisons between Likert scale type questions and Q methodology (see e.g. Havlikova, 2016; Ho, 2017; Eyvindson et al., 2015; Thompson et al., 2012), but none of these address issues of generalizability of Q results in analysis of resource conflicts.

stakeholders were asked if they could refer us to another relevant person from within their network, i.e. snowball-sampling. This was particularly useful to establish personal contact with representatives in the forest industry who generally only agreed to an interview after a personal introduction.

2.3. The Q-set: statements that reflect ecosystem services and underlying values

The concourse (Q-set) aimed at covering the extant range of positive and negative opinions, facts, and assumptions about the planting of climate forests. Often the concourse is defined through media channels only (e.g. Bredin et al., 2015). In our case the concourse was also defined through other channels, a strength was the use of extensive stakeholder interviews, which facilitated formulation and refinement of the final statements to be included. We conducted 44 stakeholder interviews across the country; 42 in-person and two by Skype. The interviews were semi-structured following an interview guide. Interviewees were first asked general questions about the cultural landscape and then the climate forest project was introduced. In all but two cases, the interviewees permitted us to record the interviews. The transcribed recordings helped us notice linguistic details and reoccurring expressions which sometimes revealed previously unclear attitudes and positions. From the interview transcripts, a long-list of 110 statements captured the diversity of the discourse. By carefully eliminating re-iterated dimensions within the concourse while ensuring that all elements of the concourse were equally represented, 46 statements remained (see column 4, Table 1).

We then classified each statement as primarily belonging to one of the ES categories of provisioning, regulation/maintenance, or cultural, according to the most recent CICES classification system (columns 1 and 2, Table 1). Not all statements fitted easily into service categories, so we added an "other" category (see e.g. Bredin et al., 2015). Classifying the statements allowed us to examine the relationships between the planting of climate forests and ES within the climate forest debate. 9 out of 46 statements referred to provisioning services, specifically the groups of animals or cultivated plants for nutrition. 17 statements were primarily about regulating and maintenance services, around equally split between the group regulation of the atmosphere (related to sequestration) and the group lifecycle maintenance (primarily related to biodiversity). 19 statements were related to cultural ES, placed in different groups varying from the concrete group of direct physical and experimental interaction with the natural environment (including e.g. enjoying scenery) to groups associated with the more intangible categories of spiritual, symbolic, intellectual, representative and non-use interactions. These groups are hard to assign and there are clear overlaps between statements (as is arguably the case in the ES classification system itself). Finally, one statement about people's willingness to change their habits and behaviour was assigned to the "Other" category. Hence, there is a great diversity of values and services underlying this particular ES management conflict, and the cultural value component is strong. We will return to the interpretation of the three last columns in Table 1, N1, N2, and N3, which are the three main narratives derived from the Q-results.

2.4. Q-data collection and analysis

For a statistically sound analysis it is recommended to have approximately one Q-participant for every third statement, that is a 1:3 ratio between the number of participants and the number statements (Webler et al., 2009). The number of participants needed increases with increasing number of perspectives since one ideally would like there to be at least three participants loading solidly on each perspective. Because one cannot know a priori how many perspectives there will be, one must make sure to have enough participants available to accommodate all potential perspectives (Webler et al., 2009).

The P-set included 15 persons of whom about half were persons who were involved in the concourse definition and the other half were new participants. We conducted the Q-interviews across the country May–August 2016. Participants were first asked to sort the 46 Q-statements according to how well they represented their own thoughts within a pyramid-shaped matrix (i.e. a Q-sort; ordering of statements). The matrix conformed to a quasi-normal distribution and a scale running from disagree most (-5) to agree most ($+5$), and all 46 Q-statement cards had to be accommodated within the matrix. Thus, participants had to weight all statements relative to each other. After the sorting exercise, participants were encouraged to explain their reasons, thus revealing their subjective opinions on the topics.

We analysed the data from the Q-sorts using the PQMethod software.[5] We performed a principal component analysis (PCA) considering both commonality and specificity among Q-sorts (Webler et al., 2009). We then combined the results of the PCA analyses with the follow-up discussions from the Q-interviews to explore the interpretability of narratives across possible solutions. The variation in opinions across the Q-sorts was most coherently described using three factors (narratives), which explained 67% of the variance in the opinions of the 15 individuals (Q-sorts).

The first three factors explained 32, 26 and 9% of the variance, respectively. The fourth and fifth factor each explained 6% of the variance. We concluded that the third factor was the cut-off point for the number of factors (Johnson and Wichern, 2007).[6]

The factors were thereafter rotated to obtain more interpretable factor loadings using the Varimax algorithm (Johnson and Wichern, 2007) available in the PQMethod software. The factor loadings indicate the degree to which a participant's sort correlates with a factor. Positive (negative) values indicate (dis)agreement. A large absolute value of the loading indicates a strong correlation between the participant and the factor/narrative. We calculated the factor z-scores[7] of each statement for each of the three factors and used these to create idealised sorts i.e. the orderings of the 46 value statements (in Table 1) as they would appear for a person who fully agree with the narrative.

We completed the narrative analysis by considering the statements the most in agreement with each narrative (last three columns in Table 1 above and the idealised sorts) as suggested by Webler et al. (2009). We also evaluated how key participants grouped into the different narratives to uncover patterns in affiliations among participants. Finally, we compared the narratives to identify the more important value arguments (i.e. arguments that attracted stronger dis/agreements) within each narrative as well as similarities and differences among narratives.

2.5. Linking the Q study to a general population survey using the scale creation method

An Internet survey including a selection of Q-statements was emailed to 2696 of the survey company TNS Kantar's panel members in April 2017; a nationally representative sample. The final sample of completes was $n = 1222$ with a response rate of 45%, which is high for such surveys. The survey was representative of the population aged 18–81 years, except that women were slightly overrepresented and young people slightly underrepresented.

The survey consisted of three main parts. First, the respondents were asked about their attitudes towards political, climate and other

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environmental challenges. Some information was provided about the consequences of climate change for Norway as well as globally before the information about the CFP was presented. Second, the survey included a selection of Q-statements. The Q-statements each had a follow-up question asking which ES was the most salient to the respondent for each Q-statement. Third, the survey ended with some standard demographic questions.

While Q studies should include representative statements of the complete and unbiased discourse, general population surveys should use a representative sample of the population under study. Based on our analysis of the concourse and the wide interest in the issue we reasoned that the whole Norwegian population may potentially be affected by the CFP in some way, especially as more indirect use and non-use values are involved. In any case, we thought it would be interesting to assess geographical differences in preferences among the whole population, in areas affected by the planting scheme.

We used the scale creation method to explore the prevalence of the different narratives found among stakeholders in the general population (Danielson, 2009). Using this method one first evaluates the idealised Q-sorts (cf. Section 2.4) for each narrative. From the idealised Q-sorts, one considers the descending array of differences in pairwise comparisons between narratives found in the factor analysis. From this list, one selects for inclusion in the general population survey, the subset of the Q-statements with the strongest defining effect[8] on the narratives, the distinguishing Q-statements. The fifteen most distinguishing Q-statements are in grey colour in Table 1.

Survey respondents were asked to indicate their degree of dis/agreement (on a Likert scale from 0 to 10) with the statement, where 0 was "completely disagree" and 10 was "completely agree" (and a "don't know" option was included) (see Fig. A1, upper panel, in the Appendix). This Likert scale was recoded to be from -5 to 5 in the analysis. Respondents were then asked a follow-up question regarding which ES they had been the most concerned about when evaluating the statement. As an example from the survey: "When evaluating the statement 'Norway is overgrown with brush and shrubs' what issue were you the most concerned about?" As response options, the survey listed the main ES, accompanied by icons for illustration,[9] that are traded off under the different management regimes considered for abandoned outfields (see Fig. A1, lower panel, in the Appendix). These ES were simplified for respondents from the six ES sub-categories in Table 1, covering provisioning, regulating and maintenance and cultural ES as "climate, plant and animal life,[10] recreation, timber production and landscape aesthetics". We also included an open category "other" where respondents could indicate that they were concerned about other aspects.[11]

Based on the survey responses to the Q-statements, respondents were sorted into the best fitting narrative identified in the Q-study, following Danielson (2009). First, each respondent's score for each of the three narratives is calculated. Scores are used as is if the statement

is in agreement with the narrative and otherwise reverse-coded. The weighted sum of the Likert scores is then calculated for each narrative, where the weights is the absolute value of the ranking of each statement for each of the three Q-narratives. To rank statements, one may use the q-score or the z-score[12] (Danielson, 2009). The sums of the weighted scores are then normalised for each narrative. Finally, one places each respondent into the narrative group (NG) for which they score the highest. The NGs are used to find the prevalence of this policy orientation in the general population and the demographic and attitudinal characteristics of the group of respondents that adheres the best to that narrative. Finally, the ES emphasised was summarised as the frequency with which each ES was chosen for each Q-statement and NG.

3. Analysis and results

3.1. Q study narratives

Based on the Q-sorts, Narrative 1 (N1) was defined by individuals who were associated with forestry and agricultural interests and were favourable to the CFP. Narrative 2 (N2) was defined by individuals generally concerned with nature protection and nature recreation. Narrative 3 (N3) was not as clearly defined, but stakeholders in this group were either representatives of hunting, fishing or commercial tourism. We typified the narratives as N1 "*Climate/forestry*", N2 "*Nature/recreation*", and N3 "*Nature/tourism*". N1 had a low correlation with the two other narratives: N1 and N2 had a correlation of -0.045 while for N1 and N3 the correlation was 0.124 - indicating that N1 was quite different from N2 and N3. N2 and N3 had a correlation of 0.379 and therefore shared clear commonalities.

Table 2 summarises the main value and policy orientations of the narratives. Whereas the policy orientations of the narratives reflect the stakeholders' views as expressed through the Q-sorts and narratives, the value orientation for each of the narratives was derived by examining the associations between the idealised sorts (Fig. 1) and the ES (see Table 1). Where N1 emphasises the use value of outfields for forestry (and therefore to some extent also climate), N2 agrees with statements related to preserving habitat and maintaining cultural landscapes, while N3 is concerned with landscape aesthetics and maintaining the open cultural landscape.

Fig. 1 presents the idealised Q-sorts for each narrative, that is, how the representative stakeholder of that narrative would sort the Q-statements into the pyramid. The top rectangle of Fig. 1 provides the range of Q-sort values. Negative Q-sort values (Q-SV) indicate disagreement with Q-statements and positive Q-SV indicate agreement with Q-statements. The stronger the agreement or disagreement with a statement, the more important the Q-statement was to the stakeholder group. The distinguishing statements, both in terms of agreement and disagreement with the narrative are marked * for $p > 0.05$ and ** for $p > 0.01$. There was agreement across narratives if the statement number is in bold, and if the agreement was significant across narratives (i.e. "non-significant difference"), this is marked by ˆˆ for $p < 0.01$ and ˆ for $p < 0.05$.

The last column of Table 1 uses colours to summarise from Fig. 1 the degree of agreement with the statements for each of the three narratives. The Climate/forestry perspective agreed with many of the statements relating to provisioning and regulating ES (the atmospheric regulation subgroup), while the Nature/recreation perspective tended to agree with the statements relating to the regulating ES subgroup "Lifecycle maintenance, habitat and gene pool protection". Finally, the Nature/tourism perspective agreed with several statements related to cultural ES in the subgroup "Spiritual, symbolic and other interactions/

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[8] The biggest disagreement as indicated statistically by the biggest difference between two narratives in their z-scores for a statement.

[9] These icons were taken from The Economics of Ecosystems and Biodiversity (www.teebweb.org) project, except for the icon illustrating aesthetical landscape impacts, which does not have a direct ES correspondence, but nevertheless is important for many of the cultural ES (see e.g. discussion in Lindhjem et al., 2015a, 2015b).

[10] A proxy for biodiversity, a term that is not easily understood among survey respondents. Biodiversity is in the literature normally regarded as underpinning both ecosystem processes (and therefore other ES) and a final cultural ES in itself; see e.g. Mace et al. (2012). We did not try to distinguish these meanings for the respondents in the survey. We know, however, from other Norwegian studies that biodiversity may provide substantial benefits as a cultural ES, hence it is likely people primarily think about the concept in this way in the survey (see e.g. Lindhjem et al., 2015a, 2015b).

[11] Only 0.8–2.6% of respondents chose this option.

[12] The q-score, like the z-score, indicates the relevance of a statement to that narrative. The q-score (or q-weight) equals the participants dis/agreement with the statement, here on a scale from -5 to 5.

Table 1

Q-statements about the planting of climate forests representing key arguments in the Norwegian debate, organised in accordance with the CICES categories. The statements in grey were also included in the general population survey. The parentheses indicate the statements' question number in the general population survey. N1 (Climate/forestry), N2 (Nature/recreation), and N3 (Nature/tourism) are the three main narratives.

ES type	Group	#	Q-statement	Agreement§		
				N1	N2	N3
Provisioning services	Animals reared for nutritional purposes / Cultivated terrestrial plants for nutrition, materials or energy	1	Norway is overgrown by scrubland. The climate forest project helps putting such areas to productive use. (1)	+3	-4	+4
		3	We have little arable land in Norway and should therefore not plant trees on the few existing productive areas.	+1	+2	+2
		6	Many oil-based products can be produced of wood-based biomass instead. The climate forest project can induce more innovation in this field.	+3	-2	0
		18	Norway should become less dependent on imported fodder. Norwegian agriculture should therefore increase the use of grazing in rangelands and hayfields.	+2	+2	0
		30	Compared to today's salmon and mining industries, the forest industry is sustainable.	+2	-1	+2
		31	The economic value of forests is the most important for the forest industry. Biodiversity, landscape aesthetics, and recreation are of secondary importance.	-2	+1	-1
		37	Climate forest has to stand for at least 60 years. It is scary to "lock-in" areas for such a long time, if it is uncertain if one might need these areas before it is allowed to harvest the trees.	-2	-1	0
		45	Local food production can help reducing greenhouse gases emissions. Norway should therefore increase areas devoted to food production instead of using them for planting climate forest.	0	0	+3
		46	The climate forest project is primarily driven by the forest industry's economic interests. (15)	-3	+4	0
Regulation & maintenance	Lifecycle maintenance, habitat and gene pool protection	2	Spruce forest is a "dead forest". (2)	-5	0	+3
		5	Insects need flowers, not trees.	-3	-2	-2
		7	Afforestation will limit wild animals' grazing and migration possibilities.	-4	0	-3
		9	Norwegian rangelands and hayfields are home to a large variety of insects, plants, and fungi. Those areas should therefore not be planted with spruce. (3)	+2	+5	0
		10	Spruce forest and mixed forest attract different species. Having both forest types within one area will therefore increase biodiversity levels.	+5	+5	+3
		25	The Norwegian government already uses significant resources to remove (old) spruce forest. It is therefore wrong to use public resources to plant even more. (8)	-4	+1	0
		29	To maintain biodiversity levels, the cultural landscape should not be further fragmented.	0	+4	0
		33	To secure biodiversity levels in Norway, the area of actively managed forest should not be increased. (11)	-3	+3	-1
	Regulation of chemical composition of atmosphere and oceans	8	The aim of climate forest is not to create opportunities for recreation. Norway has enough natural forest for recreational purposes.	+1	+1	0
		26	Norway has enough space for climate forest. (9)	+4	-2	-2
		27	The climate forest project is good, even if one has to expect some negative impacts on biodiversity, recreational opportunities, and landscape aesthetics.	0	-4	-2
		28	The climate forest project's main priority should be to maximise carbon sequestration. Factors such as landscape aesthetics and biodiversity are less important. (10)	-1	-2	-3
		34	It is wrong to use public resources on the climate forest project, since its total climate effect is uncertain. (12)	-2	+1	-2
		35	The climate forest project is an important contribution to the green shift for the economy. (13)	+3	-5	-2
		36	The climate forest project will help Norway reducing its greenhouse gas emissions. (14)	+4	-4	+2
		40	Preservation of huge forest areas is an insufficient measure to meet today's climate challenges.	+4	+1	-1
		44	There is a substantial lack of knowledge about carbon storage in the soil. It is therefore difficult to estimate the project's total climate effect.	+1	+3	-1
Cultural		4	I prefer hiking in the forest compared to the open landscape.	-1	-1	-4
		11	Foreign tourists prefer traditional open cultural landscape instead of spruce forest.	-1	+2	+2
	Physical and experiential interactions with natural environment	12	The climate forest project will lead to the construction of new forest roads. This is good for recreation, as it facilitates access to recreation areas. (4)	+1	-3	-5
		13	A dense spruce forest can make it difficult to move through the landscape.	-1	+3	+5
		14	Afforestation in areas where there was no forest before will increase people's opportunities for recreation.	-1	-3	-4
		16	It is nice to walk on forest roads.	0	-1	-4
		20	The negative impact of afforestation on landscape aesthetics can be minimised by designing the forest such that it blends into the landscape.	+1	0	+1
		24	When the weather is bad, walking in spruce forest can be nice, because it protects from wind and rain.	0	-1	-3
		43	I prefer hiking in a spruce forest rather than in a mixed forest.	-2	-3	-5

(continued on next page)

Table 1 (continued)

				§		
Spiritual, symbolic and other interactions / Other biotic characteristics that have a non-use value		15	The best way to manage nature is to minimise human intervention. (5)	-1	+5	+1
		17	Poorly planned spruce planting in the 1960s is the main reason for the bad reputation spruce has today.	0	0	+2
		19	Norway is about to become overgrown. Therefore, we should not plant more forest. (6)	-4	0	+5
		23	Spruce forest does not belong in Norway. (7)	-5	-5	+1
		42	The Norwegian forest industry has not been good at conveying positive associations with spruce forest.	+1	-2	+1
Intellectual and representative interactions / Spiritual, symbolic and other interactions		21	Open cultural landscape is a considerable part of Norwegian identity.	0	+2	+4
		22	Cultural landscape in Norway was at its best before the 1950s.	-2	+1	+1
		32	The pilot project can contribute to build knowledge about forest on both local and national level.	+2	0	+1
		39	Forest owners' knowledge about forest management is sufficient to ensure that decisions about felling, renewal, and other measures generally are made on the right basis.	0	-1	-1
		41	For the last 20 years, forest expertise has been reduced in the local municipalities.	+2	0	-1
Other		38	We have to be willing to change our habits and behaviour, in order to tackle global climate challenges.	+5	+4	+4

Notes: A Q-statement could be about more than one species and be associated with more than one ES category. We have assigned statements to what we considered their primary ES category. § = Degree of agreement with statement for each of the three narratives. Green coloured cell means agreement, yellow neutral, and red disagreement. The number in each cell means degree of (dis)agreement based on Q sorts (−5 to +5, see Section 3).

Table 2
Summary of value and policy orientations of the three narratives identified.
Source: Adapted from Davies and Hodge (2012).

Narrative	Value orientation	Policy orientation
Climate/forestry (N1)	Focus on climate mitigation and production forestry.	Favour the use of abandoned outfield pastures for planting of spruce climate forests
Nature/recreation (N2)	Focus on recreation and maintaining biodiversity.	Favour no or limited spruce forest planting and the use of outfield pastures for recreation and nature experience.
Nature/tourism (N3)	Focus on tourism and landscape aesthetics/cultural landscape.	Favour no or limited spruce forest planting and the use of outfield pastures for recreation and nature experience.

Other biotic characteristics that have a non-use value". We used the idealised Q-sorts in the further interpretation of the narratives and analysis.

Fig. 2 provides an overview of the consensus statements in the debate. There is consensus that we need to change our habits if we are to handle the climate change challenge, that we should avoid planting on productive agricultural land, that local food production is more important than climate forests, that it is risky to commit productive land areas to climate forests for as much as 60 years before the trees can be felled, that we have enough knowledge about forestry to make the right decisions regarding climate forests, that the planting of climate forests will increase the knowledge about forestry in Norway, that the negative aesthetic effects of climate forests may be reduced by a more conscious planting of the forests, that evergreen and deciduous forests house different species and that keeping both types of forests in Norway increases the biodiversity, that planted climate forests are inferior recreational areas but that Norway has sufficient other forested areas for recreation, and finally that "insects need flowers and not trees".
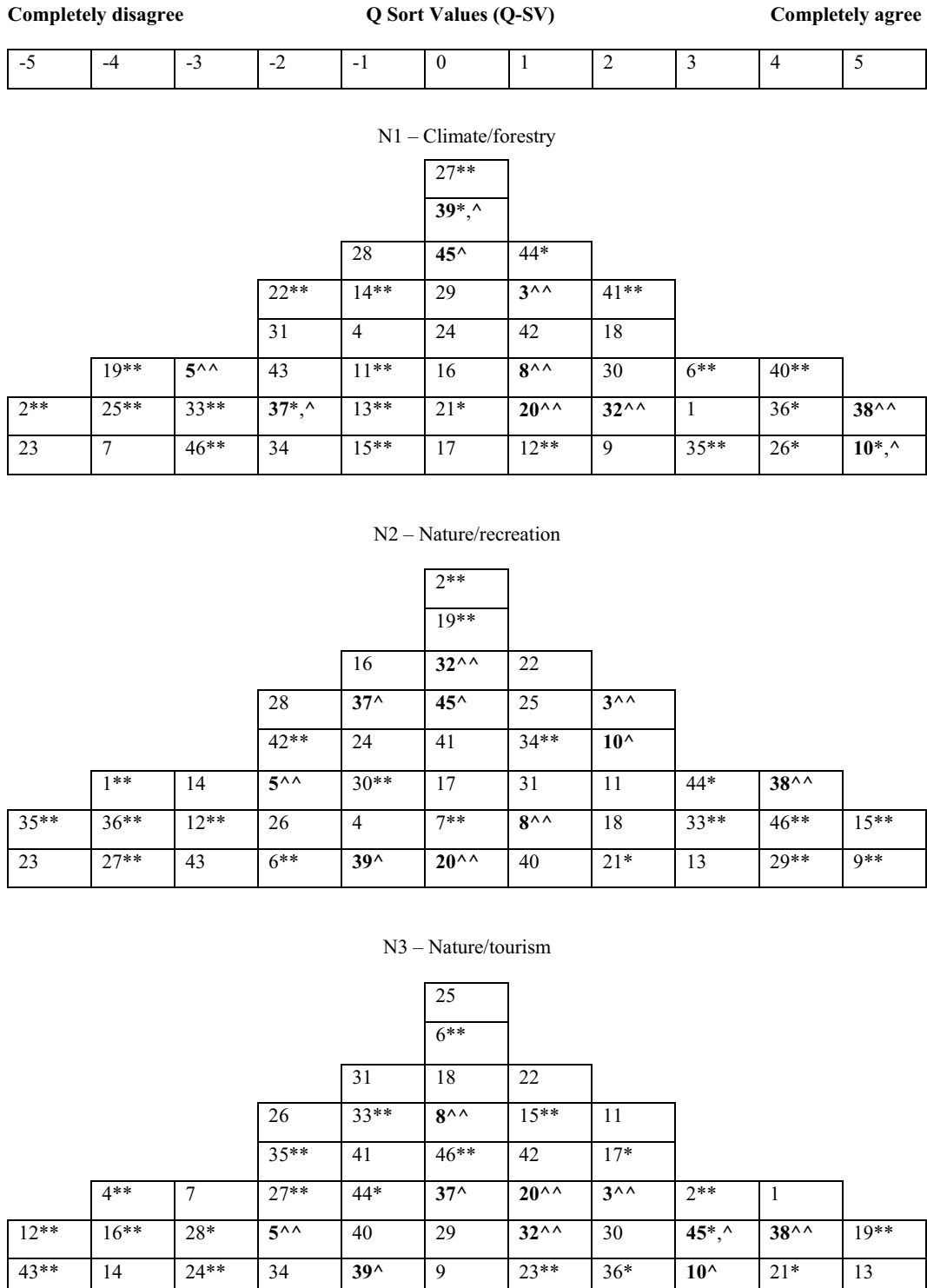
3.2. Narrative groups in the general population

Table 3 shows the descriptive statistics for the survey sample. 52% of the respondents are from Eastern Norway the most populated part of Norway. 10% are from Central Norway, 29% are from Southwestern Norway, and 10% are from Northern Norway. Table 3 also includes

summary statistics for membership in stakeholder organisations. 22% of respondents are member of an interest organisation or NGO, 6.1% of which are member of a Norwegian interest group for hunting or fishing, 5.0% are member of an environmental NGO, 12.3% are member of the Norwegian Trekking Association and 3.5% are members of an interest organisation for farming or forestry. 4% voted for the Centre party, which are known for promoting the interests of rural communities, and 34% voted for a party on the political left at the last general election. Furthermore, 45% have a positive opinion about the CFP and 40% had heard about the program before learning about it in the questionnaire. 74 (88%) believe the consequences of climate change will be serious for Norway (the world).

The degree of representation of the N1, N2 and N3 perspectives among the survey respondents, that is narrative groups NG1, NG2, and NG3, respectively, was found using the scale creation method. Fig. 3 shows how respondents sorted into the three narrative-groups using the z-scores.[13] About half of the sample sorted into the Climate/forestry group, the second biggest group was the Nature/tourism and the smallest group was the Nature/recreation group. Hence, about half of the sample support the views maintained by the climate/forestry group, including the planting of forests for climate regulation.

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[13] We explored sorting using both *q*-scores (Q-SV) and the more fine-tuned *z*-scores- the results were quite close.

Completely disagree Q Sort Values (Q-SV) **Completely agree**

-5	-4	-3	-2	-1	0	1	2	3	4	5

N1 – Climate/forestry

-5	-4	-3	-2	-1	0	1	2	3	4	5
					27**					
					39*,^					
				28	**45^**	44*				
			22**	14**	29	**3^^**	41**			
			31	4	24	42	18			
		19**	**5^^**	43	11**	16	**8^^**	30	6**	40**
2**	25**	33**	**37*,^**	13**	21*	**20^^**	**32^^**	1	36*	**38^^**
23	7	46**	34	15**	17	12**	9	35**	26*	**10*,^**

N2 – Nature/recreation

-5	-4	-3	-2	-1	0	1	2	3	4	5
					2**					
					19**					
				16	**32^^**	22				
			28	**37^**	**45^**	25	**3^^**			
			42**	24	41	34**	**10^**			
		1**	14	**5^^**	30**	17	31	11	44*	**38^^**
35**	36**	12**	26	4	7**	**8^^**	18	33**	46**	15**
23	27**	43	6**	**39^**	**20^^**	40	21*	13	29**	9**

N3 – Nature/tourism

-5	-4	-3	-2	-1	0	1	2	3	4	5
					25					
					6**					
				31	18	22				
			26	33**	**8^^**	15**	11			
			35**	41	46**	42	17*			
		4**	7	27**	44*	**37^**	**20^^**	**3^^**	2**	1
12**	16**	28*	**5^^**	40	29	**32^^**	30	**45*,^**	**38^^**	19**
43**	14	24**	34	**39^**	9	23**	36*	**10^**	21*	13

Fig. 1. Relative importance and sorting of the 46 Q-statements for narratives N1 Climate/forestry, N2 Nature/recreation, and N3 Nature/tourism. The 46 Q-statements are represented by their respective statement numbers, 1–46 (Table 1). The distinguishing statements, both in terms of agreement and disagreement with the narrative (Q-SV of -5, -4, $+4$, or $+5$), are marked * for $p > 0.05$ and ** for $p > 0.01$. For statements, marked in **bold,** there was agreement across narratives. Q-statements for which the agreement across narratives was significant (i.e. "non-significant difference") are marked ^^ for $p < 0.01$, and ^ for $p < 0.05$.
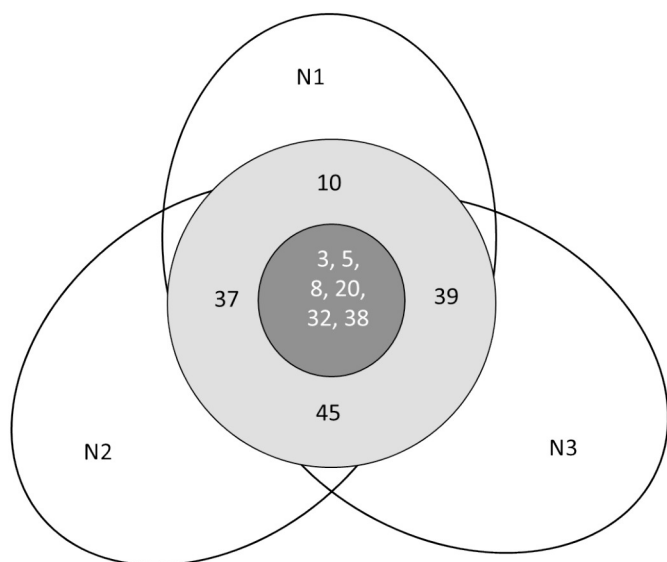
Fig. 2. The 10 consensus statements (see Table 1 for statement numbers) for the three narratives. There is (strong) consensus about the statements in the (darkest) grey circle among the narratives.

3.3. Views and values of the narrative groups

For each NG, we calculated the policy orientation (average dis/agreement with each statement) and the value orientation (average ES emphasised) (see Table 4). The NGs were in agreement on statements 9, 15, 23, 26, and 28, for which the stakeholders disagreed (see Table 1). That is NG1, NG2 and NG3 all agree that one should not plant spruce forests in former pastures with high species richness, that the best way to manage nature is to disturb it as little as possible, that spruce species belongs in Norway, and that Norway has enough space for climate forests. For the remaining statements there is some disagreement among groups.

Recreation was emphasised the most by NG2 and NG3 and for an
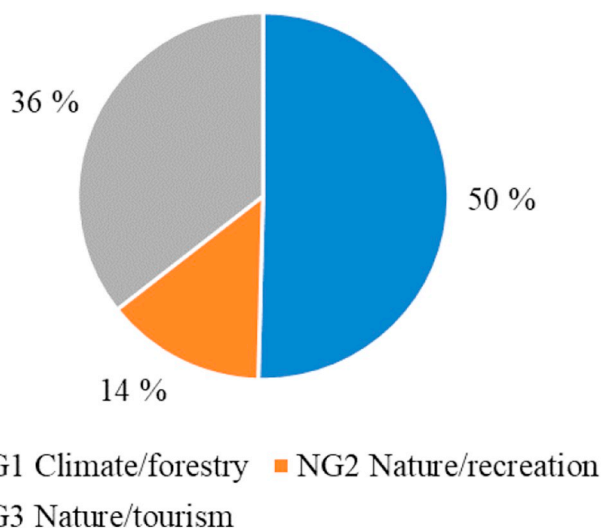
Fig. 3. The percentage of respondents in each narrative group.

equal number of statements. NG1only emphasised recreation the most on statement 12, which regards the recreation benefits of constructing new forest roads. Biodiversity was emphasised the most by NG2 on all statements apart from 1, 15, 35, and 36 where NG3 emphasised biodiversity the most, and 46 where NG1 emphasised biodiversity the most. Landscape was consistently emphasised the most by NG3 on all statements, apart from 26 where NG2 emphasised landscape the most. Climate and timber were emphasised the most by NG1 on all statements except for statement 46, which states that the CFP is for the most part motivated by the forest industry's own interests. On this statement biodiversity and climate was emphasised the most by NG1, while recreation, landscape, and timber was emphasised the most by NG3. Interestingly, the NGs disagreed on statement 46, which appears to imply that about half of the sample think that the main motivation for the CFP is the economic interests of the forestry sector.

Fig. 4 a)–f) displays graphically, for each of six Q-statements, NGs agreement and ES emphasis for that statement. In each figure NGs

Table 3
Descriptive statistics for the general population sample, $n = 1222$.

| Variable	Definition	Mean	Std. dev.
Female	1 if female, 0 otherwise	0.54	0.50
Age	Age of respondent	54.1	0.44
Edu	1 if university or college education, 0 otherwise	0.28	0.45
Under15	Number of household members under the age of 15	1.22	0.61
Lnhhinc	Natural log of household income	11.0	0.10
East	1 if from Eastern Norway, 0 otherwise	0.52	0.50
Southwest	1 if from Southwestern Norway, 0 otherwise	0.29	0.45
Central	1 if from Central Norway, 0 otherwise	0.10	0.30
Northern	1 if from Northern Norway, 0 otherwise	0.10	0.30
MemberHunt	1 if member of a hunting or fishing association, 0 otherwise	0.06	0.24
MemberEnviro	1 if member of an environmental organisation, 0 otherwise	0.05	0.22
MemberTrek	1 if member of the Norwegian Trekking Association, 0 otherwise	0.12	0.33
MemberAgFor	1 if member of agricultural or forestry stakeholder organisation, 0 otherwise	0.04	0.18
CentreParty	1 if voted at the most recent election for a political party that represents rural and farmers economic interests, 0 otherwise	0.04	0.05
PoliticalLeft	1 if voted for a political party on the political left at the most recent general election, 0 otherwise	0.34	0.01
OpinionCFP	1 if a positive opinion about the CFP, 0 if neutral, negative or don't know	0.45	0.01
KnowCFP	1 if have heard of or know the CFP well, 0 otherwise	0.40	0.01
ConsNorway	1 if consequences of climate change for Norway evaluated to be serious, 0 otherwise	0.74	0.01
ConsWorld	1 if consequences of climate change for the world evaluated to be serious, 0 otherwise	0.88	0.01

average dis/agreement with the statement is shown in the histogram to the left panel, and percent of respondents for each NG that emphasised the particular ES is shown in the spider diagram in the right panel. We picked six of the fifteen statements that we found to be of particular interest because of their combination of dis/agreement and ES emphasis. For example, Fig. 4 a) which is for the statement "The CFP is an important contribution to the green transition" shows that NG2 (orange bar) and NG3 (grey bar) disagreed with the statement while NG1 (blue bar) agreed. From the blue line in the radial graph we see that nearly 80% of respondents in NG1 emphasised "climate" while about 20% of the NG2

(orange line) and NG3 (grey line) respondents emphasised "biodiversity".

3.4. Characteristics of narrative groups

We ran a multinomial (polytomous) logistic regression (see e.g. Agresti, 2002) with group membership as the dependent variable, to investigate what characterised the respondents in NG2 and NG3 compared to NG1. NG1 was chosen as the base category since it was the least correlated with the two other groups in the stakeholder analysis. In the regression results the coefficients estimated for NG2 and NG3 can

a)

b)
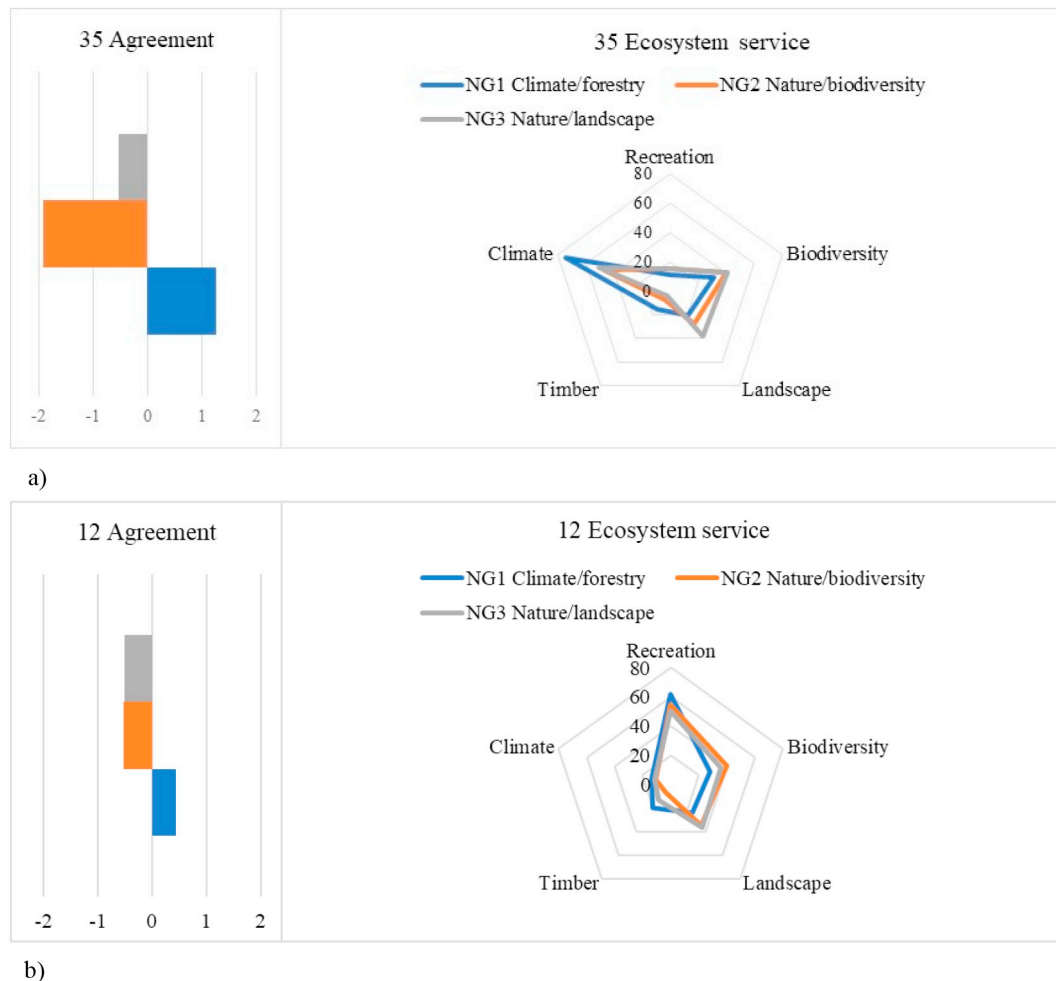
Fig. 4. a)–f): Survey results for six of the Q-statements. The bar graph shows the average Likert scores for each NG and the spider diagram shows the ES emphasised.

4a) Q-statement 35: "The CFP is an important contribution to the green transition." NG-groups disagree, and climate was emphasised significantly more ($p < 0.001$) by NG1 members than by NG2 and NG3 members.

4b) Q-statement 12: "Constructing new forest roads improves recreation because it allows for easier access to recreation areas." NG-groups disagree. NG2 and NG3 emphasised biodiversity significantly more ($p < 0.01$) than NG1, while recreation was emphasised the most by NG1 ($p < 0.07$ for NG2 and $p < 0.001$ for NG3).

4c) Q-statement 33: "To protect biodiversity in Norway, the amount of production forest should not increase." NG's disagreed whether area with production forest should increase in Norway. Timber and climate are emphasised the most by NG1(for timber significantly more than NG2 at $p < 0.01$ and significantly more than NG3 at $p < 0.001$. while NG3 emphasise landscape significantly more than NG1 ($p < 0.001$). NG2 emphasise biodiversity significantly more than NG1 ($p < 0.01$).

4d) Q-statement 28: "The climate forest project's main priority should be to maximise carbon sequestration. Factors such as landscape aesthetics and biodiversity are less important". NG's agreed that climate sequestration cannot be the only priority of the climate forest project. Climate was emphasised more by NG1 than by NG2 and NG3 ($p < 0.00001$ for both comparisons), while biodiversity and landscape was emphasised the more by NG2 and NG3 than by NG1 ($p < 0.01$ for both comparisons).

4e) Q-statement 26 "Norway has enough space for climate forest." NG1 agreed strongly, while NG2 and NG2 agreed weakly. Climate and timber were emphasised more by NG1 than by NG2 and NG3. For both comparisons for climate $p < 0.0001$, while for both comparisons for timber $p < 0.01$.

4f) Q-statement 46 "The climate forest project is primarily driven by the forest industry's economic interests" NG's disagreed about what drives the CRP. Climate is emphasised by NG1 than by NG2 and NG3 ($p < 0.0001$ for both comparisons), while timber was emphasised more by NG2 and NG3 than NG1 ($p < 0.10$ for both comparisons). (For interpretation of the references to colour in this figure, the reader is referred to the electronic version of this article.)
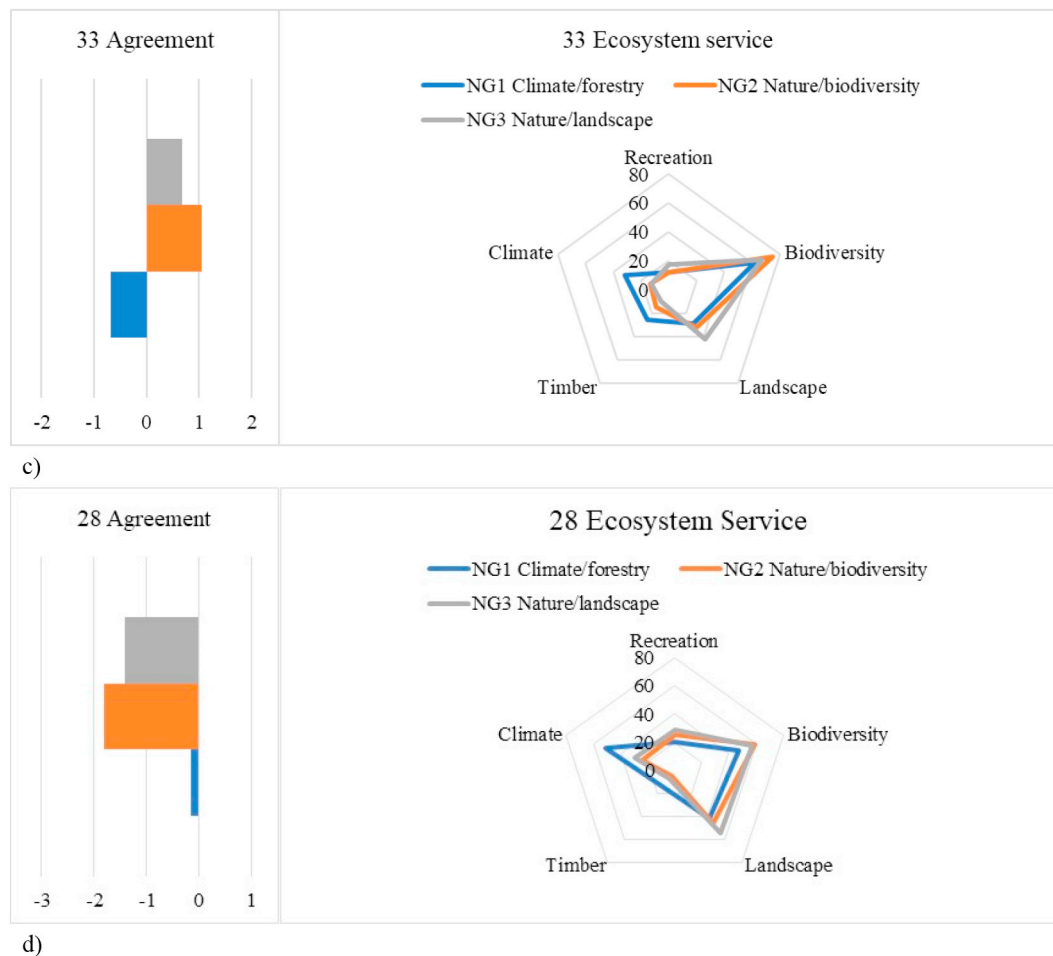
c)

d)

Fig. 4. (*continued*)

be interpreted as values relative to the base category NG1. Variable definitions and descriptive statistics are provided in Table 3, and the regression results are reported in Table A1, in the Appendix.

The regression results indicate that respondents in group NG2 and NG3 are more likely to oppose the CFP. NG3 members are more likely than those in NG1 to be female, have slightly higher income, and live in Northern or Southwestern Norway where spruce is rare and abandoned grazed outfields are common. NG2 were more likely than NG1 to be a member of a hunting, fishing or environmental organisation. NG3 was less likely than NG1 to be member of an agricultural or forestry interest organisation but are more likely to have voted for the Centre party. Other variables such as age, education, having children under 15 in the household, being from Central Norway, and knowledge of the CFP program are not significant in explaining membership in NG2 and NG3 compared to NG1.

4. Discussion and conclusions

There is an ongoing debate in Norway about whether to scale up spruce forest planting to sequester carbon more effectively on abandoned pastureland. This debate has reflected large heterogeneity in stakeholder preferences and controversy. We therefore applied the Q method to analyse this land use conflict, first to better understand this discourse and the main positions (narratives) among stakeholders in the Norwegian climate forest debate. Statistical analysis to identify patterns in the stakeholder responses produced three main narratives/perspectives in the debate: Climate/forestry, Nature/recreation, and Nature/tourism. The Climate/forestry perspective was for planting of spruce climate forests and agreed with many of the statements relating to provisioning and regulating ES (the atmospheric regulation ES subgroup). The two other narratives/perspectives were against the CFP. The Nature/recreation perspective agreed with many of the statements relating to the regulating ES subgroup "Lifecycle maintenance, habitat and gene pool protection". The Nature/tourism-perspective agreed with several statements related to cultural ES, including the subgroup "Spiritual, symbolic and other interactions/Other biotic characteristics that have a non-use value".

Further, a relatively unexplored issue in Q methodology applications in ecological economics, and environmental management and conservation more generally, is the extent to which the stakeholder perspectives from Q method applications can be generalised to the wider population (Zabala et al., 2018). Following, the scale creation method proposed by Danielson (2009), we surveyed a representative sample of the Norwegian population using distinguishing Q-statements. This survey also explored which of five important ES people emphasised when evaluating the key statements. From this survey we found three narrative groups corresponding to each of the narratives found from the Q method. About half of the sample adhered to the
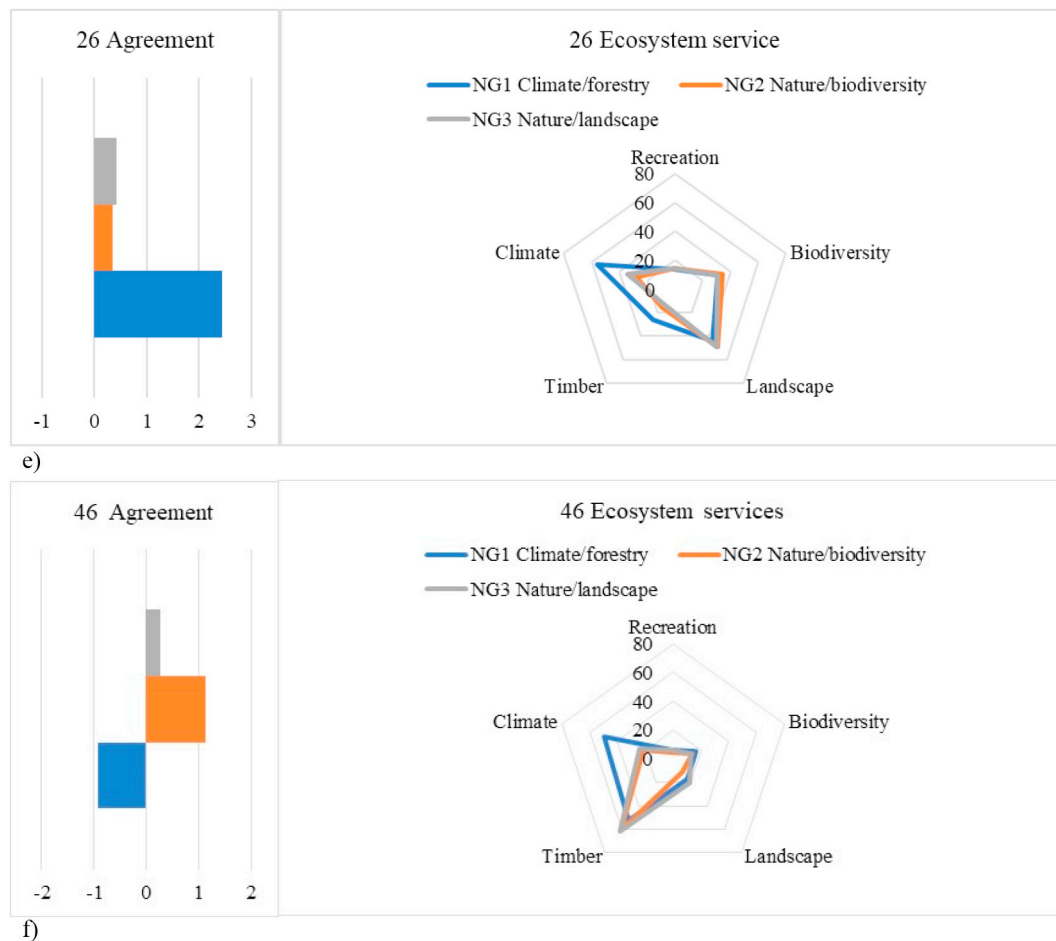
Fig. 4. (*continued*)

Climate/forestry narrative group which was for planting of spruce climate forests. This group emphasised timber and climate mirroring the ES emphasised by the stakeholders in this group. The second two narrative groups, Nature/recreation and Nature/tourism, which constituted the other half of the sample, were against planting of spruce climate forests. The Nature/recreation narrative group emphasised "biodiversity", which may be considered a simplified expression for "Lifecycle maintenance, habitat and gene pool protection" mirroring the stakeholder narrative.[14] Finally, the Nature/tourism group emphasised the "landscape" the most strongly and the corresponding stakeholder narrative was the most focused on spiritual aspects of the ES. Interestingly, the Nature/recreation and Nature/tourism narrative groups agreed with the statement that the CFP was a policy designed to benefit economic interests of the forestry sector. This was also the only statement where the Nature/tourism emphasised "timber" the most and the Climate/forestry group emphasised "biodiversity" the most.

Finally, we asked the question of whether the use of a standard Q method in combination with a population survey may contribute to our understanding of the climate forest issue and bring us closer to potential policy solutions. From our survey it became clear that the population is about equally divided between favouring climate forest planting, either due to interest in production forestry or climate mitigation (e.g. group NG1), and those favouring no or limited climate forest planting due to interests in biodiversity protection or recreation/nature tourism (NG2

and NG3). Using a multinomial logit model to compare NG2 and NG3 (those that oppose the CFP) to NG1 (those that are for the CFP), we found indications that respondents from regions of Norway where dense spruce forests are less common or where there is a large share of abandoned grazed outfields considered for planting, had views concurring most with the Nature/tourism group. This may be interpreted as sign of a NIMBY (Not In My Backyard)-effect. They are also more likely to have voted for a party with rural development orientation at the last election, to be female and to have slightly higher incomes. Compared to NG1, NG2 they are more likely to be members of environmental or hunting and fishing organisations and to be less concerned about the consequences of climate change globally.

This is, to our knowledge, the first study of its kind in ecological economics exploring the combined use of a standard Q methodology with a general population survey, as explained in Danielson (2009) and as recently recommended by Zabala et al.'s (2018) review of the applications of Q method in conservation research. Our aim has not been to compare the results from the two methods as e.g. Thompson et al. (2012) and Eyvindson et al. (2015) do. Instead, we have attempted to combine the strengths of the two methods: the depth of the Q method with the breadth of the general population survey. Identifying the perspectives in a policy debate and in the general population should help design climate and environmental policies with greater acceptance. Considering the sometimes-adverse effects that climate policies' have on biodiversity, one needs to design policies with all perspectives in mind. For abandoned pastures, an alternative policy should be chosen that can contribute to both carbon sequestration and the preservation of landscape aesthetics and biodiversity. Our study demonstrates one potential way forward to explore the combination of these

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[14] As noted in Section 2.5, respondents may also have considered biodiversity («plant and animal life») as a cultural service to them.

Table 4

Dis/agreement with each Q-statement by NG, and the NG that emphasised the ES the most. Blue, orange, and grey fields indicate that the ES were emphasised the most by NG1, NG2, and NG3, respectively.

Statement no in Table 1	Dis/agreement Likert Score			NG group emphasising the ES the most for statement				
	NG1	NG2	NG3	Recreation	Biodiversity	Landscape	Timber	Climate
1	0,58	−0,44	2,4		NG3			
2	−2,62	−0,88	0,66	NG2				
9	0,58	2,61	2,13		NG2			
12	0,45	−0,53	−0,51	NG1		NG3		
15	1,34	2,43	1,86	NG3	NG3			
19	−2,09	−0,06	1,43					
23	−4,02	−2,93	−0,52	NG2			NG1	NG1
25	−1,92	0,85	0,83					
26	2,43	0,35	0,42	NG3	NG2	NG2		
28	−0,15	−1,81	−1,42					
33	−0,69	1,05	0,68	NG2				
34	−1,4	1,81	0,45			NG3		
35	1,27	−1,92	−0,54		NG3			
36	1,14	−2,05	−0,27	NG3	NG3			
46	−0,93	1,13	0,27		NG1		NG3	

Note: The three first columns indicate the degree of dis/agreement with the Q-statement for each NG as in Table 1. Yellow means neutral (Likert score was ± 0.2), green means agree (Likert score > 0.2), and red means the disagree (Likert score < −0.2).

two methods. Undoubtedly, more research and testing of the method is required to ascertain its usefulness in terms of justifying the additional effort required to use the generalised Q method. Promising areas of future research include methodological advancements such as using visual stimuli to accompany or compare with standard textual Q statements, to account for temporal dynamics (as suggested by Zabala et al., 2018) and uncertainty in statements (e.g. Zabala and Pascual, 2016), and to conduct robustness checks of the stability of Q results from sample size and stakeholder selection. To increase its usefulness for policy design, one idea for the generalised Q method is to include questions of the acceptance of concrete policy proposals in the population survey (e.g. Grimsrud et al., 2019) that could be directly linked with identified narrative groups from the Q method.

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.

Appendix A

6/15

To what extent do you agree or disagree with the following statement?
- 'Norway is about to become overgrown. Therefore, we should not plant more forest.'

0	Disagree completely
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	Agree completely
	Don't know

When evaluating the statement 'Norway is about to become overgrown. Therefore, we should not plant more forest', which issue were you the most concerned about?

More than one answer is possible

| Animal and plant life | Timber production | Recreation | Landscape aesthetics | Climate |

Other, note

| None | Don't know |

Fig. A1. Screen shots from the web survey of one of the Likert scale questions for one of the 15 Q-statements and the follow-up question on which element the respondent emphasised in her answer.

Table A1
Multinomial logit estimates with NG1 Climate/forestry is the base outcome.

Variable	NG2 Nature/recreation		NG3 Nature/tourism	
	Beta	*p*-Value	Beta	*p*-Value
Female	0.248	0.211	0.560***	0.000
Age	−0.005	0.421	0.007	0.185
Edu	0.029	0.894	−0.050	0.762

Table A1 (*continued*)

	NG2 Nature/recreation			NG3 Nature/tourism	
Variable	Beta	*p*-Value		Beta	*p*-Value
Under15	0.042	0.782		−0.070	0.583
Lnhhinc	−0.006	0.815		0.035*	0.097
Southwest	0.388	0.081		0.756***	0.000
Central	−0.481	0.170		−0.347	0.181
Northern	0.554	0.107		1.209***	0.000
MemberHunt	0.979**	0.006		0.500	0.123
MemberEnviro	1.144**	0.003		0.044	0.904
MemberTrek	0.010	0.974		0.360	0.112
MemberAgFor	−0.716	0.229		−1.151*	0.015
CentralParty	0.847	0.126		1.324**	0.002
PoliticalLeft	−0.267	0.221		0.049	0.756
OpinionCFP	−2.093***	0.000		−2.016***	0.000
KnowCFP	0.002	0.993		−0.051	0.744
ConsNorway	−0.339	0.187		−0.129	0.527
ConsWorld	−0.645*	0.044		0.003	0.992
n = 1222	Pseudo-R^2 = 0.1647				

Legend:

  * $p < 0.05$.

  ** $p < 0.01$.

  *** $p < 0.001$.

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