Does Cooperation between Finnish Forest Owners Increase Their Interest in Capercaillie (*Tetrao Urogallus*) Lekking Site Management?

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**ABSTRACT**

This research reviews the factors that are associated with the willingness of forest owners to participate in cross-boundary management of capercaillie (*Tetrao urogallus*) lekking sites. The data were collected with a double-sampling survey that was targeted at Finnish forest owners. Our findings infer that forest owners are quite often willing to participate in cooperative actions, and most interestingly, the opportunity for cooperation seems to increase the interest of forest owners to manage lekking sites. However, achievement of an ecologically and socially valuable cooperative solution would require finding forest owners with similar objectives and properties with suitable ecological values. Our results provide important evidence of how cooperation can inspire forest owners in natural resource management, which will also provide benefits to the wider socio-ecological system.

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**Introduction**

Many of the current global environmental challenges, such as ecosystem or habitat degradation, forest fragmentation, and declines in wildlife populations or watershed quality are processes that are situated over wide spatial scales. In areas that are characterized by small, privately owned properties, responding to such resource management challenges requires cross-boundary cooperation by owners of adjacent properties (e.g., Bergmann and Bliss 2004; Schulte, Rickenbach, and Merrick 2008). The foundations for such an approach have been increasingly studied within different cooperation contexts (e.g., Rickenbach and Reed 2002; Bergmann and Bliss 2004), as have the patterns, processes and structures of social networks that could drive/complicate cooperation efforts (e.g., Bodin et al. 2016; Bodin, Garcia, and Robins 2020). However, the factors that underpin the willingness of small-scale private landowners to participate in coordinated cross-boundary management remain poorly understood.
A wide ecological system that potentially requires cross-boundary management is the lekking habitat of the game species capercaillie (*Tetrao urogallus*). A lekking site can cover a forest area of 20 hectares, whereas a lekking area that includes the lekking center (and the feed and resting territories of the males) can cover a forest area up to several hundred hectares (Wegge and Larsen 1987; Sirkiä et al. 2011). For example, forest land in Finland is characterized by private properties that are, on average, slightly wider than the average lekking site (30.3 hectares, see Peltola et al. 2020), and are often managed in a self-sufficient manner by their owners. Capercaillie lekking sites are negatively impacted by the fragmentation of forest areas, and thus (game-oriented) forest management with landscape-level coordination could prevent further fragmentation of these habitats (see e.g., Sirkiä et al. 2011, 2012).

Overall understanding of how to influence the wellbeing of capercaillie and other game birds through forestry practices has increased in recent years. Game-oriented forest management, also called grouse-friendly forest management (Rautiainen et al. 2017; Haara et al. 2021) or game-friendly forestry (Haakana et al. 2020), is a voluntary forestry approach that specifically acknowledges and manages grouse habitats within forestry practices. Yet, the locations of the lekking sites are often poorly known by non-industrial private forest owners (hereafter referred to as forest owners), which would indicate that the lekking sites are rarely actively managed, even on individual properties. The norms of self-sufficient management or current soft policy instruments do not support landscape-level management as traditional forest management or even game-oriented forest management on the individual properties. Cooperation between forest owners in lekking site management could ensure that the importance of this habitat is acknowledged and could also provide forest owners with an attractive alternative to forest conservation, which could be beneficial for lekking sites for example but may also restrict the utilization of forests for timber. A shift toward cooperative landscape management calls for a new cross-boundary approach, which must be learned and adopted by forest owners.

The support of peer forest owners and horizontal knowledge exchange between forest owners has been found to be important for the adoption of novel forestry practices (e.g., West et al. 1988; Korhonen, Hujala, and Kurttila 2013; Meadows, Herbohn, and Emtage 2013). Examples from the United States and Australia have also shown that forest owners often prefer peer-based learning in regard to management (see Meadows, Herbohn, and Emtage 2013; Fischer, Klooster, and Cirhigiri 2019), and actively seek the views of other owners for advice (Schubert and Mayer 2012). Information on cooperative action could raise interest among forest owners and lead to participation in cooperative activities, whereas positive experiences of cooperation could bolster interest and lead to the continuation/elaboration of existing cooperation and enhance knowledge exchange between forest owners. For cooperative (collective) management, peer interaction and learning can also be regarded as essential preconditions (see Wondolleck and Yaffee 2000; Schusler, Decker, and Pfeffer 2003; Muro and Jeffrey 2008; Berkes 2009). However, forest owners in Finland appear to have limited opportunities to achieve communication with other forest owners (e.g., Hamunen et al. 2015).

Information on the willingness of forest owners to participate in cooperative landscape-level actions in Finland also remains poor. Although cooperative lekking site
management requires interest from the part of forest owners, it is reasonable to assume that a cooperative approach to lekking site management might also influence the interest of forest owners to manage a lekking site: Cooperation is based on peer work that has proven to be important in the acquisition and application of novel forest management methods by forest owners. Therefore, our double-sampling survey study focuses on two main research questions (RQs). First, we studied the willingness of forest owners to participate in cooperative lekking site management (RQ1). Second, we sought to evaluate whether the opportunity for cooperation increases the interest of the forest owners toward the management of lekking sites (RQ2).

An understanding of the interest and willingness of forest owners to cooperate is a requirement for determining the foundations for cooperative natural resource management. In a broader sense, our study aimed to consider how perceptible interest in cooperative lekking site management is reflective of the possibilities and restrictions related to the cooperative management of natural resources beyond our capercaillie lekking site example. While this study advances the understanding of the potential willingness of owners to cooperative action, it complements the wider social network research (see e.g., Bodin, Garcia, and Robins 2020) and adds to the literature around spatially explicit participation in natural resource management. Simultaneously, it introduces novel possibilities for the management or conservation of natural resources and brings value to the design, coordination, and application of different cooperative schemes for scenarios that include private family forest ownership.

Conceptual Framing

Cooperation might be considered as an action with multiple new dimensions for participants (see Rickenbach et al. 2011; Stallman and James 2015). Here, cooperative lekking site management requires that forest owners be willing to apply a necessary course of actions for cooperation (e.g., negotiations or coordination of forestry activities) but also to accept context-specific game-oriented methods in their forests. Therefore, our conceptual framing employs aspects from both the collective action literature and forestry adoption literature.

The theory of collective action (Ostrom 1990, 1992) aims to explain the willingness of an individual to participate in cooperation, whereas the theory of innovation adoption (Rogers 1995) attempts to describe the ability of an individual to adopt novel practices. Collective action theory suggests that individuals may switch to cooperative strategies when such strategies (that people are capable of participating in) exist, individuals share an understanding of reciprocity, and that cooperative action is better for the common resource, and that they will receive positive benefits from cooperation (Ostrom 1992; Stallman and James 2015). Thus, cooperation is fostered by the presence of shared objectives, the value of the resource, and strong social connections (e.g., Fischer and Charnley 2012, Stallman and James 2015). Also, resource characteristics, such as small participant groups and determined resource boundaries, can promote collective action (e.g., Ostrom 1990; Meinzen-Dick, DiGregorio, and McCarthy 2004). In regard to cooperative lekking site management, both aforementioned resource characteristics could potentially fulfill this requirement since the number of participants in the
Finnish property structure is likely to be limited, and the activity at the lekking site might provide reliable evidence for its boundaries. Therefore, it becomes important to focus on the above-mentioned social factors that foster the willingness of forest owners to cooperate.

Rogers (1995) suggests that the adoption of novel activities (cooperative lekking site management here) emerge within social systems, in which the cooperative participants are involved and engaged in solving a problem or accomplishing a mutual goal. In terms of the theory, the adoption of activities is highly reliant on “near-peers,” who are able to influence the attitudes and behavior of others by their own example (Rogers 1995; Khanal et al. 2019), although “change agents” (e.g., forestry experts) may substantially influence forest owners to attain new methods (Rogers 1995). Social interaction through communication channels contributes to the adoption process (Khanal et al. 2019) and information provided by trusted peers is often sufficiently valued and conclusive for individuals to adopt the information (Rogers 1995; Khanal 2019). For example, Meadows, Herbohn, and Emte (2013) provided examples of “over-the-fence-learning,” where neighbors helped others to adopt sustainable solutions and secure landscape-level benefits. As such, this type of peer learning, peer assistance or pressure has been suggested as especially important between forest owners (West et al. 1988; Korhonen, Hujala, and Kurtila 2013; see also Ikonen et al. 2020), which would also indicate that the adoption of lekking site management and, thus, the willingness to participate in such cooperation, might be influenced by peers.

In this study, we employ two conceptual aspects based on the theories described above: Willingness of forest owners to cooperate (see Ostrom 1990; Kahan 2003; Pretty 2003; Stallman and James 2015) for lekking site management, and the role of peers in adoption of cooperation as a novel method (see Rogers 1995). Reflection of cooperation as a form of peer action is used as a lens to evaluate our results. With the introduction of a theoretical possibility to cooperate for the management of a lekking site (cooperative strategy), the attitude between neighbors, their assumptions of cooperation and positions on game-oriented management methods can be gauged to reveal insights into their willingness to engage in cooperative lekking site management. At the same time, the results of the interaction between forest owners and their openness to cooperate in lekking site management will provide insights into the role of peers to motivate management of landscape-level natural resources.

**Materials and Methods**

**Survey Sample and Data Collection**

The study was conducted with an online survey that was targeted at Finnish forest owners. The questions were drawn from the conceptual orientation described above, and the final survey form included sections designed to measure the frequencies of phenomena related to the occurrence of cooperative lekking site management. Questions related to game-oriented forest management, capercaillie, and hunting were designed to reveal the perception of forest owners toward capercaillie habitat management, whereas questions related to the forest owners’ perceptions of participation, and previous and future cooperation were designed to gauge the willingness of forest owners to engage in
cooperative actions. Parts of the questions were designed to characterize the interactions between forest owners. The survey forms were tested with six volunteer forest owners from outside the sample group.

The forest owner sample group (with contact information) was derived from the contact information register held at the Finnish Forest Center, a state-funded organization with responsibilities related to the enforcement of forestry legislation and the promotion of forestry. The registry encompasses the Finnish forest owners in continental Finland, and a sample of 1,300 forest owners was drawn from non-industrial private forest owners, whose contact information included both email addresses and phone numbers. Forest properties on the self-governed Åland Islands (1% of all Finnish forest property entities, Natural Resource Institute Finland 2016) were excluded from the sample as the data permit procedure required by the regional government there was considered to bring low added value in relation to the effort required to elicit that information and the low number of properties in that jurisdiction.

The survey was conducted using the SurveyPal online system (SurveyPal Oy 2021) at the beginning of April 2020. After sending the survey invitations to the forest owner sample group, the survey was left open for three weeks and two reminders were sent to the forest owners during that time. The survey response rate was 25.7%, as 334 forest owners (hereafter referred to as the respondents) participated in the survey. Those who did not respond to the survey are hereafter referred to as non-respondents (966 forest owners).

Opinion surveys tend to provide biased sample mean results, as according to Thompson (2012) respondents of a survey are often not representative of the survey topic. Here, we were able to assume that forest owners with an interest in cooperation or game habitat management were more likely to respond to the survey than those without personal interest in the topic, thereby leading to biased results. We applied a double-sampling method to adjust for this volunteer bias/non-response, and so data were collected accordingly in two phases. After the first-phase survey data, a second sample was taken of the non-respondents. As obtaining information from this group might require intensive efforts, the non-respondents were contacted and surveyed via phone calls using the so-called “callback method” (Thompson 2012, see also Ikonen et al. 2020).

The non-respondents were arranged randomly and were called systematically until at least 50 responses were obtained for the second-phase data. The efforts resulted in 52 complete and 2 partial callback responses. From among those who were reached, 18 persons were unable or unwilling to participate in the callback survey, but only one person indicated that the primary reason for refusal was possibly related to the survey topic. Other non-respondents indicated that they were not able to answer the questions in Finnish or that they were unwilling to participate in any type of survey or study. Therefore, we consider that the volunteer bias in the second-phase data was marginal and that the combined results of the original and callback samples are representative of the forest owner population in Finland.

Background data were requested from the Finnish Forest Centre to determine whether the backgrounds of the respondents and non-respondents were different (Table 1). As our research focuses on describing the frequency of relevant phenomena, classification of respondents by background information was deemed unnecessary.
The initial survey data and second-phase data (considered free from volunteer bias) were combined to generate well-generalizable results. Unbiased estimates of population means were provided with the double-sampling stratified estimator (Thompson 2012):

\[ \bar{y}_d = w_1 \bar{y}_1 + w_2 \bar{y}_2 \]

where \( w_1 = \frac{n_1}{n'} \) and \( w_2 = \frac{n_2}{n'} \) and represent the weighting of respondents and non-respondents, respectively; \( n_1 \) is the number of respondents and \( n_2 \) is the number of non-respondents in the first-phase survey, whereas \( n' \) is the sample size of forest owners (1,300 from the total population). \( \bar{y}_1 \) is the estimate of the respondent population mean (i.e., proportion of responses) from the first-phase survey, and \( \bar{y}_2 \) is the estimate of the non-respondent population mean from the second-phase survey (callbacks).

Estimates of the variances in the population means were calculated using the sample variances \( s_h^2 \) from the second-phase survey (Thompson 2012):

\[ \text{var}(\bar{y}_d) = \sum_{h=1}^{L} \left( \frac{n'_h}{n'} - \frac{1}{1} \right) \frac{w_h s_h^2}{n_h} + \frac{1}{(n' - 1)} \sum_{h=1}^{L} w_h (\bar{y}_h - \bar{y}_d)^2 \]

The above formula differs from the Thompson’s formula so that the finite population corrections were not used since their significance in the outcome was marginal. Here \( h \) represents the stratum (1 = first-phase survey, 2 = second-phase survey), \( n_h \) is the number of respondents of \( y \) in stratum \( h \), whereas \( w_h = \frac{n_h}{n'} \) is the weighting (defined above), and \( s_h^2 \) is the estimated standard deviation of \( y \) in stratum \( h \). Standard errors were calculated as the square root of estimated variances:

\[ s_d = \sqrt{\text{var}(\bar{y}_d)} \]

Confidence intervals and their upper and lower boundaries were calculated with the above standard errors:

\[ \bar{y}_d \pm z s_d \]

where \( z = 1.96 \) is the 0.975th standard normal quantile, which results in two-tailed 95% confidence intervals.

**Data Analysis**

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where \( w_1 = \frac{n_1}{n'} \) and \( w_2 = \frac{n_2}{n'} \) and represent the weighting of respondents and non-respondents, respectively; \( n_1 \) is the number of respondents and \( n_2 \) is the number of non-respondents in the first-phase survey, whereas \( n' \) is the sample size of forest owners (1,300 from the total population). \( \bar{y}_1 \) is the estimate of the respondent population mean (i.e., proportion of responses) from the first-phase survey, and \( \bar{y}_2 \) is the estimate of the non-respondent population mean from the second-phase survey (callbacks).

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The above formula differs from the Thompson’s formula so that the finite population corrections were not used since their significance in the outcome was marginal. Here \( h \) represents the stratum (1 = first-phase survey, 2 = second-phase survey), \( n_h \) is the number of respondents of \( y \) in stratum \( h \), whereas \( w_h = \frac{n_h}{n'} \) is the weighting (defined above), and \( s_h^2 \) is the estimated standard deviation of \( y \) in stratum \( h \). Standard errors were calculated as the square root of estimated variances:

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**Table 1. Background information of the forest owners.**

|                  | Mean age, years | Forest ownership, years | Number of properties | Share of forest owners living in same municipality as forest property, % |
|------------------|----------------|-------------------------|----------------------|---------------------------------------------------------------------|
| Respondents      | 63             | 21                      | 3                    | 56                                                                  |
| Non-respondents  | 61             | 22                      | 4                    | 65                                                                  |
| All (1,293)      | 61             | 22                      | 4                    | 63                                                                  |

Background data were requested from the Finnish forest Centre after the first-phase and second-phase surveys (callback = CB) were conducted, and the data included seven (0.5%) missing forest owner entries (one respondent, one callback respondent, and five non-respondents). These resulted from changes in the forest owner register during the time between requesting the original study sample and the background data.
Table 2. Questions and results regarding the position of forest owners in relation to capercaillie lekking sites and game-oriented forest management methods (n = 328–331).

| Question                                                                 | ȳd, %       | sd, % | CI, LB | CI, UB | ȳ1, % | ȳ2, % |
|--------------------------------------------------------------------------|--------------|-------|--------|--------|--------|--------|
| Do you hunt? (n = 327)                                                   | No           | 64.1  | 5.1    | 54.2   | 74.0   | 65.9   | 63.5   |
| Yes, small game                                                         | 7.9          | 2.8   | 2.5    | 13.4   | 8.7    | 7.7    |
| Yes, deer                                                               | 7.5          | 2.8   | 2.0    | 13.0   | 6.9    | 7.7    |
| Yes, both small game and deer                                          | 19.9         | 4.3   | 11.6   | 28.3   | 16.5   | 21.2   |
| Choose the most important forest-related objective related to forest ownership and management (n = 328). | Timber production and incomes | 39.8  | 5.1    | 29.9   | 49.7   | 37.1   | 40.7   |
| Financial security                                                     | 15.0         | 3.7   | 7.8    | 22.2   | 15.6   | 14.8   |
| Recreation and free time                                               | 13.2         | 3.5   | 6.4    | 20.0   | 13.8   | 13.0   |
| Sentimental values of forests                                           | 8.6          | 2.7   | 3.3    | 13.9   | 12.0   | 7.4    |
| Conservation of nature and landscape                                   | 4.2          | 2.0   | 0.4    | 8.0    | 5.7    | 3.7    |
| Forest property as an investment                                       | 8.9          | 3.0   | 3.0    | 14.7   | 7.8    | 9.3    |
| Hunting possibility                                                     | 6.0          | 2.7   | 0.7    | 11.2   | 1.8    | 7.4    |
| Something else?                                                         | 3.9          | 1.9   | 0.1    | 7.7    | 4.5    | 3.7    |
| How would you react on a scale of 1–5, if you found out that there was a capercaillie lekking site in your forest? (n = 332) | Very positively | 51.9  | 5.1    | 41.8   | 61.9   | 58.0   | 46.3   |
| Positively                                                              | 25.4         | 4.6   | 16.4   | 34.4   | 18.6   | 27.8   |
| Not positively nor negatively                                          | 17.6         | 4.1   | 9.5    | 25.7   | 9.6    | 20.4   |
| Negatively                                                              | 0.2          | 0.1   | 0.1    | 0.4    | 0.0    | 0.0    |
| How would you react on a scale of 1–5, if you found out that there was a capercaillie lekking site in your forest? (n = 332) | Very positively | 51.9  | 5.1    | 41.8   | 61.9   | 58.0   | 46.3   |
| Positively                                                              | 25.4         | 4.6   | 16.4   | 34.4   | 18.6   | 27.8   |
| Not positively nor negatively                                          | 17.6         | 4.1   | 9.5    | 25.7   | 9.6    | 20.4   |
| Negatively                                                              | 0.2          | 0.1   | 0.1    | 0.4    | 0.0    | 0.0    |
| I don’t know                                                            | 4.4          | 2.3   | 0.2    | 8.9    | 0.9    | 5.6    |
| Are there lekking sites on your property? (n = 330)                     | Yes           | 16.5  | 3.8    | 8.9    | 24.0   | 15.9   | 16.7   |
| No                                                                      | 34.4         | 5.0   | 24.7   | 44.2   | 26.9   | 37.0   |
| I don’t know                                                            | 48.8         | 5.1   | 38.7   | 58.9   | 56.0   | 46.3   |
| If there was a lekking site on your property, would you be willing to take it into account in forest management? (n = 328) | Yes           | 88.0  | 3.5    | 81.2   | 94.7   | 90.7   | 87.0   |
| No                                                                      | 3.6          | 1.9   | -0.2   | 7.4    | 3.3    | 3.7    |
| I have already taken it account                                         | 8.0          | 3.0   | 2.1    | 13.8   | 4.2    | 9.3    |
| Which of the following forest management methods would you be willing to apply to manage a game habitat as a capercaillie lekking site? (n = 332) | Maintaining bush vegetation | 79.5  | 3.5    | 72.6   | 86.4   | 57.8   | 87.0   |
| Maintaining game thickets                                              | 76.3         | 4.0   | 68.4   | 84.2   | 61.4   | 81.5   |
| Favoring mixed tree species                                            | 83.4         | 3.5   | 76.6   | 90.3   | 73.1   | 87.0   |
| Preserving transitional zones                                          | 63.3         | 4.7   | 54.0   | 72.5   | 42.8   | 70.4   |
| Using thinnings from above                                             | 56.5         | 5.0   | 46.6   | 66.3   | 43.1   | 61.1   |
| I don’t want to advance game                                           | 0.7          | 0.2   | 0.2    | 1.1    | 2.7    | 0.0    |
| Which of the following forest management approaches would you be willing to apply to manage a game habitat as a capercaillie lekking site? (n = 332) | Lengthening the rotation period | 49.1  | 5.1    | 39.1   | 59.2   | 41.3   | 51.9   |
| Continuous cover forestry                                              | 71.6         | 4.5   | 62.7   | 80.4   | 64.4   | 74.1   |
| Partial/total conservation                                             | 32.9         | 4.9   | 23.3   | 42.5   | 26.3   | 35.2   |
| Something else?                                                         | 22.3         | 4.6   | 13.3   | 31.3   | 6.3    | 27.8   |
| Which of the following forest management approaches would you be willing to apply to manage a game habitat as a capercaillie lekking site? (n = 332) | Lengthening the rotation period | 49.1  | 5.1    | 39.1   | 59.2   | 41.3   | 51.9   |
| Continuous cover forestry                                              | 71.6         | 4.5   | 62.7   | 80.4   | 64.4   | 74.1   |
| Partial/total conservation                                             | 32.9         | 4.9   | 23.3   | 42.5   | 26.3   | 35.2   |
| Something else?                                                         | 22.3         | 4.6   | 13.3   | 31.3   | 6.3    | 27.8   |

ȳd is the unbiased estimate of the population mean, sd denotes its standard error. CI, LB denotes the lower bound confidence interval, and CI, UB denotes the upper bound confidence interval (95%) of the population mean ȳd. ȳ1 is the respondent population mean of the first-phase survey, and ȳ2 is the non-respondent population mean of the second-phase survey.

Results

Grounds for Forest Owners’ Participation in Cooperative Lekking Site Management

According to our results, the majority (64.1%) of forest owners were not hunters, and forests were valued most often for their economic importance (Table 2). Yet, almost 77% of forest owners indicated that they would react positively or very positively to finding out that a lekking site was located on their property, and 88% would be ready to take it into account in their forest management. More than 16% of forest owners reported that their properties included a lekking site, and 8% had already taken
measures to acknowledge it within their forest management. However, nearly half of forest owners did not know if they had lekking sites on their properties.

Game-oriented or game-friendly forest management methods were accepted (i.e., forest owners were willing to apply) by more than half of forest owners, in particular the use of mixed tree species (83.4%) and the maintenance of bush vegetation (79.5%, Table 2). Yet, of the overarching forest management approaches to manage the habitats for game, only continuous cover forestry was accepted by the majority (71.6%) of forest owners, whereas an extended rotation period was accepted by around half of forest owners, and conservation was approved by less than one-third. Moreover, nearly 10% were unwilling to employ any of the forest management approaches, although approximately 22% indicated a willingness to apply something other than the alternatives provided in our survey.

In regard to social connections, most forest owners were familiar with some (47.5%) or all (38.3%) of their neighboring forest owners, although nearly 50% lived away from their forest properties (Tables 1 and 3). The majority of forest owners had not discussed forest management cooperation with their neighboring forest owners, although 45% had undertaken cooperation with neighboring forest owners in the past. In these cases, cooperation had been mainly related to the construction of forest roads, ditching projects, hunting, and timber sales.

**Interest and Willingness to Cooperate in Lekking Site Management**

Nearly 63% of forest owners were ready to participate in future cooperation, and more than 75% were ready to participate in cooperation if it concerned management of a
lekking site (Table 4). However, these two questions were also associated with considerable uncertainty: The first question resulted in nearly 30% “I don’t know” answers, and the latter resulted in nearly 24% “I don’t know” answers. The answers to the latter question were influenced mainly by relationships with neighbors (64.5%), perceptions of cost-efficiency (59.8%), compatibility of forest management values (58.1%), and the traditional custom of managing forests independently (54.5%).

Forest owners were also rather uncertain of the necessity and type of possible compensation for cooperation (34.5%), although, most seemed to consider that it should be similar to compensation for independent lekking site management (25.8%) if it were available (Table 4). One-third of forest owners indicated that they would prefer to receive less compensation than independent lekking site management or did not want any compensation at all.

At the same time, cooperation for the management of lekking sites was considered interesting by nearly 44% of forest owners, and interesting if compensation were available by 25.7% of forest owners (Table 4), while almost 25% were uncertain. Importantly, 57.5% considered that cooperation would increase their interest in lekking site management, although this question also raised uncertainty among almost 30% of forest owners.

Discussion

Willingness of Forest Owners to Participate in Cooperative Management on Lekking Sites (RQ1)

The observed high rate of stated willingness to participate in cooperative lekking site management is a promising result for the promotion of a cooperative approach to natural resource management. As such, and in terms of collective action literature (Ostrom 1990, 1992), the high willingness and unanimity of answers could reflect that forest owners share a common understanding of the cooperative strategy needed for lekking site management. However, it should be noted that interest in such management is easy to express in a hypothetical survey, and true readiness to participate is likely to be lower and will depend on many of the finer details of cooperative action. Such details may include, but are not limited to, how trustworthy or value-compatible the owners consider the cooperation organizer (Vainio, Paloniemi, and Hujala 2018), or whether the cooperation topic is connected to a politicized stakeholder discourse (Jokinen et al. 2018).

It is possible that a proportion of the forest owners who refused to participate in the callback survey caused some volunteer bias in the results of the second-phase survey, although we consider that it did not influence the reliability of the results. Moreover, the second-phase results had a considerable influence on some of the final estimates, which would suggest that the first-phase results did include volunteer bias. Often such bias is corrected with background analysis and weightings applied to the original responses, but here it would not have led to more accurate estimates: The populations of respondents and non-respondents were very similar. Thus, the rather labor-consuming callback method was necessary but led here to more reliable estimates.

In Finland, road construction and ditch cleaning, which in this study were the most common cooperation actions previously undertaken by forest owners (see also Hujala et al. 2010), are usually carried through as organization-led projects. Such projects are often associated with cost-efficiency and by the ease of the approach of the forest
Table 4. Questions and results in regard to cooperation and cooperative lekking site management and interest to cooperation (n = 329–331).

| Question                                                                 | Yes (%) | Yes, % | No (%) | No, % | I don't know (%) | 91 (%) | 92 (%) |
|--------------------------------------------------------------------------|---------|--------|--------|-------|------------------|--------|--------|
| Would you be willing to participate in forest management cooperation in the future? (n = 331) | 62.9    | 6.9    | 29.9   | 24.5  | 72.9             | 48.8   | 7.7    |
| Capercaillie lekking sites are often located on several properties at once. Would you be willing to participate in forest management cooperation if it concerned management of a lekking site? (n = 330) | 75.3    | 0.8    | 23.6   | 4.5   | 14.7             | 32.5   | 19.5   |
| Which of the following affected your choice of lekking site-related cooperation? (n = 330) | Relationships to neighbors | 64.5    | 5.2    | 41.9   | 5.2   | 55.1             | 31.6   | 31.6   |
| Cost-efficiency of the cooperation | 59.8    | 4.5    | 46.7   | 5.2   | 55.1             | 36.4   | 26.0   |
| Compatibility of forest management values | 58.1    | 4.5    | 46.7   | 5.2   | 48.3             | 36.4   | 26.0   |
| Distribution of forest management responsibilities | Cost to operate forest management independently | 41.9    | 5.5    | 54.5   | 5.1   | 44.5             | 44.5   | 28.4   |
| Previous cooperation with neighbors | Cost to operate forest management independently | 64.5    | 4.8    | 59.8   | 4.8   | 73.8             | 69.2   | 71.2   |
| How interesting does the lekking site cooperation appear to you? (n = 329) | Not interesting at all | 5.4     | 2.4    | 4.9    | 2.0   | 0.6              | 15.7   | 34.2   |
| Interesting as itself | Interesting, if compensation was available for participation | 43.8    | 5.2    | 25.7   | 4.5   | 33.7             | 16.7   | 25.0   |
| Would cooperative lekking site management increase your interest in managing a lekking site on your property? (n = 331) | I don't know | 24.8    | 4.6    | 29.7   | 4.8   | 15.7             | 20.4   | 25.7   |
| What type of compensation should a forest owner receive for participation in lekking site cooperation? (n = 329) | I wouldn't want any compensation | 19.0    | 4.1    | 12.5   | 3.1   | 10.9             | 6.4    | 18.7   |
| Smaller compensation than from independent management on the lekking site | Larger compensation than from independent management on the lekking site | 15.5    | 4.0    | 29.7   | 4.8   | 7.7              | 4.8    | 39.2   |
| A similar compensation to independent management on the lekking site | I don't know | 25.8    | 4.3    | 4.9    | 2.0   | 17.3             | 4.3    | 23.1   |

\( \bar{y}d \) is the unbiased estimate of the population mean, sd denotes its standard error. CI, LB denotes the lower bound confidence interval, and CI, UB denotes the upper bound confidence interval (95%) of the population mean \( \bar{y}d \). \( y_1 \) is the respondent population mean of the first-phase survey, and \( y_2 \) is the non-respondent population mean of the second-phase survey.
owners (Kittredge 2005; Hujala et al. 2010). The cost-efficiency of these projects and related timber sales may suggest that the willingness of individuals to participate in cooperation is reliant on their need to perceive that cooperation will produce monetary benefits (Ostrom 1990, 1992; Pretty 2003; Fischer, Klooster, and Cirhigiri 2019). In our study, cost-efficiency was highlighted as one of the most important factors that influence willingness to manage lekking sites cooperatively.

In contrast to this, the compensation claims for cooperative management varied between forest owners. The uncertainty associated with compensation claims was notable, although previous studies (e.g., in Italy and United States; Genghini, Spalatro, and Gellini 2002; Daley et al. 2004) have found compensation to be important for landowners considering habitat management practice. In the present results, it was noteworthy that while financial compensation was a driver for cooperation for a segment of forest owners, another segment of respondents indicated a wish for lower compensation for cooperative management than for independent management—the latter may reflect either a valuable social gain or confidence of greater impact from collective action. Yet, a shift to coordinated actions would still require placing value on the mutual resource and sharing the understanding that uncoordinated action may be harmful to the resource (Ostrom 1992). Indeed, the observed high willingness to (1) manage a lekking site independently, (2) apply different game-oriented management methods, and (3) participate in cooperative management of lekking sites, are indicative that capercaillie habitats are valued. Since only one-third of forest owners in this survey were active hunters, capercaillie also appears to be valued for reasons other than as game. This is interesting, as hunters have previously been considered as important actors in wildlife management practices as they are active in this arena (see e.g., Pellikka et al. 2005; Golden et al. 2013).

According to the collective action literature, the willingness to cooperate is influenced by knowledge of others’ goals and practices and thus the ability to know how others can invest in cooperation reciprocally (Ostrom 1992; see also Kahan 2003; Pretty 2003). Individuals living in small communities (which may here relate to the small property structure in Finland) often have accurate pictures of each other’s practices (Ostrom 1992), which improves their ability to consider cooperative activities. The familiarity of neighbors observed in our study may also be reflective of social connections, which are supported by the social benefits associated with the willingness to cooperate (e.g., relationships with neighbors, shared responsibilities). Yet, the questions targeted at cooperative management were also associated with high levels of uncertainty. However, aside from conservation, game-oriented management methods were widely accepted by the forest owners. Indeed, nearly one-third of forest owners indicated an uncertainty or unwillingness to participate in cooperation. In these cases, where not all neighbors wish to be involved, the lekking sites might be only partly managed or indeed not at all, and the potential benefits expected by other participants will be left unrealized.

In regard to the previous considerations, property-specific or even regional characteristics may be of importance for the success of cooperation and underline the need for appropriate reconciliation of objectives and actions. This is in line with different social network analysis studies that have emphasized the need to understand both context-specific social connectivity and ecological requirements to reach effective cooperation in environmental issues (see Bodin et al., 2016; Bodin, Garcia, and Robins 2020). It
would be reasonable to identify owners with similar management values and promote cross-boundary management through cooperation between these owners. Improved knowledge could enable this type of spatial prioritization or management targeting, which acknowledges both the willingness of the forest owner to participate, and the areal ecological values, so as to obtain better landscape conservation or management results (see Meadows, Herbohn, and Emtage 2013; Paloniemi et al. 2018).

Peer Influence on Management of Lekking Sites (RQ2)

The experience from forest-related cooperation provides evidence that forest owners have utilized the assistance of their peers to a limited extent in the past: The two most common examples of cooperation here refer to organization-led projects in which true interaction between forest owners has been considered narrow. Indeed, the greater proportion of cooperation implemented compared to cooperation-related discussions would imply that, at times, the initiative to start mutually beneficial cooperation has come from some other entity than the forest owners themselves. Yet, our results indicate a high frequency of hunting-related cooperation, and that interaction or “peerness” is likely to have a larger role in such cooperation: In Finland, it is common to coordinate hunting through a hunting club (e.g., Pellikka et al. 2005), and forest owners tend to rent their lands to the use of local clubs. However, it seems unlikely that communication in these instances would concern forestry practices.

From the experiences described above, cooperative management would likely require an active executive entity, also considered as a change agent in terms of Rogers’ (1995) adoption theory. Although, the appointment of an expert initiator alone might not be sufficient for a successful outcome (Olsson and Folke 2001; Berkes 2009), it is likely necessary to bring the participants together and administer the proposed action(s) (Kittredge 2005; Meadows, Herbohn, and Emtage 2013). A motivated group of local forest owners capable of leadership and decision-making is still needed (see e.g., Kittredge 2005), as contribution and social capital in terms of social bonds and shared norms among peers (Pretty 2003) is a necessity for social learning and cooperative management (Berkes 2009). Indeed, the willingness of forest owners to participate in future cooperative activities indicates an openness to cooperation.

The proportion of forest owners who indicated that cooperation increased their interest in lekking site management appeared high, especially when the already high proportion of forest owners willing to manage lekking sites is considered. This is in line with the results of Jacobson, Abt, and Carter (2000), who found that forest owners interested in managing forests in the United States for reasons related to environment, water quality and wildlife (in addition to timber production) may be generally more interested in cooperative management alternatives. However, in the United States, wildlife has had a much more significant role as an objective to manage forest properties (see Campbell and Kittredge 1996; Kittredge 2005). In Finland, game management has had a long tradition (e.g., Forsman and Pellikka 2012), although implementation of game-oriented forestry practices has been considered rather modest to date (Ikonen et al. 2020). Thus, the considerable willingness of forest owners to cooperate in habitat management appears interesting, while underlining the importance of peer forest owners and
cooperation in achieving tangible habitat management to accompany the interest that may already exist in the topic.

Yet, our results do not directly reveal why the majority of forest owners are open to cooperate in forest management in lekking sites. It may be that forest owners understand that cooperation will provide benefits that would not be available through individually implemented management practices (see also considerations of cost-efficiency discussed above), as widely suggested by collective action literature. Typically, cooperation could indirectly improve the position of forest owners as service buyers, as larger management units may be more useful and desirable operational environments for both forest professionals and contractors (Kittredge 2005; see also Haara et al. 2021). Cooperation could provide possibilities to integrate into local networks, which may be true here as many forest owners live far from their properties. Although it was beyond the aims of this study to investigate more profound community influences, the local community and services could benefit from improved networks, while interaction could prevent a divergence between the forest owners that live far from their forest holdings and the local forest owners.

Yet, it should be noted that high uncertainties are associated with cooperative alternatives, and the conspicuous lack of awareness of the locations of lekking sites by the forest owners could restrict cooperative lekking site management altogether. If forest owners could see that also others are in the same habitat management situation, they could feel connected, which could enhance the “peerness” in habitat management efforts. The high uncertainties may be partly explained by the newness of the concept, and commitment to a novel practice may be difficult for some owners. For instance, there are currently no examples of policy instruments or service mechanisms in place for such interactive forestry cooperation that forest owners could draw upon. The forest owners may require a better understanding of cooperative management and what may be required of their participation (for similar consideration, see Jacobson, Abt, and Carter 2000) to evaluate their interest in cross-boundary cooperation requiring peer action. This should be acknowledged when assessing the validity of our results.

Indeed, peer influence on decision-making, motivation or actions of the land/forest owners is also highly dependent on the local community context (e.g., McCaffrey et al. 2011). Uncertainty associated with cooperation could also link to the general self-sufficiency (independence) of Finnish family forest owners in decision-making, especially given that forest legislation was amended in 2014 to diversify the available management methods and to improve the decision-making right of forest owners. Even those interested in cross-boundary forest management prefer to be involved in decisions and to maintain their property rights (e.g., Jacobson 2002, see also Creighton, Baumgartner, and Blatner 2002). If forest owners are willing to manage a lekking site cooperatively, the approach should likely act as a tool for peer interaction and reconciliation of forestry practices that highlight the right of the forest owners to implement their own forest management plan, rather than opt for a ready-made landscape plan.

**Concluding Remarks**

Our results in which volunteer bias was efficiently minimized statistically, provide generalizable information in relation to the perceptions of forest owners to engage in
cooperation and lekking site management in Finland. Our findings infer that forest owners are often willing to cooperate in lekking site management. Here, the general position of forest owners toward cooperation appears positive, yet the high proportion of uncertain and unwilling forest owners would indicate that successful cooperation will require careful service design and communication. In addition, there is a need for better information on suitable locations for cooperative lekking site management, and an improved system to acquire that information.

Although the findings reported here may be typical in Finland, we consider our results may be generalizable to some extent in similar situations in other jurisdictions, where the motive for such cooperation is a central landscape-level ecosystem service. However, generalizability is naturally limited by cultural differences in the history of cooperative management, prevailing societal values of the landowners, and the role of ownership and social capital in the socio-ecological system. As a general notion, both monetary and social gains drive the forest owners’ interest in cooperative management, but our results also show that ecological and public goods viewpoints can be relevant drivers for collective action.

Depending on the maturity of a cross-boundary approach, how well known it is, or how conflicted or politicized the cooperation topic may be, different strategies to promote cooperative management could be required. Based on our results, we suggest that instruments are designed for bottom-up landscape-level planning and to positively engage the forest owners, but that they should also be designed to collate more information related to the factors that affect the propensity to cooperate. In future research, it might be reasonable to test the cooperative capacity of locals with workshops, for example, in order to negotiate an acceptable cross-boundary management solution (see e.g., Paloniemi et al. 2018). Other studies that examine cross-boundary cooperation in similar landscapes could also advance from more detailed analysis of the type of owners that could be the most responsive to cooperative activities, the influence of regional/spatial property differences on their willingness to cooperate, and how cooperation could be best introduced in these cases.

At present, forest owners appear open to the assistance of their peers through cooperation on forestry matters, especially if the objective of the cooperation is valued collectively. In a wider sense, the potential for cooperation in habitat management could infer that cooperation could be used to motivate owners toward novel natural resource management actions. Furthermore, it is possible that interest in the cooperation would increase should it either gain social benefits, and/or if the action itself is handled more efficiently (e.g., ease, superficial motive) or more effectively (e.g., ecological, more profound motive), which should be elaborated in future studies.

In the best-case scenario, the benefits of cooperative management could extend from one forest owner to the entire socio-ecological system, thereby improving the connections and social capital among locals. These considerations imply opportunities for cooperation in landscape management in circumstances that include private ownership, yet they refer that specific attention should be directed to contextual details: It seems that successful cooperative management may require intensive efforts to reach an ecologically and socially optimal solution.
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