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The importance of threat, strategy, and resource appraisals for long-term proactive risk management among forest owners in Sweden

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In natural hazards management, it is important to understand what motivates people to act when they or their property are threatened by natural hazards. Despite the importance of both threat and coping appraisals for responses to threats, less is known about the relations between threat and coping appraisals when risk management is long term. The present study examined appraisals of threat (cognitive and emotional), personal resources (cost and self-efficacy), and strategies (response-efficacy) as predictors of proactive management responses (past behavior and future intention) among forest owners in Sweden by means of a questionnaire (n = 1482). A path analysis revealed that threat appraisals and response-efficacy were direct predictors of past risk management behavior and the intention to respond in the future. Appraisals of resources, including cost and self-efficacy, were indirectly – via forest susceptibility and threat appraisals – related to threat responses. Although the model displayed reasonable fit for both owners more and those less involved in forestry, the cognitive appraisals variable was not a significant predictor of responses among owners less involved in forestry. In the full sample, the examined model explained approximately 50% of the variance in threat appraisals, and 28 and 17% in future intention and past behavior, respectively. Theoretical implications for how threat and coping appraisals are related during long-term risk management, and practical implications for forest risk management, are discussed.

Keywords: threat appraisals; coping appraisals; forest risk management; natural hazards

Introduction

Natural hazards including storm and climate change, for example, threaten people, their property, and natural resources such as forests. The management of natural hazards requires not only immediate measures in response to hazardous events, but also long-term proactive risk management (Fuhrer et al. 2006; Höppner et al. 2012). A key to successful management is understanding what motivates people to deal with these hazards. Threat and coping appraisals have been identified as important for risk management in previous studies (Grothmann and Reusswig 2006; Lindell and Perry 2012; Reser and Swim 2011). Although threat appraisals are believed to precede coping appraisals when the threat is first encountered, it is not clear how these...
appraisals are related in long-term risk management when threat and coping strategies are re-evaluated several times.

In this study, a model depicting factors important for threat responses was proposed and tested. According to the model, physical, social, and intra-individual factors have an impact on management behavior. More specifically, appraisals of threat, personal resources, and strategies are modeled as predictors of responses. The model was tested among individual private forest owners in Sweden to explore proactive forest risk management. In Sweden forests cover almost 70% of the land area, and individual private forest owners own half of the forest (SFA [the Swedish Forest Agency] 2014). Natural hazards damaging the forest may lead to not only a reduction in revenues but also a loss of scenic beauty and damage to ecological values (Hanewinkel et al. 2008; Seidl et al. 2014). Owners are responsible for managing their forest when it is damaged by natural hazards, such as storms (Swedish Gov. Bill 2007/08:108). In the long term, risk management involves using different silviculture measures to try to prevent future damage to the forest (Fuhrer et al. 2006). Overall, the study explores what motivates individuals to proactively protect a natural resource when it is threatened by natural hazards.

Theoretical overview

Different theories have identified what motivates people to respond to threats. Based on environmental stress research and other psychological theories, for example, protection motivation theory (PMT) (Rogers and Prentice-Dunn 1997; applied to flooding by Grothmann and Reusswig 2006), Reser and Swim (2011) developed a framework of factors important for adaptation to and coping with climate change. Focusing more on emergency responses than long-term risk management, the protection action decision model (PADM) (Lindell and Perry 2012) depicts people’s responses to environmental hazards and disasters such as earthquakes, hurricanes, and flooding. Despite some differences, these conceptualizations stipulate that threat and coping appraisals are core psychological drivers of responses to threats.

Threat appraisals

Threat appraisals, also referred to as primary appraisals and risk or threat perceptions, involve cognitive and emotional appraisals of threats (Grothmann and Reusswig 2006; Lindell and Perry 2012; Reser and Swim 2011). Cognitive appraisals, for example, the perceived likelihood of being affected and the perceived consequences of a threat have been the focus of much research. Recently, though, emotional appraisals including, for example, anxiety, fear, and worry have attracted some attention. There is generally support for reciprocal relations between cognitive and emotional processes during threat appraisals (cf. Loewenstein et al. 2001; Slovic et al. 2004). However, more deliberate emotions, such as worry, have been found to be influenced by cognitive evaluations rather than the reverse (Kobbeltved et al. 2005; Rundmo and Nordfjærn 2013).

Studies in different domains (e.g. flooding, wildfire, and seismic hazards) have revealed that cognitive threat appraisals are important for responses to natural hazards (e.g. Grothmann and Reusswig 2006; Martin, Bender, and Raish 2007; Terpstra and Lindell 2012). However, especially when coping appraisals are considered, threat appraisals are not always significant predictors (e.g. Bubeck et al. 2013;
Lindell and Prater 2002; Miceli, Sotgiu, and Settanni 2008). Fewer studies have examined the importance of emotional appraisals for responses, and results have been mixed (Grothmann and Reusswig 2006; Miceli, Sotgiu, and Settanni 2008; Terpstra 2011).

Coping appraisals

Coping appraisals, secondary appraisals, or protective action perceptions concern evaluations of potential strategies for dealing with threats and occur after threat appraisals (Grothmann and Reusswig 2006; Lindell and Perry 2012; Reser and Swim 2011). For example, the PADM differentiates between hazard-related attributes (including perceived efficacy in protecting people and property, and usefulness for other purposes) and resource-related attributes (including cost and required knowledge and skills, time, effort, and cooperation with others) as important for protective action (Lindell and Perry 2012; Lindell and Prater 2002). Also according to PMT is the belief that the action will be effective, labeled response-efficacy, part of the coping appraisals. PMT furthermore highlights the importance of perceived ability of the person to carry out the action, labeled self-efficacy, and cost (including money, time and effort) (Grothmann and Reusswig 2006). Hence, although coping appraisals generally include both appraisals of the strategy (i.e. response-efficacy) and personal resources for dealing with the threat (e.g. cost and self-efficacy), the PADM focuses more on the actions involved in coping whereas PMT rather considers the individual’s abilities to deal with the threat (Lindell and Perry 2012).

Coping appraisals, particularly response-efficacy, have been found to be even more important than threat appraisals for responses to natural hazards (e.g. Bubeck et al. 2013; Grothmann and Reusswig 2006; Martin, Bender, and Raish 2007; Terpstra and Lindell 2012). Notably, whereas self-efficacy, in accordance with PMT, has been found to be significantly related to responses, the importance of resource-related attributes for responses suggested in the PADM has not been confirmed (e.g. Bubeck et al. 2013; Martin, Martin, and Kent 2009; Terpstra and Lindell 2012).

The physical setting, the social setting, and individual characteristics

Threat and coping appraisals are formed in a context. Overall, not only the physical setting (e.g. location) and the social setting (such as what the government and people in the social network say and do), but also individual characteristics such as traits, are considered important for threat and coping appraisals (Floyd, Prentice-Dunn, and Rogers 2000; Lindell and Perry 2012; Reser and Swim 2011).

The influence of physical factors on threat appraisals and responses has been sought through the mediating role of personal experience of hazards. For example, proximity to the hazard has been found to be important for hazard experience (Peacock, Brody, and Highfield 2005), which in turn has been linked to threat appraisals (Lindell and Perry 2012). How personal experience influences appraisals and responses depends on, for example, the seriousness of the hazard experience and coping (Weinstein 1989). In general, though, previous experience tends to be linked to a stronger response either directly, or indirectly via threat appraisals (e.g. Bubeck et al. 2013; Lindell and Hwang 2008; Zaalberg et al. 2009).

Studies generally support the importance of the social setting for engaging in risk management (e.g. Faulkner, McFarlane, and McGee 2009). As conceptualized in the
PADM, the importance of stakeholder perceptions for responses has received some support (e.g. Arlikatti, Lindell, and Prater 2007). In addition, descriptive norms (i.e. perceptions of others risk mitigation efforts) have been found to be important for responses in some studies (Bubeck et al. 2013; Schulte and Miller 2010; but see Poussin, Botzen, and Aerts 2014). Zaalberg et al. (2009) furthermore suggest that experience of social support may be an indirect predictor of intentions mediated by response-efficacy.

Dispositional optimism is an intra-individual trait with potential implications for coping. Optimists tend to hold more positive expectations for their future and engage more in active coping, for instance (Scheier, Carver, and Bridges 1994). For example, optimism has been found to be related to a more positive view on the expected impacts of hurricanes (Trumbo et al. 2011).

The present study

The aim of the present study was to examine factors important for proactive risk management among individual private forest owners in Sweden. More specifically, the study examined the management of three risks threatening to damage the forest in Sweden: storms, browsing damage (e.g. by moose), and climate change. Both storms and browsing damage cause large production losses in the Swedish forestry today, and climate change is expected to lead to increased damage in the future through fungi, insects, spring frost, and wind (SOU 2007). However, through forest management (e.g. site-adapted forestry), the risk that the forest will be damaged in the future can be reduced (Fuhrer et al. 2006; Seidl et al. 2014). The study thus examines the long-term proactive management of forest threats. In this context, threats and strategies may be reevaluated because of changes in the forest, since damages vary as a result of, for example, not only forest stand characteristics and changes in the weather due to climate change, but also societal developments, with new management strategies being developed and recommendations changed.

The proposed model

The literature review provides support for the relevance of both threat and coping appraisals as factors motivating responses to deal with natural hazards. However, since only a few studies have examined, for example, mediation and moderation (e.g. Martin, Martin, and Kent 2009; Terpstra 2011), it is not clear how the predictors of threat responses are related (cf. Lindell and Perry 2012). To develop this understanding, a model depicting relations between physical, social and intra-individual factors as predictors of threat responses was proposed. More specifically, the model differentiates between appraisals of threat (cognitive and emotional), personal resources (cost and self-efficacy), and strategies (response-efficacy), and suggests how threat and coping appraisals are linked in long-term risk management (see Figure 1). The PADM, PMT and environmental stress models stipulate that threat appraisals precede coping appraisals, although they also propose a feedback loop from prior responses to subsequent appraisals and responses. Since the present study examined long-term risk management, re-evaluations of threat and coping are to be expected, and the possibility to deal with the threat may thus be important for threat appraisals (cf. Reser and Swim 2011). Hence, if there are strategies available and personal resources to deal with the threat, the perceived threat is likely to be lower.
Supported by previous research (Blennow and Sallnäs 2002; Peacock, Brody, and Highfield 2005), the model stipulates that the physical setting is important for personal experience of hazards. The physical setting was represented by region in Sweden, with a higher risk of damage in the south compared to the rest of the country (cf. Blennow 2008; Blennow et al. 2010). Personal experience is subsequently linked to how susceptible to damage the forest is perceived to be, and threat appraisals. Comparable to Terpstra (2011), for example, threat appraisals – not only cognitive but also emotional – are subsequently linked to responses. Perceived forest susceptibility was included in the model since the condition of the forest is important for the type and extent of damage (Hanewinkel, Hummel, and Albrecht 2011). Although perceived forest susceptibility is also an evaluation of the threat (cf. Bright, Newman, and Carroll 2007; Eriksson 2014), it concerns the present physical characteristics of the forest (in relation to the hazard) rather than the expected impact of the hazard in the future. Forest susceptibility was thus suggested as a mediator between personal experience and more future-oriented threat appraisals.

The model furthermore stipulates that the perceived susceptibility of the forest and threat appraisals are determined by the resources available for dealing with the threat – that is, monetary cost and self-efficacy – but also indirectly by resource-efficacy. Response-efficacy is an evaluation of management strategies, and cost is an assessment of both the available strategies and monetary resources for employing them. Similarly, self-efficacy involves a combination of assessing the strategy and personal resources for employing them, but is a more general indicator than cost. Both lower response-efficacy and higher costs were expected to lead to lower self-efficacy. In turn, higher costs and lower self-efficacy were expected to be linked

Figure 1. Physical, social, and intra-individual factors, including appraisals of threat, resources, and strategies as predictors of threat responses.
to evaluating the forest as being more susceptible to damage. In line with some previous studies (e.g. Hall and Slothower 2009; Lindell and Prater 2002), the model thus stipulates that among different coping appraisals, only response-efficacy directly motivates threat responses.

According to the model, the social setting is important for response-efficacy. The social factors explored in this study assessed the risk management setting; that is, descriptive norm (others’ forest risk management) and social support (perceived support from others for risk management). In addition, having participated in activities organized by the Swedish Forest Agency (SFA) (SFA contacts) was considered relevant. Since response-efficacy reflects strategy appraisals of specific threats in this study, it was modeled as a mediator between the more general social factors and responses (cf. Zaalberg et al. 2009). Having participated in SFA activities, a stronger descriptive norm and higher social support were expected to be related to a higher response-efficacy.

To explore a potentially relevant intra-individual variable, dispositional optimism was included in the model as a predictor of emotional threat appraisals and responses. Based on previous research, optimism was expected to be negatively related to particularly emotional threat appraisals, but positively related to responses (cf. Scheier, Carver, and Bridges 1994).

When it has not been possible to assess future behavior in a cross-sectional study, responses to threats have been measured through indicators of either past behavior or future intention. Past behavior has been used because intentions may not always translate into action (cf. Martin, Martin, and Kent 2009), even though the anticipated link between intentions and future behavior in attitude–behavior theory indicates that intentions may be a more appropriate measure (cf. Ajzen 2011). Since studies indicate that different predictors may determine how people have responded to threats in the past and their intention to respond in the future (Poussin, Botzen, and Aerts 2014), the present study examined responses to threats through measures of both past behavior and future intention.

Private forest owners are heterogeneous when it comes to, for example, ownership motives, and not all of which are involved in working with their forest (Eggers et al. 2014; Ní Dhubháin et al. 2007). Since stage models (e.g. the transtheoretical model of change) suggest that different predictors may determine threat responses depending on, for example, knowledge level (Martin, Bender, and Raish 2007), the model was tested not only in the full sample but also separately among owners both less and more involved in forestry.

Method

Respondents

In 2014, a postal questionnaire was sent to a randomly selected sample of individual private forest owners in Sweden. The study was conducted by Statistics Sweden. Owners included in the sample were aged 20–80 years and owned more than 5 ha of forest land ($n = 3000$; after removing the over-coverage $n = 2957$). After two reminders, 50% ($n = 1482$) had answered the questionnaire.
**Questionnaire**

The questionnaire was 14 pages long, though only the questions analyzed in this study are described here. When the questionnaire was prepared, previous studies of psychological predictors of threat responses were drawn upon. In addition, input from forest damage experts at the SFA and private forest owners was utilized.

Information about the region where the forest estate/s were located was taken from the property register at Statistics Sweden, and a binary variable was created as an indicator of region (0 = middle and north, 1 = south, corresponding to the organizational setup of the SFA). The variable SFA contacts was based on a question assessing contacts during the past five years (0 = no contacts, 1 = received individual advice or participated in courses at the SFA). To create index variables for descriptive norm and social support, the means of the included items were calculated. Descriptive norm was assessed using two items reflecting the extent to which other forest owners were perceived to strive to prevent forest risks, and the extent to which the SFA was perceived to strive to encourage forest owners to prevent forest risks (1 = not at all, 5 = to a great extent) (α = .68). The three items measuring social support reflected the extent to which it was perceived possible to receive support from other private forest owners, forest owners’ associations, and the SFA when handling forest risks (1 = not at all, 5 = to a great extent) (α = .65). Optimism was measured using the revised life orientation test (LOT-R) including six items (α = .73) (Scheier, Carver, and Bridges 1994) (see Appendix 1). To get a measure of past risk management behaviors, how often the respondent had used 15 different strategies to avoid the three examined risks (storm damage, browsing damage, and damaged caused by climate change) were summarized (e.g. planted Norway spruce instead of deciduous trees or Scots pine because of the risk of browsing damage) (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always, sum: 1-75) (see Appendix 1).

Personal experience (Experience Storm, Experience Browsing, Experience Climate change) was examined separately for the three risks, with single items reflecting the extent to which the owner perceived that their forest had been impaired by the three risks (1 = not at all, 5 = to a great extent). Index variables of forest susceptibility (susceptibility), cognitive threat appraisals (cognitive threat), emotional threat appraisals (emotional threat E), perceived monetary cost (cost), self-efficacy, response-efficacy, and future intention were created by combining evaluations of the three examined risks. Susceptibility was based on questions concerning the extent to which the owner considered their forest to be susceptible to damage from the three risks depending on location, soil characteristics, forest stand, age, etc. (1 = not at all, 5 = to a great extent) (α = .70). Cognitive threat measured how likely the owner perceived it to be that their forest would be impaired by the three risks within a time period of 10 years (1 = not at all likely, 5 = very likely) (α = .60) and emotional threat assessed how worried the owner was that their forest would be impaired by the three risks (1 = not at all worried, 5 = very worried) (α = .71). Whereas cost measured whether the owner perceived it to be expensive or cheap to prevent damages from the three risks (1 = very cheap, 2 = fairly cheap, 3 = neither cheap nor expensive, 4 = fairly expensive, 5 = very expensive) (α = .80), self-efficacy reflected how easy or difficult the owner perceived it to be to prevent damages from the three risks (1 = very easy, 2 = fairly easy, 3 = neither easy nor difficult, 4 = fairly difficult, 5 = very difficult) (reverse-coded, low value = low level of self-efficacy) (α = .78).
Response-efficacy assessed the extent to which the owner perceived that there were effective strategies they could use to prevent damages from the three risks (1 = not at all, 5 = to a great extent) ($\alpha = .69$). In relation to the questions assessing coping appraisals (cost, self-efficacy, response-efficacy), the owner was furthermore given the option to answer ‘don’t know’. Finally, future intention measured how likely the owner perceived it to be that they would prevent damages caused by the three risks within a time period of 10 years (1 = not at all likely, 5 = very likely) ($\alpha = .81$).

Two questions were utilized to separate owners with different levels of involvement in forestry: the importance attached to production values in their forest (e.g. timber or biofuel) (1 = not at all important, 7 = very important) and participation in forestry planning (1 = everything, 2 = a lot, 3 about half, 4 = a little, 5 = nothing, leave everything to others). Forest owners emphasizing production values in their own forest (>4 on the seven-point scale assessing production values) and taking part in forestry planning (<3 on the five-point scale assessing participation in forestry planning) were categorized as forestry-involved owners ($n = 767$). The rest (i.e. either not emphasizing production values or being less involved in forestry planning) were placed in the less involved group ($n = 630$).

Despite the use of only a few items in several of the constructs, the internal reliability was generally acceptable with Cronbach alpha values around .70. Although the internal reliability of social support and cognitive threat was not altogether poor it can be questioned (George and Mallery 2003).

Analyses
First, descriptive analyses were conducted. To learn more about the owners answering ‘don’t know’ on the coping appraisals questions, they were compared to owners with a negative view on coping (i.e. high cost, low self-efficacy, and low response-efficacy) regarding threat appraisals and future intention to respond to threats. These analyses were made since a ‘don’t know’ answer to at least the response-efficacy and self-efficacy questions seemed to represent a very negative view on coping. Even though the use of parametric tests on ordinal scale data is debated, there are evidence supporting the robustness of these tests (Norman 2010). Hence, the data were further analyzed by means of bivariate correlations (Pearson $r$) and the proposed model was evaluated using AMOS. Because of missing values, the full information maximum likelihood method was used to estimate the model. To assess the overall model fit, the chi-square, root mean square index of approximation (RMSEA), and Bentler’s comparative fit index (CFI) were used. The model was first tested in the full sample with future intention as dependent variable, and subsequently with past behavior as dependent variable. Finally, the two groups of forest owners (those more and less involved in forestry) were analyzed separately with future intention as dependent variable.

Results

Descriptive analyses

About a fourth of the sample was composed of women, and mean age was 61 years (see Table 1). The mean size of forest holdings was just under 100 ha, and about half of the respondents were resident owners. Only minor deviations were found
between the sample and population; for example, men and owners older than 60 were slightly overrepresented.

Means and standard deviations of the study variables are shown in Table 2. The owners did not report much previous experience of damages to their forest. Furthermore, the examined risks were not perceived to be serious threats to their forest in the future, and the owners were not very worried about them. The owners perceived the monetary cost for dealing with the threats as expensive, and response-efficacy and self-efficacy were low. Quite a large share of the owners did not know much about risk management strategies, as indicated by the high level of ‘don’t know’ answers to the coping appraisals questions. Whereas 11% had answered ‘don’t know’ to all response-efficacy questions, 13% had done so in response to all self-efficacy questions. Cost appraisals had the highest level of ‘don’t know’ answers, at 21%. As shown in Table 3, compared to owners with a negative view on coping (i.e. high cost and low self-efficacy), those with no stated knowledge of having their own resources to deal with threats displayed lower threat appraisals and weaker intention to respond. In addition, those with no knowledge of strategies displayed a weaker intention to respond than did owners with a low level of response-efficacy, though no differences were found regarding threat appraisals.

**Bivariate correlations**

The bivariate correlations are displayed in Table 2. In line with expectations, past behavior and future intention were significantly correlated though not completely overlapping. Furthermore, the personal experience variables were more strongly

<table>
<thead>
<tr>
<th>Table 1. Descriptives.</th>
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</thead>
<tbody>
<tr>
<td>Gender (women) 25.0% [27.7%]</td>
</tr>
<tr>
<td>Age groups</td>
</tr>
<tr>
<td>0.5% 20–29 years [1.2%]</td>
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<tr>
<td>3.6% 30–39 years [5.1%]</td>
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<tr>
<td>12.5% 40–49 years [14.2%]</td>
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<tr>
<td>22.5% 50–59 years [25.6%]</td>
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<tr>
<td>34.2% 60–69 years [30.6%]</td>
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<tr>
<td>26.8% 70–80 years [23.3%]</td>
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<tr>
<td>Education 28.7% university degree</td>
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<td>Occupation</td>
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<tr>
<td>33.0% part time or full time work</td>
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<tr>
<td>18.8% business</td>
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<tr>
<td>39.5% retired</td>
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<tr>
<td>8.7% other</td>
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<tr>
<td>Number of forest estates</td>
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<tr>
<td>One: 74.2%</td>
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<td>Two: 17.3%</td>
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<tr>
<td>Three or more: 7.0%</td>
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<tr>
<td>Owner category</td>
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<tr>
<td>Resident owner: 47.2%</td>
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<tr>
<td>&lt;10 km from the closest forest estate: 16.7%</td>
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<tr>
<td>10 km or further away from the closest forest estate: 34.7%</td>
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<tr>
<td>Mean size of forest estate/s 96.3 ha (SD = 191.9)</td>
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<td>Mean years of owning forest 24.2 years (SD = 13.1)</td>
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<tr>
<td>Forest estate region</td>
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<tr>
<td>North: 28.3%</td>
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<tr>
<td>Middle: 28.9%</td>
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<tr>
<td>South: 42.2%</td>
</tr>
<tr>
<td>Forest estates in different regions: 0.5%</td>
</tr>
</tbody>
</table>

Note: [] Share in the randomly selected sample.
Table 2. Means, standard deviations, and bivariate correlations for the study variables.

<table>
<thead>
<tr>
<th></th>
<th>Optimism</th>
<th>Experience Storm</th>
<th>Experience Browsing</th>
<th>Experience Climate change</th>
<th>Susceptibility</th>
<th>Cognitive threat</th>
<th>Emotional threat</th>
<th>Descriptive norm</th>
<th>Social support</th>
<th>Cost</th>
<th>Self-efficacy</th>
<th>Response-efficacy</th>
<th>Past behavior</th>
<th>Future intention</th>
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</thead>
<tbody>
<tr>
<td>Optimism</td>
<td>3.73 (0.73)</td>
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<tr>
<td>Experience Storm</td>
<td>−10***</td>
<td>2.49 (1.14)</td>
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<tr>
<td>Experience Browsing</td>
<td>−0.03</td>
<td>.19***</td>
<td>2.25 (1.02)</td>
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<tr>
<td>Experience Climate change</td>
<td>−12***</td>
<td>.21***</td>
<td>.19***</td>
<td>1.22 (0.52)</td>
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<tr>
<td>Susceptibility</td>
<td>−0.09***</td>
<td>.38***</td>
<td>.39***</td>
<td>.28***</td>
<td>2.73 (0.83)</td>
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<tr>
<td>Cognitive threat</td>
<td>−.06*</td>
<td>.36***</td>
<td>.38***</td>
<td>.32***</td>
<td>.71***</td>
<td>2.79 (0.89)</td>
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<tr>
<td>Emotional threat</td>
<td>−15***</td>
<td>.31***</td>
<td>.38***</td>
<td>.32***</td>
<td>.71***</td>
<td>.67***</td>
<td>2.54 (0.94)</td>
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<tr>
<td>Descriptive norm</td>
<td>.16***</td>
<td>.08**</td>
<td>.04</td>
<td>.03</td>
<td>.12***</td>
<td>.13***</td>
<td>.10***</td>
<td>2.92 (0.93)</td>
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<tr>
<td>Social support</td>
<td>.14***</td>
<td>.07**</td>
<td>.11***</td>
<td>.05</td>
<td>.16***</td>
<td>.15***</td>
<td>.14***</td>
<td>.52***</td>
<td>2.76 (0.95)</td>
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<tr>
<td>Cost</td>
<td>−14***</td>
<td>.15***</td>
<td>.24***</td>
<td>.14***</td>
<td>.43***</td>
<td>.33***</td>
<td>.38***</td>
<td>−.04</td>
<td>.01</td>
<td>3.39 (0.93)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>.07*</td>
<td>−.16***</td>
<td>−.20***</td>
<td>−.13***</td>
<td>−.41***</td>
<td>−.34***</td>
<td>−.35***</td>
<td>.00</td>
<td>−.04</td>
<td>−.61***</td>
<td>2.19 (0.93)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response-efficacy</td>
<td>.06*</td>
<td>.07**</td>
<td>.04</td>
<td>.00</td>
<td>.15***</td>
<td>.14***</td>
<td>.11***</td>
<td>24***</td>
<td>26***</td>
<td>−15***</td>
<td>.25***</td>
<td>2.36 (0.92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past behavior</td>
<td>.05</td>
<td>.29***</td>
<td>.30***</td>
<td>.14***</td>
<td>.33***</td>
<td>.31***</td>
<td>.31***</td>
<td>22***</td>
<td>22***</td>
<td>.08**</td>
<td>−.03</td>
<td>30***</td>
<td>29.0 (9.9)</td>
<td></td>
</tr>
<tr>
<td>Future</td>
<td>.07*</td>
<td>.24***</td>
<td>.28***</td>
<td>.18***</td>
<td>.41***</td>
<td>.40***</td>
<td>.38***</td>
<td>25***</td>
<td>28***</td>
<td>.07*</td>
<td>−.02</td>
<td>.41***</td>
<td>.57***</td>
<td>2.24 (1.10)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001.
Table 3. Means and standard deviation for threat appraisals and future intention among owners answering ‘don’t know’ to coping appraisal questions and owners with a negative view on coping (high cost, low self-efficacy, and low response-efficacy).

<table>
<thead>
<tr>
<th>Cost</th>
<th>Self-efficacy</th>
<th>Response-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Don’t know (n = 318)</td>
<td>High cost (n = 175)</td>
</tr>
<tr>
<td>Cognitive threat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>2.62 (0.96)</td>
<td>3.12 (0.93)***</td>
</tr>
<tr>
<td>High cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional threat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>2.30 (0.99)</td>
<td>3.03 (1.02)***</td>
</tr>
<tr>
<td>High cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future intention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know</td>
<td>1.58 (0.89)</td>
<td>2.29 (1.13)***</td>
</tr>
<tr>
<td>High cost</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparison groups: High cost = perceived coping to be very expensive (5 on the response scale), low self-efficacy = perceived coping to be very difficult (5 on the response scale), low response-efficacy = perceived strategies to be not at all effective (1 on the response scale).

*aFive-point scale (1 = not at all likely, 5 = very likely).
*bFive-point scale (1 = not at all worried, 5 = very worried).

***p < .001.
correlated with threat appraisals and forest susceptibility than with past behavior/future intentions, thus corresponding to a potentially mediating role of forest susceptibility and threat appraisals. As expected, cost and self-efficacy displayed weaker correlations with past behavior/future intention than response-efficacy did. Although response-efficacy was suggested as a mediator between social factors and responses, the correlations between social factors (social support and descriptive norm) and responses were almost of the same strength as between social factors and response-efficacy.

**Model evaluation**

The share of missing values of the index variables (including ‘don’t know’ answers) was less than 5%, except for two of the personal experience variables and the coping appraisals variables (Experience Browsing: 9%, Experience Climate change: 13%, Cost: 26%, Self-efficacy: 17%, Response-efficacy: 15%). In the *Discussion* section, the decision to treat ‘don’t know’ answers as missing values is further deliberated on.

First, the model was tested with future intention as dependent variable (see Figure 2 for path coefficients and explained variances). Results revealed that all paths were significant in the expected direction, except those between region and two of the personal experience variables (i.e. browsing damage and damage by climate change). As expected, threat appraisals, response-efficacy, and optimism were

![Figure 2](image_url)

*Notes:* Explained variances in exogenous variables: Experience Storm = 10%, Experience Browsing = 0%, Experience Climate change = 5%, Susceptibility = 31%, Cognitive threat = 47%, Emotional threat = 54%, Self-efficacy = 38%, Response-efficacy = 10%, Response = future intention 28% and past behavior 17%.
significant predictors of intention. The model explained 47% of the variance in cognitive threat appraisals, 54% in emotional threat appraisals, and 28% in future intention. The goodness-of-fit measures (see Table 4) indicate reasonably good, though not perfect, fit.

Second, the model was tested with past behavior as dependent variable (see Figure 2, path coefficients in brackets) and the same predictors as in the model with future intention were significant. However, both cognitive threat appraisals and response-efficacy displayed slightly weaker correlations with past behavior than with future intention and explained variance was lower, at 17% (see Table 4 for goodness-of-fit measures).

Third, the model was tested in the two subgroups of forest owners with future intention as dependent variable (see Figure 3). For those less involved in forestry, slight deviations were found from the model tested in the full sample. Cognitive threat appraisal was not a significant predictor of future intention, and response-efficacy was not significantly related to self-efficacy. The explained variance was 25%. For those more involved in forestry, results were comparable to the model testing in the full sample. Explained variance was higher in this subsample, reaching 34% (see Table 4 for goodness-of-fit measures).

Discussion
To understand what motivates people to implement long-term proactive strategies to protect their assets when threatened by natural hazards, real-life situations of risk management involving appraisals and reappraisals need to be examined. In accordance with previous research (Grothmann and Reusswig 2006; Lindell and Perry 2012; Reser and Swim 2011), results from the present study examining forest owners’ long-term proactive risk management revealed that physical, social, and intra-individual factors are linked to threat and coping appraisals. In addition, the importance of threat and coping appraisals for risk management was confirmed. However, whereas threat and coping appraisals have generally been conceptualized separately, though with a feedback loop from responses to appraisals, this study proposes that during long-term risk management people may evaluate both threats and coping strategies several times in parallel. Threat and coping appraisals may thus be part of a joint assessment when one decides how to respond to threats. Previously,

<table>
<thead>
<tr>
<th>Table 4. Goodness-of-fit measures in the examined models.</th>
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<tbody>
<tr>
<td><strong>Full sample</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>χ²</td>
</tr>
<tr>
<td>df</td>
</tr>
<tr>
<td>CFI</td>
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<tr>
<td>RMSEA (90% confidence interval)</td>
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</table>
| **Note:** Dependent variable: future intention. ***p < .001.
Lindell and Prater (2002) and Lindell and Perry (2012) have distinguished between appraisals of strategies and resources. The present study advances this reasoning, when resource-related appraisals are conceptualized as important for threat appraisals and strategy appraisals are linked to responses directly. Even though the study cannot confirm causality because of its cross-sectional design, it suggests how threat and coping appraisals may be related at a specific time during long-term risk management.

Lindell and Hwang (2008) suggested that there may be additional mediators (along with threat appraisals) between personal experience and responses, and the present study assessed perceived susceptibility to damages as one potential mediator. The concept has previously been noted in forest research (Eriksson 2014), and this study further explored relations with other key concepts. Although forest susceptibility and threat appraisals were highly correlated the measures were not completely overlapping, indicating that how people evaluate the hazard in relation to their specific asset is important in order to subsequently evaluate future threats. This concept may be particularly relevant not only when attempting to understand appraisals of ubiquitous hazards, whereby damages are not limited to close proximity to a specific location (e.g. storm), but also when examining appraisals in areas prone to damage by natural hazards, to learn more about the physical characteristics people believe are important when evaluating hazards threatening their assets.
Although the fit of the model was reasonable for the different types of owners explored in this study, a few differences were noted between the owners more and less involved in forestry. Whereas previous studies have focused mainly on the importance of cognitive appraisals (but see Terpstra 2011), in the present study both cognitive and emotional threat appraisals were important in order to understand threat responses, however mainly among owners more involved in forestry. For owners, less involved in forestry, worry about the hazard, rather than a consideration of the likelihood of damages in the future, was important when deciding to act. The link between response-efficacy and self-efficacy was furthermore weaker among owners less involved in forestry compared to those more involved. It was thus mainly among those more involved that the variable self-efficacy was linked to their awareness of available strategies (i.e. response-efficacy). For those less involved, appraisals of resources and strategies seem to be conducted separately, and only appraisals of strategies seem to be based on social factors, such as descriptive norms and perceived social support.

The examined model explained approximately 50% of the variance in threat appraisals and reached a level of explained variance in threat responses comparable to previous studies: 28% in future intention and 17% in past behavior (cf. Terpstra 2011; Terpstra and Lindell 2012). The psychological predictors were furthermore the same for future intention and past behavior. Although theory supports the use of intention as dependent variable (Ajzen 2011), it would be beneficial to explore relations between past behavior, appraisals, and future behavior in a longitudinal study, especially in the context of long-term risk management. Social factors were found to be determinants of response-efficacy in the present study. Although it would also have been possible to stipulate links between optimism and different coping appraisals based on previous research (Scheier, Carver, and Bridges 1994), and optimism was weakly correlated with the coping appraisals in this study, encouraging social factors were believed to be more important than an optimistic view on life when proactive management is still a marginal phenomenon. Intra-individual variables may however be more influential for coping appraisals in contexts where people display higher awareness of coping. Future studies should furthermore include additional indicators of self-efficacy, explicitly assessing ability, in order to clarify whether self-efficacy can in some instances be directly linked to responses (cf. Martin, Martin, and Kent 2009). In addition, there is a need to further consider the role of response-efficacy as a mediator between social factors and responses, considering that correlations were almost of the same strength between social factors and responses as between social factors and response-efficacy. The present study focused on the psychological drivers of threat responses. Although, previous studies indicate a need to also consider different socio-demographics such as gender and age when explaining threat responses in different contexts (e.g. Blennow et al. 2012; Finucane et al. 2000; Lindell and Hwang 2008; Poussin, Botzen, and Aerts 2014; Shavit et al. 2013). There is for example a need to explore whether socio-demographics have direct effects on threat responses, or if these variables generally influence risk management indirectly through, for example threat and coping appraisals.

In interpreting the results, limitations should be considered. Overall, the response rate was high and the sample only displayed minor deviations from the population. However, since the model explained a slightly lower level of variance in threat responses among owners less involved in forestry, and one attrition motive was that the owner took no part in forestry planning, the results are likely to apply mainly to
owners at least somewhat engaged in forest issues. The substantial number of
owners answering ‘don’t know’ to the coping appraisals questions was furthermore
problematic when the model was tested. Since the ‘don’t know’ answers seem to be
indicative of a very negative view on coping, it would perhaps be appropriate to
replace the ‘don’t know’ answers with low values on these variables during model
testing. However, even though this reasoning applies to the more general coping
appraisals questions concerning response-efficacy and self-efficacy, it is not possible
to do the same for the more specific monetary cost questions, since being unaware
of the cost of a strategy is not necessarily the same as believing it is expensive.
Notably, different ways of dealing with ‘don’t know’ answers did not produce
substantially different results; thus, all missing values were estimated in AMOS dur-
ing model testing. Even though a few of the measures displayed a relatively low
internal reliability (e.g. cognitive threat appraisals), expected correlations with other
variables were revealed indicating that this was likely not biasing the results to a
great extent.

This study reveals that private forest owners were not really concerned about the
threats examined in this study, even though storm, browsing damage, and climate
change cause damage to a great deal of forest in Sweden and are considered serious
threats to forests from a societal standpoint (Swedish Gov. Bill 2007/08:108). In addi-
tion, the owners generally did not believe there was much they could do to manage
their forest to reduce the risk of damage in the future. From a societal point of view, it
is thus important to increase the awareness of both these threats and potential man-
agement strategies. Notably, though, to achieve a more active risk management, the
owners have to both believe in the effectiveness of strategies and find it worthwhile
to employ them in relation to available resources (e.g. time and money). Because
social factors may drive risk management, governmental organizations (e.g. the SFA),
and non-governmental organizations (e.g. owners’ associations) can boost forest risk
management directly in their meetings with forest owners, but also through the for-
mation of descriptive norms and a social setting supportive of risk management.

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References
and Health 26: 1113–1127.


Appendix 1.

LOT-R

(1) In uncertain times, I usually expect the best.
(2) If something can go wrong for me, it will (R).
(3) I’m always optimistic about my future.
(4) I hardly ever expect things to go my way (R).
(5) I rarely count on good things happening to me (R).
(6) Overall, I expect more good things to happen to me than bad.

The Swedish version of LOT-R (Scheier, Carver, and Bridges 1994) proposed by Muhonen and Torkelson (2005) was used in the present study, except in Item 2, where the English version was translated.

Past behavior

(1) Planted Norway spruce instead of deciduous trees or Scots pine because of the risk of browsing damage.
(2) Fenced plantations to avoid the risk of browsing damage.
(3) Planted new tree species (e.g. Sitka spruce, Contorta pine) because they are less sensitive to browsing damage.
(4) Used some kind of wildlife repellent (mechanical or taste/smell).
(5) Used forage-production measures.
(6) Tried to reduce the risk of browsing damage through hunting.
(7) Managed the forest to increase resistance to storms in wind-exposed locations.
(8) Thinned early and heavily the first time for a more storm-resistant forest (at about 2 meters lower than usual).
(9) Conducted final felling earlier to reduce the risk of storm damage (when the trees are about 10–20 years younger than what is usual).
(10) Increased the share of mixed stand during clearing, thinning, or rejuvenation.
(11) Increased the share of deciduous stand during clearing, thinning, or rejuvenation.
(12) Implemented site-adapted forestry (i.e. more carefully selected the right tree species on the right land).
(13) Increased the variation in felling age and thinning program.
(14) Increased the share of new tree species (e.g. European larch).
(15) Conducted stump treatment against root rot with, for example, Phlebiopsis gigantea, during thinning or final cuts of Norway spruce.