This is the published version of a paper published in *Scandinavian Journal of Forest Research*.

Citation for the original published paper (version of record):

Extreme events and climate change: The post-disasters dynamics of forest fires and forest storms in Sweden.
*Scandinavian Journal of Forest Research*
http://dx.doi.org/10.1080/02827581.2015.1113308

Access to the published version may require subscription.

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To cite this article: Rolf Lidskog & Daniel Sjödin (2015): Extreme events and climate change: the post-disaster dynamics of forest fires and forest storms in Sweden, Scandinavian Journal of Forest Research, DOI: 10.1080/02827581.2015.1113308

To link to this article: http://dx.doi.org/10.1080/02827581.2015.1113308

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Extreme events and climate change: the post-disaster dynamics of forest fires and forest storms in Sweden

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ABSTRACT

How are extreme events understood in the forest sector? What are the implications of forest professionals’ understandings and evaluations of extreme events? These questions are central to this study, which analyses the handling of the largest forest storm and the largest forest fire in modern Swedish history. The theoretical approach is that of risk governance in practice, which stresses that understanding the framings, practices and strategies used by members of professional organizations is pivotal for how disasters are managed. Two interview studies have been conducted with forest professionals involved in the two cases. The analysis shows that there were fundamentally different understandings of the two events and their implications for forestry practice. The storm was seen as an unavoidable natural disaster, but the consequences of future storms were considered possible to mitigate through changed forest practices. The forest fire, on the other hand, was conceptualized as a partly natural and partly man-made disaster, and forestry was seen as having very limited possibilities to reduce the likelihood as well as the consequences of similar events. The different understandings had significant implications for the post-disaster dynamics and for which management practices that were developed. Thus, understanding how extreme events are perceived is crucial to understanding which management practices that emerge in their wake, a topic of growing relevance because climate change is predicted to increase the frequency of forest fires and storms.

Introduction

The last couple of decades have seen a growing debate about how to mitigate as well as adapt to the changing climate. The forest sector is an important part of this discussion in terms of providing biomass and serving as a carbon sink. However, forests are not only a central means for mitigating climate change, they are also threatened by it. The changing climate will create new conditions for forestry, and the challenge is to develop a forest that is both adapted to climate change and able to withstand increasing societal pressure to provide ecosystem services. Extreme events, such as storms and forest fires, are predicted to increase due to climate change. In its latest report (2014), the Intergovernmental Panel for Climate Change states that the greatest increase in temperatures will occur in northern latitudes, over land and in winter/spring. A warmer world will probably have longer fire seasons, more lightning activity and, most importantly, drier fuels, making it easier for fires to start and spread. However, while storms are an important part of climate change discussions within the Swedish forest sector, forest fires are not. The question therefore arises: Why does this difference in risk perception occur and, more importantly, what are its implications? Obviously, storms and fires are different phenomenon; they function differently and involve different challenges and implications for forestry as well as society at large. At the same time, both kinds of disasters have great implications for forestry and are related to climate change. To understand the responses to these events, it is of central importance to investigate how they are framed. This is because how a phenomenon or issue is framed determines whether or not action is taken (Schön & Rein 1994; Hajer 2009). Even though storms and forest fires result from natural forces, our understanding of them are always framed. Thus, how decision-makers, professionals and stakeholders perceive and conceptualize fires and storms determines the post-disaster management, including preventive practices for building a forest capable of surviving extreme events. Understandings – like, for example attributions of causality or blame – have consequences for risk assessments and mitigation initiatives, which in turn influence what kind of forest is created (Carroll et al. 2004; Kumagai et al. 2004; Cohn et al. 2008). Thus, forest vulnerability is the result of a combination of ecological factors and social interpretations (cf. Cohn et al. 2008; Cortner 2008; McCaffrey 2008). It is also important to recognize the performative aspects of understandings; all beliefs and opinions – regardless of whether or not they are seen by others as dubious – may have real and important consequences. Thus, beliefs, perceptions and interpretations cannot simply be reduced to cognitive or cultural phenomena; they influence actions and thus
have effects on the material, political and social worlds. This is particularly noticeable in the forest sector, where beliefs and values can transform forests and landscape for decades to come.

It is therefore of great interest to investigate what sorts of understandings that arise and gain acceptance concerning forest fires and forest storms. The guiding research questions are as follows: What different understandings of storms and forest fires exist within forestry? What are the implications of these understandings? Through two interview studies of forest professionals involved in modern Sweden’s most severe forest storm and forest fire respectively, this paper sheds light on the significance of framing for the post-disaster dynamics, in terms of both managing the direct consequences of the disasters and the work to create a more robust forest. The fire and storm studied here are the two most severe disasters affecting forestry in modern Swedish history. In research as well as public debate they are both linked to climate change. What makes them interesting to compare is that the responses within forestry to the events are divergent. While the storm generated an impulse for change, the fire was characterized by a lack of response.

Materials and methods

Theoretical approach

The theoretical approach chosen for the study consists of two theoretical strands: risk governance in practice and frame theory. The concept of risk governance in practice is developed in order to understand how organizations and professions practically deal with risks. Different organizations develop different way to discursively invent, shape and negotiate the meaning of a particular risk, including what social definition of reality that counts, what knowledge is authoritative, what resources to allocate, what intervention to make and what temporal-spatial frame is appropriate. Frame theory stresses that actors orient themselves in the world through frames. Frames are structures of beliefs, values, perceptions and appreciation through which actors reduce the complexity of an issue in order to support a certain understanding and promote a specific agenda (Schön & Rein 1994, p. 23). Through frames, a multifarious issue or situation is translated into simpler terms, and certain aspects of it are stressed. By reducing the complexity of an issue in order to foster a specific understanding of what it fundamentally concerns, frames mobilize opinion for certain kinds of action. Together, these theoretical strands stress that in order to understand how disasters are managed, as well as how and why particular regulatory changes, organizational routines and professional practices are formed, it is necessary to explore framings, practices and strategies used by members of professional organizations (Boholm et al. 2012).

Of further importance is that extreme events confront people with an unfamiliar situation where they perceive the limits of their knowledge. In such cases, people and organizations have to develop a sense of what they are up against and what they have to do. By noticing, bracketing and labeling, they develop a plausible and coherent image that facilitates certain options and actions and constrains others (Weick et al. 2009). Facing a new situation does not necessarily lead to developing new schemes of interpretation and action strategies; people often make extreme situations meaningful by drawing on routine experiences or prior knowledge of similar situations (Kreps & Bosworth 2007).

To study risk governance in practice means bringing the practical and contextual reasoning of “street-level” risk managers (Corvellec 2009; Lidskog & Löfmark 2015) – in this case forest professionals – to the fore. Their understanding of the extreme event – what kind of response it demands (based on their understanding of its causes and consequences) – is of central importance when investigating what action to take. The reason for this is that when there is little knowledge and no applicable routines, issues often wind up in the hands of professionals at local level who have to reinterpret regulations, set priorities and allocate resources (Lipsky 1980).

The cases

The Swedish context

In Sweden, approximately 50% of productive forestry land is owned by individuals, mainly in the form of small parcels, such that about 3% (327,000 persons) of the Swedish population own forestland (Lidskog et al. 2013). Individual forest owners have considerable latitude in how to manage their forests (Appelstrand 2012). In a governance system that relies rather heavily on social norms and general guidelines to shape individual forest owners’ actions, forest consultants – employed by the Forest Agency, forest companies or forest owner associations – play an important role in influencing forest owners’ practices. In general, spruce is the dominant tree species in Sweden. Today the standing volume of the Swedish forests comprises 42% Norway spruce, 39% Scots pine and 12% birch (SFA 2014, p. 46). The cases compared differ in ownership structure and forest composition. In the southern Swedish region struck by the storm Gudrun, most forest stands have small-scale private owners, and the dominant species was spruce. The forest fire in Västmanland affected an area dominated by a few large-scale private forest companies and state-owned forests. The most prevalent species in the fire area was pine.

The storm

On 8 January 2005, the most severe storm in modern Swedish history (henceforth called the storm Gudrun) swept across the south of Sweden with winds gusting up to 42 m/s. The storm fell almost 20% of the total standing volume in the region. In total 250 million trees or 75 million cubic metres was windthrown (Blennow & Eriksson 2006). Approximately 270,000 hectares were damaged by the storm, while between 110,000 and 130,000 hectares required replantation (Svensson et al. 2011, p. 11). Some 50,000 forest owners were severely affected. It took almost five years for the last wind-felled trees to be transported from temporary storage sites to sawmill. The storm resulted in fears of a bark beetle outbreak, in some interviews described as complete panic. Forest owners and companies were also afraid that the
quality of the wood would be damaged if it was left lying too long. Therefore, it was generally agreed that the wind-felled trees should be removed from the forest as quickly as possible. This resulted in the impressive logistical accomplishment of moving 75 million cubic metres of wood to temporary storage sites where it remained for years (Lidskog & Sjödin 2014).

The fire

On 31 July 2014, a forest vehicle performing subsoiling ignited a forest fire. It had not rained for weeks and the weather was, from a Scandinavian perspective, extremely hot. It was initially believed that the fire was under control, but after four days there was a change of weather with temperatures over 30°C and strong winds. During that day, the fire spread from 2800 to 13,800 ha. Not until 8 August was most of the area placed under control, but after four days it was considered completely under control a few days later. In total, 2300 persons – police, military, fire brigades, forest companies and volunteers – were mobilized to fight the fire or evacuate people and animals. Over 1000 people and 1700 animals (cattle, lambs and sheep) were evacuated, and thousands of people were prepared for evacuation when the fire approached towns. Approximately 1.4 million cubic metres of wood and 71 buildings were damaged or destroyed by the fire. The burned area is owned by some 100 small-scale private owners and a handful of large forest companies and organizations (CAB 2014; Fire Protection Nerikes 2014; MSB 2015). In Spring 2015, about half of the area (8000 ha) was declared a nature reserve.

The empirical material

The empirical material consists of two interview studies complemented by document studies. The storm study comprises 13 interviews with forest consultants working in the region at the time of the storm and were all heavily involved in the forest owners’ handling of the consequences. The interviews were conducted in winter 2013–2014, that is, nine years after the event. However, it should be noted that the storm had long-lasting consequences. The last transports of wind-thrown trees occurred in December 2009 and the replantation of the forest in the area took place between 2006 and 2010. Besides the interviews, public records and investigations of the storm disaster are emphasized. The last interviews about the storm disaster were conducted only weeks after the fire was put out and while the consequences still were evolving, implying that these interviewees could provide more detailed information but found it harder to give a more reflective view of the disaster. However, the difference in the character of the interviews should not be overemphasized. The last interviews about the fire were conducted almost six months after the disaster, which means that the interviewees had had time to reflect. Also, it is important to note that storms regularly affect Swedish forestry, the last one occurring only some weeks before our interview

Methods

The interviews were semi-structured with an interview guide that allowed for asking follow-up questions and exploring themes that arose during the interview. The interviews were tape recorded and transcribed verbatim. The interviews varied between 30 and 180 minutes in length, most lasting about an hour. A contextualized thematic analysis was conducted (Bryman 2012) using NVivo software for the analysis of qualitative data. The analysis focuses on how the respondents understand the disaster. In particular it focuses on four aspects of their understanding: (i) their view on the causes and consequences of the disaster; (ii) their risk assessment of the situation, including strategies to cope with it; (iii) what uncertainties and disagreements they perceive to be connected with these coping strategies; and (iv) the disaster’s relation to climate change, and what learning opportunities the disaster provides for forestry.

Because the interviews about the storm disaster were retrospective, the interviewees may have forgotten some details, actions, thoughts, and feelings, but at the same time they have had time to reflect on the events and could provide a broader picture of disaster and the post-disaster dynamics (cf. Boin & ‘t Hart 2007, p. 52; Murphy 2009, p. 350). In contrast to this, the first interviews about the fire were conducted only weeks after the fire was put out and while the consequences still were evolving, implying that these interviewees could provide more detailed information but found it harder to give a more reflective view of the disaster. However, the difference in the character of the interviews should not be overemphasized. The last interviews about the fire were conducted almost six months after the disaster, which means that the interviewees had had time to reflect. Also, it is important to note that storms regularly affect Swedish forestry, the last one occurring only some weeks before our interview
study with the forest consultants. It is reasonable to believe that memories and knowledge concerning the 2005 storm disaster are actively upheld through the frequent recurrence of storms (cf. Olick & Robbins 1998).

Results
The results of the two case studies are structured around four themes: perceived severity, causes, learning and climate change. The perceived severity of the disaster – how organizations and people conceive it in terms of consequences, scope and magnitude – is crucial for what kinds of plans that are developed (Witte 1998; Weinstein 2000; Haraoka et al. 2012). Whether the causes of a disaster are seen as natural or man-made is central for what preventive measures are seen as relevant, as well as for attribution of responsibility (Erikson 1994; Freudenberg 1997). Extreme events often trigger social learning, i.e. are used pro-actively to reduce exposure, strengthen resilience and develop capacities to handle unexpected situations, thereby decreasing the vulnerability of a particular system (Freudenberg et al. 2012). Due to climate change, storms and wildland fires will probably increase in frequency, intensity and area affected (Flannigan et al. 2009; Felton et al. 2010; Gill et al. 2013). Further, if the storm and fire disasters are related to climate change, this implies a growing need to develop strategies (preventive and proactive measures) for adapting forest to a changed climate.

The framing of the storm
Perceived severity
The interviewees show homogeneity in their understanding of storms, which are seen as a major problem for forestry today, and one that will increase due to future climate change. There are hardly any positive consequences associated with storms, only negative ones such as spruce bark beetle outbreaks and large economic losses due to windthrow. At the same time, the interviewees stress that even though they see storms as natural and unavoidable, there are many things forestry can do to mitigate their consequences, such as increasing the proportion of deciduous trees, practising continuous harvesting or modifying clearing and thinning practices.

Causes
The forest professionals understand storms as natural disasters remote from human influence. At the same time they stress that the consequences of a storm are partly human made. The general view in the interview material is that the storm was as harmful as it was because specific forest practices – such as the dominance of spruce, and thinning, clearing and harvesting practices – had created a wind-sensitive forest.

Learning
The interviewees agree that much was learned from the disaster, not least with regard to crisis management in general, but also with regard to forestry. In particular, they emphasized the lesson that it was not necessary to hurry as much as initially believed. This had led to a too hasty removal of timber, which caused extensive damage to the forest area due to ill-organized transports of timber. Another lesson was how hard it was to change current forest practices. Despite recommendations to the contrary, and Forest Agency subsidies to encourage replanting with other species, most forest owners replanted spruce, thereby reproducing a wind-sensitive forest. As shown elsewhere, there were several reasons for this. Most importantly, forest owners associated change with short-term economic risk. They also lacked knowledge about alternatives to spruce, making the alternatives seem uncertain and risky. Forest owners had embodied knowledge about spruce based on their experience of growing it, but only abstract or theoretical knowledge, or none at all, about the alternatives (Lidskog & Sjödin 2015).

Climate change
Most interviewees believed climate change would affect forestry, though they were uncertain how. The storm served as a wakeup call about the importance of trying to create a forest that is less vulnerable to storms and other risks associated with climate change. The most common strategy recommended by the forest professionals was risk-spreading, for example in forest composition and harvesting methods. It was generally believed that forestry can adapt to climate change and produce a less wind-sensitive forest in the future.

The framing of the forest fire
Perceived severity
Interviewees show homogeneity in their perception and understanding of forest fires. Most are ambivalent towards forest fires in general. They see fires as beneficial for biological diversity and the environment, even though they acknowledge that this particular fire had disastrous consequences for affected forest owners and residents. Forest fires are regular and non-extreme phenomena, and this exceptional case was exacerbated by human failure, making it in this sense a technical (man-made) disaster. They say it is possible to reduce the frequency and impact of large-scale forest fires by improving the organizational capacity for firefighting and crisis management, that is, by changing or strengthening practices and routines of actors outside the forest sector. But there is no reason – nor is it possible – to create a forest that is less fire-prone. Thus, forest fires may occur frequently, but they do not constitute a major problem for forestry, nor will they do so in the future.

Causes
All interviewees stressed that forest fires are frequent phenomena that have a multitude of causes, such as lightning, trains, subsoiling and recreational activities (such as making campfires carelessly). They also agree that forest fires rarely constitute any threat because in most cases they are extinguished immediately. The severe fire in August 2014 was an exception; all interviewees point to the extreme weather (hot, dry and windy) as a crucial condition for the disaster. Besides this main cause, aspects of the
human response to the fire – the poor job done by the fire brigade and badly organized crisis management – are mentioned as important causes. Important to note is that the interviewees do not make a “blame-game” (Hood 2011) of the origin of the disaster. Despite the fact that the fire was initially caused by a single contractor hired by a specific forest company, neither of the latter were made scapegoats. Blame was attributed outside of forestry, to the organizations and agencies responding to the fire. Alongside this dominant view, some interviewees also gave structural explanations, such as financial cuts that compel contractors to perform sub-soiling even in fire-prone weather, or the fact that the fire brigade is not trained and equipped to extinguish large-scale forest fires. None of the interviewees voiced the belief that Swedish forestry over time had produced a forest especially vulnerable to fires, that is, that the fire more indirectly was the result of forestry practices.

Learning
The interviewees stress that it is the organizations responsible for firefighting and crisis management that have a learning opportunity. They need to improve in such areas as communication, coordination and management, and also need to acquire better equipment. The forest sector, however, appears to have very little to learn from the fire disaster. Even though the interviewees say that everyone must learn from the disaster, they have difficulty articulating what should be learned and by whom. Some mention that stricter regulations should perhaps be imposed on the use of vehicles in hazardous weather conditions, whereas others say that agreements already exist, for example that vehicle operators should be equipped with a fire extinguisher. The interviewees believe that the fire will not lead to any changes in forest practices. There is a general consensus that forestry cannot change to be more resilient to fire, and even if it was possible to create a less fire-prone forest, it is not economically justifiable due to the low probability of severe forest fires in the future.

Climate change
Several interviewees talk about uncertainty and lack of knowledge about forest fires, at least among forest professionals in Sweden. Several believe that climate change will lead to more and larger fires at the same time as they do not see any possibility for forestry to adapt to these increased risks. This does not constitute a problem, in their view, because even if fires increase in frequency, they will still be a minor problem compared to other risks related to climate change, such as insect infestation and storms. Also, forest fires – if controlled – are associated with substantial positive values, and one interviewee even mentioned that the fire disaster may draw too much negative attention to forest fires. Thus, there is a seeming paradox in their understanding of fires; they state that there is great uncertainty about forest fires in Sweden, but at the same time are generally convinced that forestry cannot do anything to make forests less fire-prone (Table 1).

Discussion
How should we understand the different framings of the two disasters and their implications for forestry? First, it is necessary to stress the similarities between them. Both disasters caused severe communication and coordination problems, and led to an intense period of chaos and social disruption. Both caused psychological traumas for the individual forest owners, who lost assets of great economic and social value, but they also caused social traumas for affected communities that have had to reorient themselves in the new situation and new surroundings. Also, both cases show the interpretative flexibility of the situation; consequences and risks can be estimated on different spatial scales. The hard-hit forest owners share a similar situation regardless of whether it is a storm or a fire that has destroyed the forest (even if managing the situations may pose different challenges), whereas on an aggregate (national) level, storms have historically been much more severe events than fires (due to their magnitude). Thus, the risk assessment varies greatly depending on which perspectives and scales are applied.

Most striking, however, are the fundamental differences in the forest professionals’ understandings of storms and fires. A first difference is that whereas storms are seen as regular occurrences that have severe consequences and need to be acted upon, forest fires, though also seen as regular occurrences, are thought to have minor consequences and therefore not to require special action. Hence forest fires share with storms the high likelihood of occurring again, but because they hitherto have been brought under control rapidly their consequences have not been severe and they are therefore not considered potentially catastrophic. The forest fire of 2014 is framed as an exceptional and unique event which does not need to be considered in the regulation of forestry. Thus, whereas severe storms will regularly take place, severe wildfires will not. Second, storms and fires are differently valued by the forest professionals. While forest fires are primarily considered to be positive, not least for maintaining biodiversity, storms are seen as negative events, both directly (through windthrow) and indirectly (though insect pests attacking the damaged forest). Third, the causes of storms and fires are understood differently, with storms being seen as unavoidable natural events but (severe) forest fires as human failures.

Important to note is that it is hard to evaluate the framings in terms of right and wrong, or true or false; this is due to intrinsic uncertainties in predicting the consequences for forestry of climate change. Current estimations of the frequency and magnitude of storms and their consequences for forestry may be shown to be accurate, inflated or underestimated – just as estimations for forest fires may be accurate or underestimated.

| Table 1. Comparing forest professionals’ understandings of storm disasters and fire disasters. |
|-----------------------------------|------------------|------------------|
| Cause of disaster                | Storm disasters  | Fire disasters   |
| Regularity of event              | Nature           | Man              |
| Consequences                     | Entirely negative| Generally positive|
| Threat to forestry               | Large threat     | No threat        |
| Future threat to forestry        | Increasing threat| No threat        |
| Protective measures              | Change forestry  | Change society’s response |
|                                  | practices        |                  |

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Forest fires are generally framed as something positive and as not posing a problem for forestry, now or in the future. Intrinsically to this framing are economic estimates performed on a national level, and cost–benefit calculations made by large forest companies. Moreover, even in those cases where forest fires do have some negative consequences (for example for the individual forest owner), it is believed that their likelihood and consequences cannot be affected by changing forestry practices. The forest fire of 2014 is understood both as a unique event and a disaster that the forestry sector neither caused nor exacerbated. This frame encourages fatalism and passivity, and thereby discourages change of practices and active risk management. As other studies have shown, severe consequences of fires are commonly attributed to natural conditions such as wind, extreme dryness and topography, implying a somewhat fatalistic belief that forest fires are bound to happen (Cohn et al. 2008, p. 32).

This also points to the fact that risk management is based on underlying framings, the implications of which rarely are reflected upon by those holding them. For example, by shifting the cause of the fire from forestry practices to the failure of the fire brigade, and by mainly estimating the risk on national or regional scales, certain risk management strategies become more probable and credible than others. For example, if there had been a belief that the vulnerability of forests to fire is partly determined by earlier or current forestry practices, risk management strategies would also have focused on the need to change forestry practices, not only how to develop better responses to fires. Moreover, holding the preconception that there are no effective preventative measures for forest fires, while at the same time admitting one’s lack of knowledge, entails a passive attitude towards the risk of forest fires. Furthermore, if the risk of wildfires had been discussed on the individual level (consequences for small-scale private forest owners) or the community level (economic and social consequences), the positive attitude towards fires and the passive acceptance of their consequences would have been harder to maintain. (Compare the situation in other societal sectors, such as human health or road safety, where the individual consequences of disasters are impossible to disregard.) Had the fire been framed as a matter of forests putting individual lives and properties at risk, a more cautious risk management strategy might have been motivated.

Storms are framed in rather opposite terms than fires. They are seen as examples of a general problem which will probably increase over time, not least due to climate change. The storm disaster in 2005 caused a substantial change in threat perception within the forestry sector. There was no intermediary human activity between nature and the disaster to hold accountable, which led to a destabilization of earlier beliefs and now-discredited forestry practices that came to be seen as part of the process that made the storm into a disaster. In short, the storm was framed in a manner that encouraged change and active risk management. The fact that severe storms have regularly occurred since the 2005 disaster, even if without such dramatic consequences, has caused a constant re-activation of the collective memory of storm disasters and also reinforced the sense of urgency to create a less storm-sensitive forest. Obviously, the continuing occurrence of storms, even if they have not been as devastating as the one in 2005, has made the need for change more urgent, but the main trigger for this change was the storm in 2005. These different understandings result in different opportunities and incentives for action. Among interviewees, there is a perceived need to change forest practices in order to create a less storm-sensitive forest, whereas there is neither need nor possibility to create a less fire-prone forest. In their evaluation of the implications of climate change, they believe that windthrow will be a growing problem for forestry, whereas severe forest fires will not increase.

Extreme events may trigger learning. To a large extent, everyday decisions and practices are routinized, non-reflexive and habitual. However, sudden changes, crises and catastrophes often result in a destabilization of certain beliefs and may provide critical moments to question previous decisions, organizational routines and professional practices (Bourdieu 1977, p. 16; Boin & t Hart 2007). The framing of an event is vital to gaining an understanding of the destabilizing consequences of disasters, and by extension of whether an event will lead to change or the reproduction of practices and beliefs. The storm and the fire were framed differently, and thus how they are understood as well as their implications are different. Whereas forestry was problematized in relation to storm disasters, crisis management was problematized in the case of fire disasters. Thus, the interviewees’ understandings can be summarized as follows: forests can be made more resistant to wind, and society can become better prepared to cope with fires. It is the intrinsic function of frames to make this outcome seem self-evident. If the disasters had been framed differently, they would probably have threatened taken-for-granted assumptions about forestry practices and forest fire risks. Whereas other findings (Cohn et al. 2008) show a multi-causal view, involving not only weather conditions and (bad) crisis management, but also forest practices, in the fire case studied here no causality is attributed to forest practices, and there is therefore no need to question established beliefs and practices and search for new knowledge.

Last but not least, even if extreme events may trigger learning processes, it should also be taken into account that this learning may not necessarily be optimal, for at least three reasons (Meyer 2006). First, the events are so rare so that it is difficult to learn by trial and error. In short, with few cases there is always a risk of drawing too far-reaching conclusions (i.e. of generalizing conclusions with restricted relevance and applicability). Second, psychometric studies of risk perception have shown that time is a strong risk-discounting factor, which means that short-term costs take precedence over long-term ones (Slovic 2000). This means that learning processes may support the standpoint that mitigation investments are too costly, when facing uncertain future consequences. Third, in the process of framing disasters there is a risk of extrapolating from the present into the future. While this normally is an effective way to handle uncertainty about the future, climate change makes such
generalizations questionable (Meyer 2006). Knowledge about the frequency and magnitude of extreme events may be valid today, but be invalid in the future due to changing climate conditions.

To conclude, this study has shown the pivotal importance of how forest professionals understand extreme events; it leads to different management strategies and different demands for changed forest practices. Even if the studied disasters are not large from an international perspective, they are very large for Sweden. They are also extreme events that reveal how forest professionals conceptualize and interpret these phenomena. They show how understandings, beliefs and perceptions are important aspects of all post-disaster management. The framing of an event establishes whether it is seen as hazardous or harmless, natural or man-made, preventable or inevitable, and thereby states whether action is needed and, if so, what kind of action and by whom. Fires and storms are indeed biophysical hazards, but at the same time the way they are understood, and how their consequences for forestry are assessed, is social- and context-dependent. Thus, it is crucial to analyse frames when investigating responses and non-responses to an extreme event. Knowledge about how extreme events are framed is therefore crucial to understanding the incentives for adaptation and change of forestry practices in accordance with predicted climate change effects, predictions that point to a greater likelihood of forest fires and severe storms in the future.

Disclosure statement
No potential conflict of interest was reported by the authors.

Funding
This study was financed by the Swedish Research Council Formas and written as part of the interdisciplinary program Future Forests financed by Mistra (The Foundation for Strategic Environmental Research), the Forestry Research Institute of Sweden (Skogforsk), the Swedish University of Agricultural Sciences (SLU), and Umeå University.

Notes
1. Important to note is that frames are not synonymous with information, but rather concern how information is categorized, organized and understood. On the most basic level, framing processes help organizations and professions determine what should be considered meaningful knowledge (knowledge relevant for problem-solving) and how different facts are related to each other.

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References


