Time, Knowledge, And Risk: Decision Making In The Aftermath Of Storm Disasters

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Responses to disasters and crises are often characterized by decisions made in situations of urgency and uncertainty. Decisions are often made under time constraints and without full knowledge of the consequences of the available options. This paper investigates the role of time and knowledge in the practical governance of disasters and crises. It empirically examines the sense-making and risk governance practices developed in response to the consequences of two detrimental storms that affected a forest area in Sweden. The data were gathered in an interview study of forest advisors at a public agency, forest associations, and private companies. The analysis indicates that the actors' adjustments to their perception of available time (time regime) and the accessibility of knowledge (desktop knowledge) explain how certain risk governing practices evolved. Thus, of greatest significance is not what is known and unknown but who knows what and when.

Key words: disaster, storm, time compression, uncertainty, risk governance

Introduction

On January 8, 2005, a storm swept across the south of Sweden with wind gusts of up to 42 m/s, making it the worst storm to affect Sweden on record. The storm destroyed 30,000 kilometers of power lines, and 730,000 people suffered from power outages. Damage to telecommunications masts as well as the loss of electric power resulted in telecommunications disruptions for 260,000 households. Furthermore, roads and railroads became impassable or dangerous. People were isolated in their homes. With the loss of power came the loss of water and heating in the midst of the

Swedish winter. Fourteen people died. Many people were unable to get to work, causing a standstill for many organizations and agencies. The catastrophe caused significant economic damage, and the direct costs were estimated at 2.5 billion Euros (for an overview of the disaster and its aftermath, see Eriksson 2009; Guldåker 2009; Lidskog and Sjödin 2014 and 2016; Linné 2011; Sellerberg 2011; Svensson et al. 2011).

The utility companies mobilized more than 5,000 employees to repair power lines, and in addition to their own employees, workers were recruited from at least six countries. Furthermore, 3,000 individuals from the affected areas and 3,000 members of the Swedish armed forces were deployed in restoration and recovery work (Westling 2006). Through this massive mobilization, the consequences of the disaster – despite its magnitude – were handled. In a matter of weeks, life returned to normal for most people; electric power and telecommunications were restored, roads and railroads were cleared of fallen trees, and people returned to work. In a sense, the disaster was over because the core functions of society were reestablished.

In this sense, the storm Gudrun can be conceptualized as an ordinary disaster, defined as an event that causes a breakdown of the core functions of society or parts of it, threatens the lives of individuals, and disrupts the routines and structures of people's everyday lives (Perry 2007). It was a disaster with a distinct location in time and space that involved distinct phases of impact, post-impact, recovery, and reconstruction (cf. Fischer 1998). However, this interpretation does not take into consideration the long-term challenge the storm presented. A single storm has never caused such extensive forest damage in modern Swedish history (Holmberg 2005). The storm struck a forest region with a wind throw of approximately 250 million trees (75 million m^3). At the regional level, 18% of the total standing volume was felled (Blennow and Eriksson 2006).

In the immediate aftermath of the storm, the forest owners mobilized enormous efforts to clear the forest and remove the wind-thrown trees to temporary storage, a challenge that was not completed until summer 2006. The work continued to remove additional scattered fallen trees or groups of trees to minimize the risk of future insect damage to the forests and to rationalize replantation efforts. A new storm (the storm Per) hit the area in 2007, which further complicated the work. In December 2009, nearly five years after the storm Gudrun, the last wind-felled trees were transported from temporary storage sites to sawmills. However, this is only half of the story; it does not end with the clearing of the forest and the transporting of the timber to saw mills. Between 110,000 and 130,000 hectares required replantation (Svensson et al. 2011, p. 11). The Forest Agency allocated 50 million Euros to economic support for replantation, and during 2006-2010, more than 90,000 hectares were replanted by the forest owners (SFA 2013, p. 3). Therefore, the storm Gudrun preoccupied forest owners and informed their activities for many years. Whereas the most emergent phase was over, the core functions were repaired, and everyday life was reestablished for many people, the forest owners faced a new challenge: to allocate time, resources, and knowledge to reforest the area. Most, if not all, of these individuals had never made a decision regarding replantation on this scale. For 10% of the affected forest

owners (7,500 persons), the wind-thrown trees represented ten years' worth of harvest or more (Blennow and Eriksson 2006). A further complication was that the storm raised questions about how to create a forest that is less sensitive to storms. Thus, the forest owners were in a situation with high stakes and great uncertainty. Their experience and knowledge did not provide sufficient guidance on how to act, and they were forced to make important decisions about what type of forest they should replant.

Conceptually, crisis is often defined as a threat to fundamental structures or values in society (Rosenthal, Charles, and 't Hart 1989, p. 10), whereas disaster is seen as a manifestation and materialization of these threats resulting in devastating and detrimental consequences (Boin and 't Hart 2007). Crisis may lead to disasters, and resources are often mobilized to prevent a crisis from developing into a disaster. What is important to note, however, is that the reverse development can also occur: the handling of a disaster may lead to unintended consequences resulting in risk, crisis, or even a new disaster. Thus, the way that actors address the risk they face in the wake of a disaster is central to understanding the social dynamics and trajectory of a disaster (Birkland 2007).

The forest owners faced a situation of enormous magnitude. First, they had to decide how to manage the wind-thrown forest and the risk associated with it, and then they had to decide what type of forest they should replant in light of the fact that the current spruce-dominated forest had proven to be wind sensitive and other options would perhaps be better. In this sense, the disaster caused by the storm was followed by a crisis, a threat that must be managed to avoid disastrous consequences. The forest owners had to address a situation of great uncertainty and high stakes in which their experience and knowledge did not provide sufficient guidance on how to act. Using the storm Gudrun as starting point, this paper investigates the role of time and knowledge in the practical governance of disasters and crises. By introducing the concept time regime and desktop knowledge, this paper makes a substantial contribution to the field of crisis research. Empirically, this paper investigates how the forest advisors and forest owners handled the risk in the aftermath of the two storms, Gudrun and Per, as well as why they developed their specific risk governance practices. The research questions are as follows: Why did certain risk governance practices develop? How did the actors' perceptions of time influence their risk governance practices? What type of knowledge was gathered and used to determine the measures necessary to minimize the risk associated with the storm Gudrun? The empirical material consists of an interview study of forest advisors at a public agency and private companies. The paper is organized into four parts. The first part is this introduction. The second part outlines the design of the study, including its theoretical approach and the method and material used. The third part presents the results of the interview study and discusses how forest actors assessed the storm – including the risk associated with it, the time available, and the relevant knowledge – to develop responses to the consequences of the storm. The fourth and final part returns to the more general issue of governing disasters and crises and concludes that of greatest import is not what is known and unknown but who knows what and when.

Research Design

Risk Governance in Practice: Time Regime and Desktop Knowledge

A crisis involves at least three key components: threat, urgency, and uncertainty (Boin and 't Hart 2007). A threat means that something people or organizations value is at stake. Closely related to this is the notion of risk, which refers to uncertainty about and the severity of the consequences (or outcomes) of an activity with respect to something that humans value (Aven and Renn 2009). Thus, risk is connected to a present action and the future consequences of this action. It is also connected to uncertainty; it presupposes that the future is not determined and that human action shapes the future, often in unintentional ways (Beck 2009). The reason for this is that organizations and people cannot gain sufficient knowledge about what possible future will result from a decision. Through efforts to anticipate future consequences of present action, risk opens up space for action. By transforming threats to risks, they are made governable.

Governing risk is largely a contextual and practical matter. It is not society per se but specific organizations and professionals that must ponder how to understand and what to do in particular situations. Thus, risks cannot be characterized independently of the institutional and practical arrangements that are configured to address these situations and events (Boholm, Corvellec, and Karlsson 2012). The reason for this is that risks are always situated in a social context and are necessarily connected to actors' activities (Lidskog and Sundqvist 2013).

An extreme event implies that people face a situation with which they are not familiar and in which they perceive limits to their knowledge. In this situation, people and organizations develop a sense of what they are up against, what their own position is relative to what they sense, and what they need to do (Weick 1999, p. 42). By noticing, bracketing, and labeling, people develop a plausible and coherent image that facilitates certain options and actions and constrains others (Weick, Sutcliffe, and Obstfeld 2009, p. 131). Many times this sense making is accomplished by associating an extreme experience with routine experiences and by drawing on prior knowledge of similar situations (Kreps and Bosworth 2007). It should be noted, however, that there is no straightforward path from interpretation to action. Instead, these are intertwined and co-produced. A certain interpretation shapes an action, which, in turn, opens space for new interpretations. Thus, there is a dynamic interaction between an event, the meaning attached to it, and the practices that respond to it.

Time compression is a defining element of crisis; a threat is present and must be addressed rapidly (Boin and 't Hart 2007, p. 44; Murphy 2009; Wisner et al. 2004). The time frame is crucial for the understanding of a situation and how it is actively addressed (Bankoff 2004; Brown, Heyman, and Alaszewkski 2013). Time is also connected to uncertainty; there are uncertainties about how to define the threat (including who should define it), what risks are associated with it, and what remedies

are deemed relevant. Thus, in a situation of crisis, actors are tasked with rapidly understanding what is at stake and, with very little time for knowledge gathering and risk evaluation, making decisions to manage the crisis. This is one important reason why actors' methods may lead to more rather than fewer risks (Lidskog and Sjödin 2015).

Thus, time and knowledge are central aspects in handling risk, crisis, and disaster. The extent to which there is a lack of time and a lack of knowledge about the consequences of different options has substantial implications for actors' decision making. To investigate this issue in more depth, we will introduce and develop two concepts that explain why particular risk governance practices, "time regime" and "desktop knowledge", evolve.

A *time regime* is a particular rationality formed by the perception of how quickly decisions must be made and how quickly practices must be performed.[1] A time regime constrains what actions are possible, what knowledge is available, how decisions are made, and how actions are performed. Thus, it imposes a particular rationality or a particular way of reasoning and acting. As organizations and individuals adapt their activities and decision-making processes to their perception of time, their time perception acquires autonomy and durability to a larger or lesser extent. Therefore, a time regime is a structuring mechanism. Different groups may have different time regimes, but to guide other actors' decisions and practices, a particular time regime must be spread and shared. A time regime is an enactment of urgency (Weick 1988; 2010). On the one hand, a time regime is about the sense making of a threat through a specific perception of time. On the other hand, this definition of the situation shapes decision making and action. Thus, cognition and action mutually shape each other. What this concept highlights is how the constraining results of the sense making of a crisis take on a life of their own as individuals and organizations institutionalize and routinize actions based on their perceptions.

The enactment of urgency generates uncertainty because time pressure frequently makes it difficult to determine what relevant knowledge exists. Uncertainty should therefore not be limited to the question of whether relevant knowledge exists. The pivotal question is whether relevant knowledge is accessible and ready to be used. The important form of knowledge in a crisis or a disaster is *desktop knowledge*, which is defined as knowledge that is easily accessible, recently referred to or discussed, or articulated in management or regulations. An important aspect of this concept is that it deepens understanding of what knowledge is. Instead of seeing knowledge as something that either exists or does not exist, it stresses that knowledge is personal and situational. The fact that there is a lack of knowledge for actors in a specific situation does not necessarily mean that something is truly unknown; it only means that there is no knowledge that is easily accessible for those actors who must make decisions. Another aspect of the concept is that it relates time to knowledge. In many pressing situations, there is no time to find out what is known in the time available. This situation underlines the usefulness of the concept when studying extreme events, such as disasters and crisis. Such events often require individuals and organizations to

act rapidly, and decisions must be made on the basis of what is known here and now (Boin and 't Hart 2007; Murphy 2009; Woodhouse 2007). Actors might have brief time to search for knowledge, but the search is, to a greater or lesser extent, circumscribed by the necessities of the situation. Therefore, the type of knowledge that becomes important in such situations is knowledge that is easily accessible, or knowledge that is available to the individual or the organization without too much effort and time consumption. The most available knowledge is, of course, knowledge that is routinized, internalized, or embodied or knowledge that has recently been discussed. However, it is important not to conflate desktop knowledge with the taken for granted or the current state of knowing. Desktop knowledge implies that there is a search for knowledge, such as through the exploration of documents or by consulting expertise. It is usually an acknowledged lack of knowledge about how to act or decide in a situation that precedes the search. In a situation of crisis or disaster, it is reasonable to believe that actors search crisis management documents, directives, and policies. These documents should, at least ideally, be on the desks of decision makers in an extreme situation.

Thus, central to risk governance is not what knowledge exists, but what knowledge is available and to whom. Additionally, the perceived urgency of the situation (how rapidly decisions need to be made) is central to how actors respond. Thus, desktop knowledge and time regime are important factors in explaining why particular risk governance practices emerge.

Method and Materials

The empirical data consists of an interview study of thirteen forestry consultants, eight of whom work at the Forest Agency and five at the private forest owners' association Södra or the private forest company Sydved.[2] Forest advisors employed by the Forest Agency, forest associations, or forest companies are of key importance to the forest owners' risk governance because their advice and recommendations are crucial as providers of knowledge and as representatives of either the regulatory agency or the timber buyers.

The respondents selected were working in the region at the time of the storm and were actively involved in the forest owners' response to the consequences of the storm. Consultants at the Forest Agency were selected by contacting the local offices in the most affected areas and inviting all of the consultants actively involved in the work related to the storm Gudrun to participate in the study. Of the nine consultants invited, only one declined to participate, claiming that he was not involved enough in the response to the storm. The Södra forest association and Sydved, a private company, were also sampled because they were the dominant forest organizations in the affected area. These organizations were contacted and asked to identify employees especially involved in decision-making and forest counseling after the storm Gudrun. In total, thirteen consultants were interviewed. Only one was female, though this reflects the general male dominance among forestry consultants. All of the

interviewees had been involved in response efforts to several large storms, but none had experience prior to the storm Gudrun disaster. Some parts of the analysis include what the forest owners thought and how they acted to handle the situation. This analysis is based on secondary sources: our interviews with forest advisors and consultants. These individuals were deeply involved in the forest owners' situation and deliberations, and their descriptions in the interviews about the forest owners' reasoning are in accordance with published studies on forest owners' reasoning, deliberations and decision making after the storm Gudrun.[3] Thus, we see them as trustworthy informants about the forest owners' ways of understanding and acting in the situation.

The interviews were semi-structured with an interview guide that allowed for follow-up questions and deepening of themes that arose during the interview. The interviews were tape recorded and transcribed verbatim. A contextualized thematic analysis was conducted (Bryman 2012) using NVivo software for the analysis of qualitative data. In the analysis, special attention was paid to thematizing everything that was said about time, decision making, knowledge, and what could have been done differently.

The interviewees were asked questions about their actions, feelings and thoughts during and after the storm; about the risks attending the storm; what they and the forestry sector learned from the disaster; about the decisions and advice given concerning the spruce bark beetle; and about the advice given to forest owners in different phases, such as replantation. Furthermore, they were asked general questions about the practice of giving advice, their relationship to forest owners, knowledge, risk, global warming, uncertainty, forestry as a practice, biological diversity, the social value of forests, and environmental concerns.

The interviews were conducted in winter 2013-14, almost nine years after the storm Gudrun and almost six years after the storm Per. Most interviews were conducted in November, only a few weeks after the region was hit by a storm. Although this storm was not a disaster, it seemed to have re-activated the interviewees' experiences and thoughts about the storms Gudrun and Per.[4]

An understanding of the storms Gudrun and Per should not be limited to seeing them as discrete events that occurred at specific times in 2005 and 2007 because the consequences of those storms had a much larger temporal extension. The last transports of wind-thrown trees occurred approximately five years after the storm Gudrun. The replantation of the forest in the area occurred between 2006 and 2010. Thus, until three years before the interviews, the actors were still involved in consultation and decision making related to the storms.

The interviews were retrospective, which has advantages and disadvantages. The drawbacks are that some details, actions, thoughts, and feelings may have been forgotten. The benefits are that the interviewees had time to reflect on the events and their experiences and could provide a broader picture of the course of events, including their own role in them. They also had time to analyze the advice given and the decisions made (Murphy 2009, p. 350), to ascertain the significance of the crisis,

and to understand both the changes and the knowledge gains that the crisis produced (Boin and 't Hart 2007, p. 52).

Results

The three components that define a crisis – threat, urgency, and uncertainty – were evident in the interviewees' descriptions of the events following the storms Gudrun and Per. They experienced a threat to the forest and its economic value. They described intense time pressure and a sense that they needed to act rapidly to avoid a catastrophe for the forest. In this situation, many important decisions had to be made that had long-term consequences. At the same time, they were uncertain about what actions should be chosen, partly because some threats were largely weather dependent and therefore difficult to take into account and partly because some measures had never been conducted on such a scale.

A time regime was generated when the forest agency, forest organizations, and forest owners adapted their actions and behaviors to the perception of time shortage and the need for urgent action. Several factors combined to produce a fast pace in the work to remove the wind-felled timber. Although the underlying reasons differed, forest owners, forest companies, and the forest agency shared a belief in the importance of removing as much timber as possible from the forest as quickly as possible. The rapid pace and the need for urgent action, in turn, had great implications for the risk evaluations they made as well as their decisions on replantation. The time restrictions and the fast pace also affected the extent to which knowledge of earlier large storms was considered and re-activated. The urgency directed their focus to knowledge that was easily available—that is, desktop knowledge.

Causes of The Fast Pace

Three interests converged when forest owners, forest companies, and the forest agency all wanted to remove as much timber as possible as quickly as possible.

The Forest Agency acted through counseling and directives to ensure that the wind-felled trees were managed as quickly as possible. The reason for this was a fear of a massive bark beetle infestation, which could ultimately cause more damage than the storm itself. They used an approach typically used after smaller storms that had proven feasible and functional in those situations. The fear of a bark beetle outbreak coupled with the scale of the disaster resulted in some options being excluded. The use of insecticides was ruled out because it was deemed too time consuming, due in part to the bureaucratic process of obtaining permission and in part to the political awkwardness of using insecticides in such a large area. The option of pheromone traps (traps into which bark beetles are lured and then sprayed) was considered impracticable at the required scale. Even if all these measures were applied to a lesser extent, removing the wind-felled trees quickly appeared as the most reasonable and effective strategy for managing the risk of bark beetle infestation.

Forest companies and forest associations also wanted to remove the storm-felled timber as soon as possible. The reason for this was the belief that the quality of the timber would be reduced if the trees were left lying in the woods. However, in retrospect, the fast pace was not fully justified. Storm-felled trees that still had some root contact did not lose quality to the extent feared. Additionally, this was a lesson learned after massive storms in the 1960s, although it was not part of the desktop knowledge in the crisis.

Forest owners, according to the interviewed forest advisors and consultants, were very active in pushing for the fast pace. Forest advisors described how, after the storm, they immediately received numerous calls from the forest owners requesting them to immediately visit their area to investigate the storm damage. The main reason for the fast pace was not concern about the quality of the timber, fear of a bark beetle outbreak, or the risk of plunging timber prices. According to the interviewees, the main reasons were social and psychological: for many of the owners, it was painful to see their destroyed forest every day. The removal of the wind-thrown trees and replantation of a new forest also seemed to be psychologically very important for the forest owners. The interviewees expressed it as follows:

> They were so tired of looking at what they saw outside the window. [...] It was really [laughs], actually, it was this mess of trees, and you couldn't walk where you used to walk, and all of this was really the basis of the frustration. (Forest consultants, Södra)

> Yes, I think it's a psychological thing, that they wanted it gone so they didn't have to see it, simply put, because really you could say that there was no panic, after all. (Forest consultants, Södra)

The scale of the storm Gudrun necessitated efficiency, rationalization, and a high work rate; 75 million cubic meters of wind-felled trees had to be managed. This required high speed and efficiency of the organizations and agencies involved in the work. Forest agency advisors described how "assembly-line principles" were introduced with a higher degree of specialization for the employed. The actual handling of the timber constituted an extraordinary organizational achievement. The number of trees felled created a visual impression, an image of the landscape that generated feelings of helplessness or even panic, which further reinforced the perceived urgency of the situation. The interviewees described the time after the storm as a high-stress situation in which the magnitude of the damage created a persistent sense of emergency.

The Storm Per

In 2007 the storm Per hit the area. It was a huge storm, but compared to Gudrun, it was not as destructive; the amount of wind-thrown trees was less than 20 million m^3

compared to Gudrun's 75 million m^3. The significance of Per has much to do with temporal and spatial aspects. Per struck part of the same area as the storm Gudrun and at the time when forest owners and advisors had just finished most of the work of clearing and transporting the timber out of the forest. The interviewed advisors and consultants described how they suddenly had to restart storm inspections and consulting work. The bark beetle threat once again became acute because the population of the insects had increased and the wind-thrown trees were more spread out in the landscape and therefore more difficult to effectively handle.

Two themes emerge in the interviews. First, the interviewees noted that it was emotionally taxing for both forest owners and advisors to start over just as everything was returning to normal after Gudrun. They used words such as hopelessness, saturation, or burdensome. Second, the interviewees described how the operating procedures, contacts, and division of labor established after the previous storm were resumed. Consequently, Per could be seen as an extension of Gudrun in which the ways of working and thinking as well as the working relationships were extended in time:

> So you had all the routines and all of that ready; all the contacts and all that were already established. (Forest consultant, Sydved)

The storm Per struck just when the actors believed the crisis was over, and it prolonged the crisis by an additional year. Suddenly, there was a new spruce bark beetle threat, additional wind-felled trees to take care of quickly, and new timber to be stored awaiting transport to a sawmill. The storm Per meant that forestry was subordinated to the established time regime for even longer and that it was consolidated further.

The Consequences of The Storms

The fast pace and time pressure were caused partly by the destructiveness of the storm and partly by the fact that different actors, for different reasons, adopted a belief about an urgent threat and felt that the storm-felled trees had to be taken care of as quickly as possible. This situation had several consequences.

Organizational changes. One effect of the compression of time, in combination with the scale of the damage, was that organizations, particularly the local offices of the Forest Agency, were forced to rationalize working procedures and decision making. The organizational adaptation to the workload caused by the storm lingered after the need for efficiency had ceased. Among the lingering effects for the Forest Agency were an increased division of labor within the organization and less time to visit forest owners and dialog with them about forestry. As a forest advisor described it,

One of the problems with Gudrun, really, has been that it has become more, more ... assembly line work, so to speak. Someone has been working on a particular thing and just worked with that thing; someone else has not worked with the same issues but just had to work with other things then. It has after all been more effective, but we, we lose in this wide-ranging expertise, so to say. (Forest consultants, Forest Agency)

Depots. A direct consequence of the fast pace was that a large amount of timber was removed from the forest in a short time. However, the saw mills did not have the capacity to handle this amount. Therefore, the timber had to be temporarily stored in large depots. Storing this amount of timber had never been attempted in Sweden, and the storage was in operation for several years. Interviewees who were involved in the decision making and the construction of the depots stressed the great uncertainty attached to the depots.

What happens to this timber when it remains lying on the ground? Can it be used for the purposes we want to use it for? How should we store it? What happens to the environment when we store it? (Forest consultant, Södra)

The risks acknowledged when making the decision to construct the depots included the possibility of phenols and nitrogen resulting in acidification. However, subsequent environmental investigation showed that this was not the case. Instead, the leakages of phosphor (resulting in eutrophication) turned out to be the serious problem associated with the depots. The investigations show that, fortunately, this risk was not realized to any greater extent, and the depots had no long-term detrimental effects on the environment. Thus, the risk acknowledged and addressed at the time of the decision making proved to be of less importance, whereas other unforeseen risks proved to be the real problem. This situation was grasped by one of the interviewees, who described the depot decision as based on "what we thought we knew". Desktop knowledge was intrinsic in the decision-making process.

It would misrepresent the course of events to characterize the forest companies as irresponsible risk takers with regard to the construction of the depots. The depots became a necessity because of the fast pace, and the forest owners, the Forest Agency, and the forest companies all pushed for an accelerated handling of the storm-felled trees. Urgency and threat were important components of the sense making of the crisis, and the effect was that decisions had to be made under great time pressure.

Damage by vehicles. Other important consequences of the perceived time constraints were a shortage of forest machinery (including harvesters and forwarders), unskilled machine operators, and a lack of consideration for natural values during the clearing and reprocessing work. The advisors describe how vehicles did extensive damage to the forest areas as a direct consequence of the fast pace and the resulting lack of suitable vehicles and trained personnel:

Another thing that changes the landscape is, of course, all the damage done by vehicles. Machines came here from France, Austria, Finland … from everywhere. Some … looked more like excavators than forestry machines, and they were terribly destructive. [...], Machines just appeared, like out of nowhere, so to speak. We didn't have any [chance] whatsoever… everyone was just grateful if they could get a vehicle. So I believe if we would have started standing there and stopping vehicles, we would [laughs] have ended up in a very difficult situation because the problem was that there were too few vehicles. (Forest consultant, the Forest Agency)

Replantation. The fast pace became routinized and normalized as a time regime was developed and consolidated. Although there was no longer any reason to hurry, the high pace continued when the replantation work was started. According to the interviewees, this resulted in a shortage of tree seedlings and a lack of time to reflect before making decisions about replantation. As previous studies have shown, a consequence of the storms was that a new forest was planted that made the forest owners feel skeptical (Linne 2011; Sellerberg 2011). Spruce was planted almost exclusively. Given the predicted effects of climate change and storms, this might be understood as long-term risk taking. The following quote is from an advisor who spoke about a lingering effect of time pressure and how the effectiveness "was in the spine":

In hindsight, in my personal opinion… it went too fast, somehow, and rationally. And, it was like a reflexive response after Gudrun, when all those millions of cubic metres were taken care of so quickly, with a vast build-up of vehicles and rolling up of shirtsleeves, and then it just kept going somehow with the reforestation as well. It just kept rolling, so to speak.
(Forestry consultant, Forest Agency)

According to the interviewees, the reforestation was conducted much faster than necessary. Many forest owners wanted to plant at roughly the same time, leading to a shortage of tree seedlings. The consequences were that choices were limited, and forest owners had to take the plants that were available, mainly spruce. According to some advisors, the hasty replantation resulted in a lack of time for thought and reflection:

Yes, but that's what I was talking about, that everything was efficient as hell then, and rationally handled, and it all just continued on into the reforestation. So there was… you didn't have, you didn't take the time to think […] Well, seedlings were just tossed out there; the ground was prepared and, somehow, was planted right away. (Forestry consultant, Forest Agency)

Discussion and Conclusion

Storms and wind-felled spruce occur regularly in southern Sweden, and all forest owners are familiar with cleaning up wind-thrown trees. Although storms are extreme events that disrupt everyday life and routines, they are not new phenomena, and forest owners and forest advisors know how to handle the aftermath of storms. In this sense, storms can be defined as normal non-normal events. When a storm hits, organizations and agencies know what to do. In this sense, Gudrun was no different; it was understood as another storm, another act of nature against which one could not protect oneself. Yet, the extreme magnitude of the storm made it something qualitatively different. In that sense, the storm Gudrun can be defined as normal in type but abnormal in effect.

There are several reasons why the storm's magnitude made the situation atypical. The task of removing the wind-thrown trees was enormous and on a scale that demanded novel ways of organizing the work. The number of dead or damaged trees in the forests created a serious risk of spruce bark beetle infestation; however, the forest owners and forest companies lacked the capacity to remove all wind-felled trees. There was therefore a risk that a large amount of timber would be left lying and cause an uncontrolled insect outbreak. Moreover, the sawmills and the lumber industry did not have the capacity to process the removed timber, leading to the construction of huge timber depots. The number of forest owners in need of guidance put extreme demands on the forest organizations and the forest consultants, who had to find ways to adapt to the intense demands and time constraints. Finally, all of the work had to be performed in an emotional context of grief, despair and loss.

Despite these disadvantages, the forest consultants and forest organizations responded adequately to the situation. Initially, when the magnitude of the storm was known, no normal procedures or strategies were applicable. The forest owners, the Forest Agency, and the forest companies faced disorder, confusion, and pressure. However, over time, this catastrophic phase was replaced by a crisis. This new situation, defined by urgency and threat, was understood as a non-normal event that forestry nonetheless was prepared to handle. Organizations, agencies, and individuals knew what needed to be done, but they had to do more of it and more quickly. They understood the threat as heavily time dependent because the longer the timber was left where it had fallen, the greater the threat of a spruce bark beetle infestation and reduced quality of the wood. At the core of the sense making of the crisis was the question, "Can we act fast enough to do what we normally do after large storms, given the enormous amount of wind-felled trees?" In this way, the Gudrun and Per storms were simultaneously normal and extreme. The sense making of the situation as a normal non-normal event enabled the establishment of a shared belief among diverse actors that as many of the trees as possible needed to be removed as quickly as possible because the strategy designed for a normal situation was applied to an extreme one. In turn, this situation fed back into the perception of the urgency and the threat of the crisis, which restricted the opportunity for the pursuit of knowledge. Due to a lack of time, desktop knowledge was used when deciding on the proper course of action. Some of the interviewees stated that they later realized that experience and

knowledge from similar storm disasters existed in Swedish history, not least from the 1960s. This knowledge existed but was not known by the advisors and forest owners. Paradoxically, less time pressure might have led to the knowledge that the removal of the timber from the forest was not as urgent as it was believed to be.

Several of the interviewees expressed both pride and wonder that the situation was managed and the huge amount of storm-felled trees was handled. They used words such as incredible, unbelievable, and extreme achievement when describing the work. It was truly an accomplishment, and it demanded efficiency and rationalization in all organizations involved. The magnitude of the crisis led to a perception of urgency; therefore, work was performed under time pressure. The threat of a spruce bark beetle outbreak and large economic losses due to low timber quality combined with the time compression to produce a time regime. This regime involved a perception of time as well as ways of reasoning and acting. It also produced uncertainties; it was a direct cause of the risk taking connected to the timber depots. All actors wanted the wind-felled trees out of the forest as quickly as possible, which led to unintended consequences in the form of forest damage and uncertainties in the form of timber depots where little was known about the effects on the timber or the environmental effects on the surroundings. Additionally, the perception of urgency was extended to the reforestation work, leading forest owners to follow the established pathway and rapidly plant spruce, despite recommendations to create a more mixed forest. Abstract knowledge that prognosticated climate change would create less favorable conditions for spruce forests was subordinated to owners' practical and embodied knowledge that spruce was the most favorable tree species. The result was the reproduction of a storm-sensitive forest. Thus, crisis resulted not only in the handling of existing risks but also in the creation of new ones.

Our study shows that a crisis has its own independent social dynamics that generate unintended consequences. In line with other research on disasters and crisis, this study finds that the strategies, ways of thinking, and practices that are central in non-extreme situations also become central in extreme situations (Fischer 1998). The reason for this is mainly found in the time regime, which gives little space for seeking less accessible knowledge and for new knowledge and novel thinking. The fast pace and persistent feelings of a shortage of time produce circumstances in which there is little opportunity to analyze, reflect, and gain perspective on events or to search for knowledge in a profound way. There was no time to explore the lessons learned from previous large-scale storms. The knowledge that mattered was the knowledge that was close at hand, or desktop knowledge.

The study also has implications for the understanding of disasters and crisis in relation to knowledge. Learning from disasters and crisis is a common theme in the literature (Birkland 2007; Brunsma, Overfelt, and Picou 2007; Daniels, Kettl, and Kunreuther 2006; Murphy 2009; Woodhouse 2007). Applied to disasters or extreme events, desktop knowledge enables a more nuanced understanding of what it means to learn from an event. One participant describes what the actors in the forest sector have learned from storm disasters and the subsequent crises: "After some time, we realized that what we learned from the catastrophe was what was already known before the

event. In the acute situation, however, it was not known to us that this knowledge existed. However, now we know that some people knew all along". The last sentence focuses on who has knowledge, which is another aspect of desktop knowledge. Knowledge is not only about knowing or not knowing in a general sense; it is specifically bound to who knows what and when. In a situation of urgency, there is limited time to search for and evaluate relevant experiences and existing knowledge. From an actor perspective, certain facts were both known and unknown at the same time. This understanding of learning is in line with arguments put forward by disaster researchers who argue that much of what is learned in a disaster is already known, although the knowledge can have new significance for certain individuals (Birkland 2007; Clarke 2003).

The implications of the time regime and desktop knowledge are important in the evaluation of actors' behavior in extreme events. According to Dynes and Rodriquez (2007, p. 28-29), there is often a belief that there is a responsible and evil wizard hidden behind a curtain (what they call the "Oz Theory of Authority"). However, they conclude that there is no wizard and no curtain, only evolving social dynamics. Not infrequently, when blame is to be allocated in the aftermath of a disaster or a crisis, the argument is put forward that decision makers should have known better and acted differently. Instead, our study stresses that the risk governance practices that evolve are a function of time and the availability of knowledge.

Notes

[1]A "time frame" (Brown et al. 2013) is a related concept, but this concept primarily serves to show the specific relation between past, present, and future times as well as the relation between standardized time and perceived time. It does not involve the speed of time and its relation to the practices of governance, which are central to our concept of a "time regime".

[2]A unique feature of Swedish forestry is its ownership structure; approximately 50% of productive forestry land is owned by individuals, 30% is owned by private companies, and 20% is publicly owned (Lidskog et al. 2013). The individually held forestland generally takes the form of small parcels. More than 51,000 forest owners in southern Sweden are members of the economic forest association Södra. The forest company Sydved buys shipping timber and standing timber and offers full forest service to forest owners in southern Sweden.

[3]Primarily interview studies of forest owners conducted in 2005-06 (Guldåker 2009), 2006 (Sellerberg 2011) and 2009 (Linné 2011) but also, to some extent, a survey conducted in 2005 (Ingemarsson et al. 2006).

[4]The storm Simone hit southern Sweden on October 28, 2013, resulting in almost 2 million m3 of wind-thrown trees (compared to the storm Gudrun's 75 million m^3 and Per's 15-20 million m^3).

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