

## Societal impacts of storm damage

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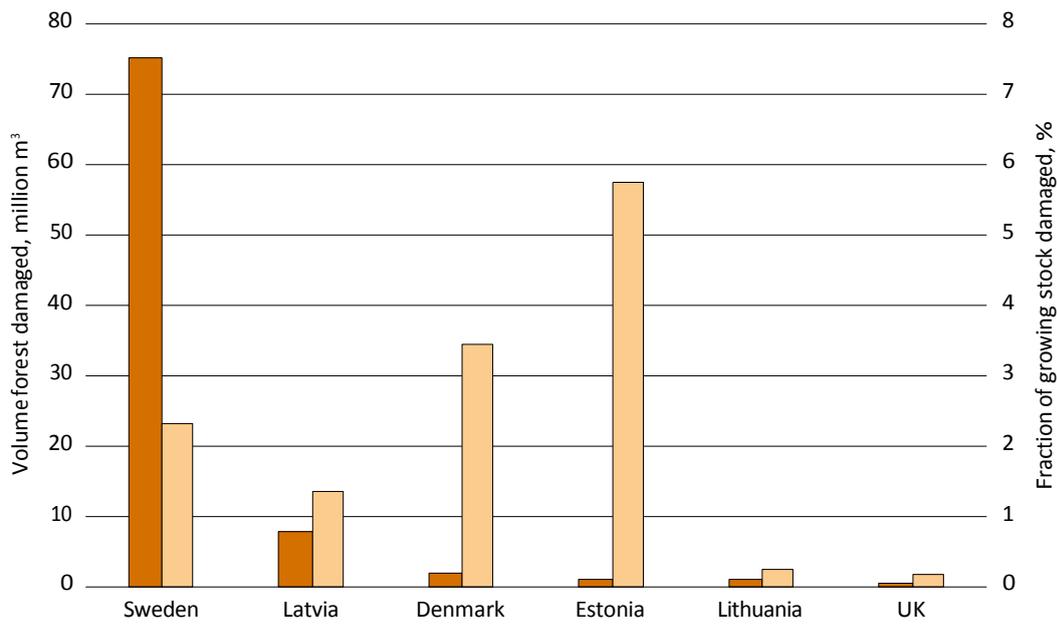
Wind damage to forests can be divided into (1) the direct damage done to the forest and (2) indirect effects. Indirect effects may be of different kinds and may affect the environment as well as society. For example, falling trees can lead to power and telecommunication failures or blocking of roads. The salvage harvest of fallen trees is another example and one that involves extremely dangerous work. In this overview we provide examples of different entities, services, and activities that may be affected by wind damage to forests. We illustrate how valuation of the damage depends on the perspective applied and how the affected entities, services, and activities may represent different types of values. Finally we suggest means for how to actively manage the risk in an ethically sustainable way. Many of our examples will be drawn from the experiences of the wind damage Gudrun in southern Sweden on 8–9 January 2005. The direct as well as indirect effects, which are described, are by no means unique to the Gudrun wind damage event and similar or even worse effects have been described after the wind damage events Martin and Lothar in 1999, and Klaus in 2009.

### The Gudrun wind damage event on 8 January 2005

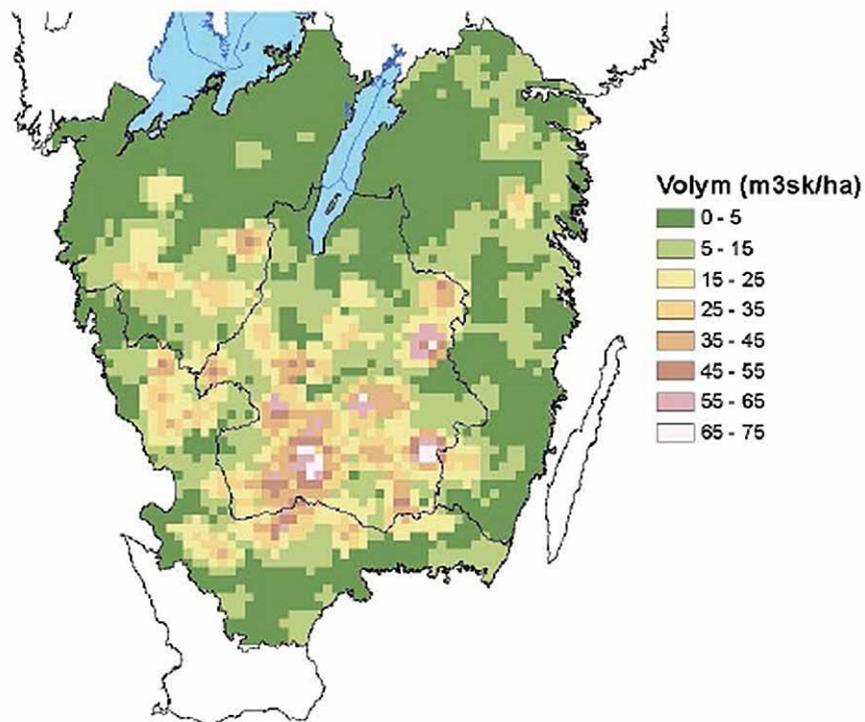
On the evening of 7 January, 2005, a low-pressure system formed northwest of Iceland. At mid-day of 8 January the center of the low-pressure system reached southwest Norway and the wind speed increased to gale force on the Swedish west coast. The peak in the storm was reached somewhat later during the same day and during the following night when the low-pressure system passed Sweden it had developed into the most damaging weather event known to occur in Sweden. Damage of different kinds was done also in other countries along its path; from Great Britain to the Baltic States and Finland. The total volume of forest damaged was largest in Sweden while the fraction of the total growing stock damaged was largest in Estonia (Figure 21).

### Impacts on society

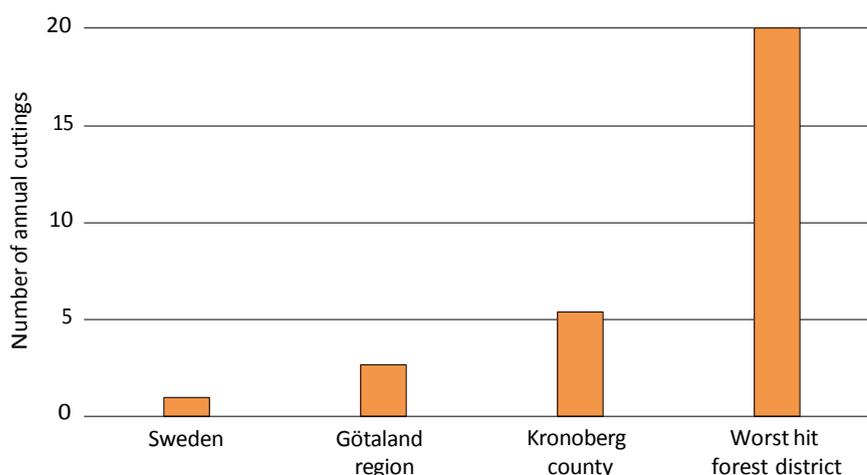
From a Swedish timber and wood production perspective the Gudrun wind damage event resulted in damage to forest corresponding almost a full year's Swedish harvest. But the damage done to the Swedish forest was done in a limited part of the country (Figure 22). Even though at a Swedish national level the impact was big but manageable, at a local level it was devastating. In the affected region approximately 80% of the productive forest area was owned by mainly small-scale private individual owners.



**Figure 21.** Damage volumes and percentage of growing stock by country for the ‘Gudrun’ wind damage event on 8–9 January 2005. Darker bars indicate volume of damage, lighter bars fraction of growing stock.



**Figure 22.** Damaged volume (m³/ha) in southern Sweden after the 8 January 2005 wind damage event based on visual inspection from aircraft (from SFA, 2006).



**Figure 23.** The volume of forest damaged by the storm Gudrun divided by the annual cutting volume for the corresponding area.

In the most extensively damaged forestry district the damage done corresponded to more than 20 annual harvests (Figure 23). Here, individual land-owners saw their forests devastated (Figure 24).

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The forested landscape provides a plethora of entities, services, and activities that can be affected by wind damage. The region of Götaland was the most affected by storm Gudrun and had 3.9 million inhabitants (43% of the Swedish population) in 2005. The directly affected individuals were mainly found among those living in the countryside.

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The fallen trees resulted in a peak of timber and wood to be harvested, transferred to and used in the industry. While this in turn resulted in job opportunities, the fallen trees damaged and blocked infrastructure. For example, 300,000 Swedish subscribers' non-mobile telecommunications systems were not functioning, and two months later a large number of subscribers were still without telecommunications. The mobile systems and data-traffic was also severely affected. Furthermore it took 34 days before all railway lines in the region were in use again. With respect to power-failures, approximately 730,000 subscribers were affected. Some areas were particularly difficult to reconnect, and customers suffered failure for up to 45 days after the storm. The implications were particularly important for the maintenance of civil security. A large number of people became isolated and during the night of the storm many of the municipal officers on emergency call worked under high risk. For example, home medical service personnel exposed themselves to high risk when they, sometimes under escort from rescue service personnel, tried to reach patients that were without electricity and telecommunications. The lack of heating due to power outage made people use old and non-functional stoves for heating which in turn resulted in fires. The power failure also caused severe problems



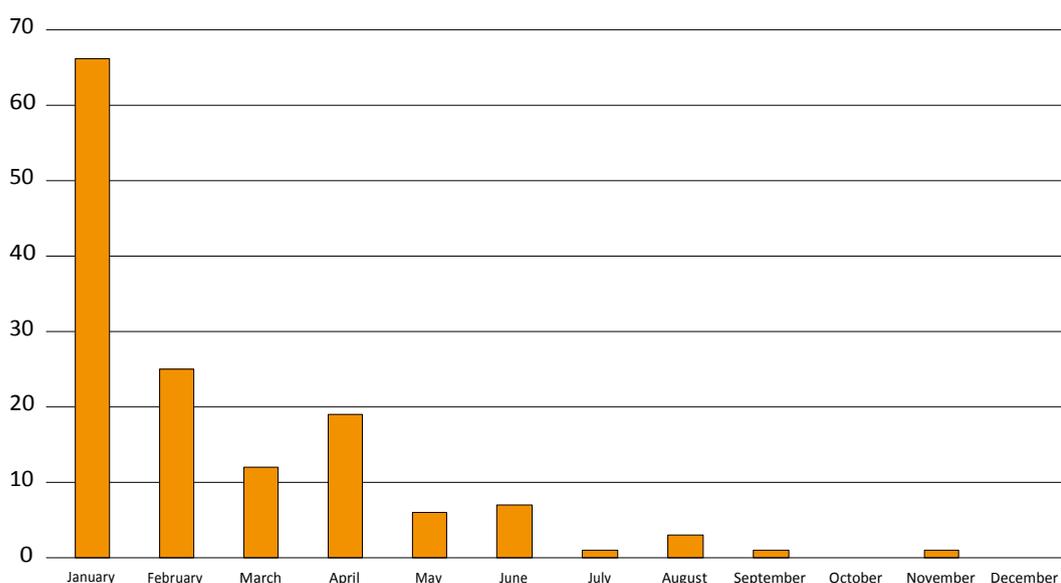
**Figure 24.** Wind damage after the storm Gudrun in southern Sweden on 8 January 2005. (Photo by Kristina Blennow)

for dairy farms. At this time, the Swedish security system was stretched to its limits and there could have been more severe consequences had not favourable circumstances, such as mild weather, mitigated the situation.

In Lithuania during the same storm fallen trees caused an almost complete collapse of the power supply, leaving 1.4 million people without electricity. While in Lithuania for most subscribers the power was back within a week, power outage caused a 23 days long emergency situation in Latvia.

After the Gudrun wind damage event the landscape was dramatically changed in many ways. There were reports that people were unable to find their way home in areas where they had spent most of their lives, and people had to cope with the forest that they had spent a life-time tending being destroyed. Some individuals have been reported even to have committed suicide because of the devastating consequences of the storm. One year after the storm approximately one third of the respondents to a questionnaire to private individual forest owners in the affected part of Sweden claimed that their well-being was reduced.

Wind is an important dynamic factor for forest ecosystems with the areas affected by wind damage ranging from small-scale gaps to large-scale tracts. Recently it has been shown that the wind exposure also affects the remaining forest; the growth of the remaining spruce forest in the affected region in Sweden was reduced by 3 mill. m<sup>3</sup> during the three years following Gudrun. The impacts of wind damage to forest on the biodiversity depend to a large extent on the post-storm management. The changes will affect both fauna and flora and wind felled logs in the forest may reduce access to the forest for activities such as mushroom and berry picking which are highly valued activ-



**Figure 25.** Number of accidents to Swedish workers in clear-up after the 'Gudrun' storm damage in Sweden during 2005. Data source Arbetsmiljöverket.

ities in many European countries. At present we don't know to what extent wind damage affects the availability of berries and mushrooms but recreation activities such as trekking and sport in the forest can be disrupted, generating losses in the local tourism sector. In contrast the availability of game for hunting may increase after a wind damage event. Road accidents have been reported to increase as a consequence of larger game populations resulting from higher availability of food in wind damaged areas.

### Accidents

Accidents and casualties from wind damage to forest result both directly from falling trees, and indirectly from work in salvage harvesting, work in association with repair of damaged infrastructure, and because of consequences from power failure caused by fallen trees. Seven people were killed in Sweden by falling trees and other objects during the night of the Gudrun storm. The clean-up work after a wind damage event often involves extremely dangerous work (Figure 25). Indeed, the number of reported accidents per volume harvested timber in Sweden was double in 2005 to that in the year before the storm. During 2005, 141 working accidents were reported from the clean-up work and up to January 2006 11 fatal working-related accidents had been reported. The number of accidents is, however, likely to be underestimated since workers involved in accidents are known often not to report the accident.

Furthermore, only accidents by individuals registered in Sweden are included in the statistics for Sweden even though workers from several countries were involved in the salvage work.

### The utilitarian versus the rights-based approach to valuation and risk-taking

A risk is usually conceived of as a combination of probability and effect. The probability tells us how likely it is that something will happen. The effect tells us the importance of the consequences if it happens. If a risk is large or small is thus a question both of how probable it is that something will happen, and how important the consequences. Risks and possible benefits can then be weighed in different ways. If our aim is only to maximize the total amount of benefits and minimize the total amount of negative effects for the whole population, it is called a utilitarian approach. If we include other things such as a fair distribution, respect for individual rights or the dignity of our acts as such among our aims, we call it a rights-based or deontological approach.

Risk is the combination of the probability of a damaging event and the consequences if such an event occurs. The impact and value of the consequences depends on who is making the judgement and could be very different for a private individual, a forester, a sawmill owner, or the regional or national governments. Therefore, even though the probability of a damaging event is the same for everyone, the risk will be different.

Storms do occur from time to time. There is not much we can do about that. Storms may even get more common with climate change and the sensitivity of the forest to wind is expected to increase with climate change. Hence, the probability of wind damage is expected to increase. Sometimes people take a defeatist approach to wind damage. The probability of wind damage is, however, strongly dependent on the way we manage the forest, and we do have plenty of opportunity to modulate the probability of wind damage to the forest. We could even remove the risk of wind damage by cutting down all trees if we wanted to. Forest management options for modulating the probability of wind damage include choice of silviculture system, spatial planning, modification of the thinning regime, and the choice of tree species, as described in more detail in Chapters 2.3 and 4.2.

How negative are the consequences of the wind damage is obviously a matter of valuation. The valuation of the wind damage can be done in different ways. When the society is weighing risks and benefits it generally takes a utilitarian approach, meaning that it concerns itself with the total sum of good and bad effects for the whole society. The valuation of the direct effect of wind damage to forest is traditionally made in this way for instance in terms of the percent of national growing stock damaged by wind.

Risks and benefits are however rarely distributed equally through a society. If the national growing stock is large, even extensive local damage will amount to only a small fraction of the national growing stock. If we look again at the effects of the Gudrun event, we notice that it damaged only 2–3% of the total growing stock of forest in Sweden, and the damage was concentrated in a small part of the country (Figure 21). When we look at the access to timber for the industry and the costs to society (i.e. the taxpayers) it makes sense to take an overall view. We then discover that the effects were noticeable but not devastating. If we however look at other effects such as the financial effects from loss of revenues, being without electricity or communication for several weeks, the emotional costs of seeing a forest you have spent your life tending being wiped out in one night, or even being crushed under a falling tree, the picture is very different. In these cases it does not seem to make sense to look at the total or even the average costs since in fact a small (relative to the whole population) number of people had to bear the entire burden, and that was in many cases a devastatingly large burden for an individual.

## Values at stake

To claim that something has value can in fact mean many different things. It is often convenient to as far as possible express all values in monetary terms since by doing so it is possible to weigh them on the same scale, and to fit them into existing accounting systems. This is, however, not always possible and it is commonly acknowledged that there is no perfect way of doing this. One reason for this is that not everything is or can be sold for money on a market. Take for example the relationship a forest owner has with a forest he planted together with his grandfather and that he has lived with all his life and is now tending with his granddaughter. Something that cannot be sold on the market means that putting a monetary value on it will be somewhat artificial and it is not clear that it can be measured on the same scale as something that has real monetary value because of real transactions in a real market. Another problem with translating all kinds of value into monetary value is that we lose information in the process. There can be many different reasons why someone wants to buy something on the market. It might be because she values it as an end in itself, because she sees a value in it as a tool for achieving some other value, or because she expects you to value it and plans to sell it to you. All these motives can be transformed into a demand on a market and measured in monetary terms, but when planning our own lives as well as our everyday decisions it is still useful to distinguish between different motives. The same goes for those who are in charge of a community or a whole country. We believe it is of particular importance to distinguish between instrumental values and final values. That something has a final value means that it is valuable as an end in its own right. You might say that it is the ultimate goal of your act or decision – the thing you value not because of what it can further accomplish but for what it is in itself. An instrumental value then is something that only has value because it helps you to accomplish your final values.

## Ethically sound risk management

For so long as we want to have forests there will be a risk of wind damage. To actively manage the risk we need to understand the causal relationships (Chapter 2), how we can modulate the probability of wind damage (Chapter 4.2), and what are the effects following inaction as well as action (Chapters 4.1 and 4.3). But we also need to clarify what are the ultimate consequences of our decisions. To avoid regretting a decision if the risk materializes, it is rational to consider different possible future states, including the undesired ones before coming to a decision. Our causal knowledge then gives us the opportunity to prioritize between management options and to choose an option so that we can avoid situations in which our ultimate ends are not fulfilled. Sometimes one has to come to a compromise and that can only be done by the individual from his or her own subjective perspective.

As we have seen, wind damage to forests has effects that reach outside of the forestry sector. This means that to be able to manage the forest in a sound way we need to consider not only the volume of timber and wood that is at risk of being damaged but also what type of values are at risk and for whom. We also need to openly discuss what ethical basis we use for our decisions. As we noticed above, values and damages are usually weighed in a utilitarian fashion. This might, or might not be the best way of doing it but we believe it should be clearly stated and open for debate and improvement.

Whether we use a utilitarian approach and aim only for maximizing the total value, or if we also want to find a fair distribution of value, or a solution based on respecting certain basic rights, we will need some way of dealing with the sometimes rather complex and entangled web of different values that are at stake. As we have seen, the method of coding all values in monetary terms is very useful for making comparisons but it has drawbacks. This is not a reason to abandon the idea however. Instead, we need to complement it with a method for keeping track of the different kinds of values involved, and of the relations between them. Such methods are currently being developed by social economists.

### Recommended reading

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