





Barry Gardiner

(EFI Atlantic, Bordeaux, France and Forest Research, Scotland, UK) + Mart-Jan Schelhaas (Alterra, Netherlands), Kristina Blennow (SLU, Sweden), Christophe Orazio (EFI Atlantic, France) and Guy Landmann (GIP-Ecofor, France)

Wind Storms and Forest Losses

A Brief History of Wind Damage to European Forests







- Review wind damage to European forests: 1950-2010
- Discuss factors influencing vulnerability to wind damage
- Review tools available to assist forest managers and planners
- Summary

Project funded by DG Environment in support of Green Paper on "On Forest Protection and Information in the EU: Preparing forests for climate change"





































Storm Damage as Percentage of Growing Stock





www.forestresearch.gov.uk www.efi.int

Schelhaas (2008)

Storm Damage Classification



- Primary Damage (~ day)
 - Direct damage to forest during the storm
 - Injury to people, and damage and disruption to infrastructure
- Secondary Damage (~ weeks to years)
 - Further damage to forest from other agents (primarily biotic)
 - Impact on biodiversity
 - GHG release from disturbed soils
- Tertiary Damage (~ years to decades)
 - Impacts on markets and prices
 - Long term impact on resource availability
 - Effect on employment
 - Damage to forest ecosystem services (biodiversity, water quality, recreation, carbon sequestration, etc.)

Damage from Storms Gudrun, Kyrill, and Klaus



| | Storm | | | | | | | | | | | | | | |
|-----------|---|--|---|--|--|--|--|--|--|--|--|--|--|--|--|
| | GS = Growing Stock, AF = Annual Felling. European Annual Felling ~ 470Mm ³ | | | | | | | | | | | | | | |
| Damage | Gudrun (8 th – 9 th Jan 2005) | Kyrill (18 th Jan 2007) | Klaus (24 th Jan 2009) | | | | | | | | | | | | |
| Primary | • 77.5Mm ³ timber damaged | • 52-54 Mm ³ timber damaged | • 45 Mm ³ timber damaged | | | | | | | | | | | | |
| | • 270,000ha affected in | • 1.1% GS, 57% AF | 684,000ha affected in | | | | | | | | | | | | |
| | Sweden | 45 people killed | France | | | | | | | | | | | | |
| | • 2.3% GS, 96% AF | • €3.5 billion cost to insurance | • 1.8% GS, 100% AF | | | | | | | | | | | | |
| | • 20 people killed | industry | 31 people killed | | | | | | | | | | | | |
| | | | • 1.7M homes without power | | | | | | | | | | | | |
| Secondary | 3Mm³ additional timber | Low impact of bark beetle | Not yet assessed | | | | | | | | | | | | |
| | destroyed by bark beetle | possibly due to cold weather | | | | | | | | | | | | | |
| Tertiary | 1600 accidents clearing up | Market remained stable | Prices reduced from €1- | | | | | | | | | | | | |
| | damage | because of wood shortage | 45/m ³ to €1-10/m ³ | | | | | | | | | | | | |
| | Tax reduced by €5/m³ for | in region | Likely gap in resource over | | | | | | | | | | | | |
| | damaged timber | €1 billion lost in revenue | next 15 years | | | | | | | | | | | | |





Components Affecting Wind Risk of Trees





Impact of Topography on Damage Location Forest Research



Factors Controlling Wind Damage



- Gust peak wind speeds can be roughly ascribed to different levels of damage (Low < 100 km/h, Moderate 20 km/h-140 km/h, High > 140 km/h)
- Topography can have large impact on wind speeds and damage location
- Vulnerability to wind damage is mainly a function of tree height.
- Both broadleaf and conifer species can be relatively wind stable or unstable
- Soil condition is very important and rooting strength is particularly influenced by water-logging and heavy rain prior to damaging storms
- Recent thinning often associated with increased wind damage
- Stand structure (e.g. irregular versus regular) appears to have little influence on stability but the evidence is contradictory
- Mixed species stands including more stable species do not appear to have any additional stability benefit.









Mapping Wind Risk





www.forestresearch.gov.uk www.efi.int

5

6

















Online European Storm Catalogue In preparation

Forest Research

| 🕹 EFIATLANTIC - Storm catalogue - Mozilla Firefox | | | | | | | | | | | | | | <u>_8×</u> | | | | | | | | | | | | | | | |
|--|--|--------------------------------|------------|-----------------------------|--------------------------|----|----------------------------|-----|------------------------------|----|--------------------|------------------|--|------------|--------------------------|------------------------------------|------------|-----------------------------------|---------------------|------------------|-----------------------------------|----------------------------|-------------------------------|----|--|----|-------|----------|------------------------|
| <u>Eile E</u> dit | ⊻ie | w Hi <u>s</u> tory <u>B</u> oo | kmarks | ; <u>T</u> ools <u>H</u> el | p | | | | | | | | | | | | | | | | | | | | | | | | |
| $\langle \rangle \rangle$ | 🤇 🗁 🖻 🗶 🏠 👎 http://w3.pierroton.inra.fr/IEFC/bdd/storm/storm_liste.php 🗘 🖓 Kryrill damage images | | | | | | | | | | | | | | P | | | | | | | | | | | | | | |
| 🧟 Most Visited 🗋 Getting Started 🔊 Latest Headlines 🗋 Customize Links 🗋 Free Hotmail 📋 Windows Marketplace 📋 Windows Media 📋 Windows Media | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 🚱 QUEST: Meetings and activit 🗵 🥁 ACER Aspire 1810TZ 📧 🔄 Carte et Plan Pessac ViaMich 🗵 📫 Meltwater Drive: Workflow 📧 💶 DRAAF Aquitaine - DDTM et 🗵 🔧 Google Image Result for htt 🗵 👎 EFIATLANTIC - Storm ca 🔯 🛃 | | | | | | | | | | | | | | | n ca 🔀 🔄 – | | | | | | | | | | | | | | |
| References | | | | | | | | | | | | Filter Country = | | | | | | · | | | | | | | | | | | |
| | | | | | | | F | Cui | opean | S | torms | s C | atalog | gue | è | | | | | | | Event ID = Vear = [All] | | | | | | | |
| Number of matching rows : 316 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ID 3 | Year | Date | Even ID | ^t Country | Area affected (ha) | QA | Primary damage (Mm3) | Q1 | Secondary damage (Mm3) | Q2 | Tertiary damage | Q3 | Estimated Growing Stock (Mm3) | QG | % of Growing Stock | XXXX Annual Harvest (Mm3) | хххх он | XXXX % of Annual Harvest | f Removals (Mm3) | % of Removals | Maximum Wind Speed (m/s) | QW | Duration of Storm (Hrs) | QD | Value (Euro) ir Year FOREST Damage | QV | email | accepted | last_update |
| See storm 1 1 | 1950 | August 23 | 1 | Netherlands | | | | | | | | | 16.80 | | 0.00 | | | | 0.94 | | | | | | | | | yes | 2010-04-01 12:19:50 |
| See storm 1 2 | 1951 | December 30 | 2 | UK | | | 0.12 | 3 | | | | | 114.56 | | 0.00 | | | | 4.00 | | 37 | 3 | | | | | | yes | 2010-04-01 12:19:57 |
| See storm 1 3 | 1952 | February 11 | 3 | Denmark | | | 0.36 | 3 | | | | | 40.20 | | 0.01 | | | | 2.03 | | | | | | | | | yes | 2010-04-01 12:20:25 |
| See storm 1 4 | 1952 | May 4 | 4 | Germany | | | 0.06 | 3 | | | | | 1329.04 | | 0.00 | | | | 50.74 | 18.00 | | | | | | | | yes | 2010-04-01 12:20:29 |
| See storm 1 5 | 1952 | November 26-27 | 5 | France | | | | | | | | | 861.42 | | 0.00 | | | | 40.31 | | | | | | | | | yes | 2010-04-01 12:20:56 |
| See storm 1 6 | 1952 | December 12-13 | б | France | | | 0.70 | 3 | | | | | 861.42 | | 0.00 | | | | 40.31 | | | | | | | | | yes | 2010-04-01 12:22:04 |
| See storm 1 7 | 1953 | January 31 | 7 | UK | | | 1.80 | 3 | | | | | 124.69 | | 0.01 | | | 5.00 | 3.69 | | 76 | 2 | 7 | 2 | 5820000 | 2 | | yes | 2010-04-01 12:22:07 |
| See storm 1 8 | 1953 | February 1 | 7 | Netherlands | | | | | | | | | 15.34 | | 0.00 | | | | 0.93 | | | | | | | | | yes | 2010-04-01 12:22:10 |
| See storm 1 9 | 1953 | February 21 | 8 | Denmark | | | 0.10 | 3 | | | | | 40.70 | | 0.00 | | | | 2.05 | 61.90 | | | | | | | | yes | 2010-04-01 12:22:15 |
| See | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 2010.04.01 |
| Done | _ | | | _ | _ | _ | | | | _ | | _ | _ | | | | | _ | | | | | | | | | | | |





- Wind damage to forests has increased in Europe over the last 50 years
- Wind now causes more than 50% by volume of all forest damage
- Number of storms has not apparently increased
- No clear indication yet that storm intensity/frequency will increase due to climate change but need to account for changing temperature and rainfall
- Storm damage is a common phenomena at a European level but may be infrequent at a national level
- Recent forest damage from storms is strongly linked to growing stock
- Wind damage is a complex interaction between wind speed, storm duration, topography, site conditions and stand conditions
- Tree height, water-logging and recent thinning are strongly related to wind damage
- Tools exist to help predict the probability of wind damage
- Informed management can reduce the risk and incidence of wind damage







