European Commission

# Database of European Forest Insect & Disease Disturbances – DEFID2

## Protocol for data collection

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Ips typographus outbreak in Lower Saxony due to climate change/abandoned spruce plantations. Bienenfreund2018 / CC BY-SA.

## 1. Rationale and aim

European forests provide a set of fundamental services that contribute to climate mitigation and human well-being. At the same time, forests are vulnerable systems because the long life-span of trees limits their ability to rapidly adapt to drastic environmental changes. Natural disturbances – large pulses of tree mortality that originate from climate-related abiotic and biotic agents such as fires, strong winds or insect and disease outbreaks – are drivers of many ecological processes and can impact on the provision of forest services and products, particularly if they are exacerbated by climate change. Of particular concern are insect and disease impacts, the most destructive biotic forest disturbance, as they affect tens of millions of hectares annually, particularly in temperate regions in the Northern Hemisphere. Impacts associated to these forest losses are expected to rise drastically with global warming and key forest ecosystem services, such as carbon sequestration and supply of wood products, could be seriously compromised in the near future. Examples from other countries, like Canada and the United States, show that biotic disturbances driven by the rapidly changing climate may substantially alter the state of forests to the point that they become carbon sources instead of carbon sinks.

**Despite the risks insect and disease outbreaks pose, there is currently no spatially explicit database of such disturbances across Europe**. However, a multitude of local, national, and transnational initiatives have accurately mapped forest areas affected by insect outbreaks over the last decades. These data represent highly informative observational records for characterizing spatial patterns and severity of forest damage. However, data have been collected by different actors and methods, and are therefore difficult to retrieve or harmonize. The lack of a large-scale consistent reference observational data of insect and disease disturbances is hampering the quantitative assessment of their effects on European forests.

The Joint Research Centre (JRC) of the European Commission aims to **develop a comprehensive spatially explicit database of insect and disease outbreaks in European forests and neighboring regions.** To achieve this, we call for a joint effort of research institutes and forestry services engaged in mapping forest damages due to insect and disease outbreaks. Data recorded and shared by participating institutes will be collected and harmonized in a consistent **Database of European Forest Insect & Disease Disturbances (DEFID2)** covering the 1981- to present period. This dataset will be made freely available and will be periodically updated with new and historical events. **DEFID2 will represent an essential source to improve our capacity to observe, understand, and predict biotic disturbances and quantify their impact on forest ecosystems, their service, and on the land–atmosphere system.**

Data providers and sources will be properly acknowledged. In this respect, results of the planned data collection will be published in a high-profile scientific journal and coauthorship will be offered to all data providers. This initiative develops within the exploratory JRC-funded research project FOREST@RISK ("*Climate-driven risks and adaptation measures for European forests*") and follows a similar, and successful, collaborative effort on wind disturbances in European forests[1]. DEFID2 will be coordinated and curated by the JRC. The JRC conducts research on a range of forest-related topics (https://forest.jrc.ec.europa.eu/en/) and is currently developing the EU Observatory on Deforestation, Forest Degradation, Changes in Forest Cover and Associated Drivers, as part of EU actions to protect and restore the world's forests .

[1] Forzieri, G., Pecchi, M., Girardello, M., Mauri, A., Klaus, M., Nikolov, C., Rüetschi, M., Gardiner, B., Tomaštík, J., Small, D., Nistor, C., Jonikavicius, D., Spinoni, J., Feyen, L., Giannetti, F., Comino, R., Wolynski, A., Pirotti, F., Maistrelli, F., Savulescu, I., Wurpillot-Lucas, S., Karlsson, S., Zieba-Kulawik, K., Strejczek-Jazwinska, P., Mokroš, M., Franz, S., Krejci, L., Haidu, I., Nilsson, M., Wezyk, P., Catani, F., Chen, Y.-Y., Luyssaert, S., Chirici, G., Cescatti, A. and Beck, P. S. A.: A spatially explicit database of wind disturbances in European forests over the period 2000–2018, Earth System Science Data, 12(1), 257–276, doi:10.5194/essd-12-257-2020, 2020.

## 2. Protocol for data collection

In the following lines, we described the DEFID2 common protocol that data providers are encouraged to follow in order to assure consistency. To facilitate this, **the JRC offers technical assistance to help data providers with data restructuring, reformatting, or harmonization**.

- **Contact point.** Data and questions should be sent to JRC-DEFID2@ec.europa.eu.
- **Tentative deadline.** We aim to have a first release of DEFID2 by the end of 2020. Therefore, data should ideally be provided by November 2020.
- **Contents and acquisition methods.** The protocol covers information on the insect(s), the pathogen(s), the host(s), and the spatial extents of the forest areas affected by insect disturbances. Damaged areas can be derived from ground surveys, visual interpretation of aerial or satellite imagery or some form of automatic classification algorithms of remote sensing data.
- **Spatial and temporal coverage**: records of interests should geographically fall within geographic Europe, European Russia, Northern Africa and Middle East in the 1981-to-present period.
- **Geographical format.** Each record of insect disturbance should be represented as a polygon feature in shapefile format (.shp). The geometry of a feature should outline the forest area damaged by a given insect disturbance (information on severity reported in the following descriptive attributes). Records should be geo-referenced in geographical coordinates, i.e. latitude and longitude, following the WGS84 reference system (EPSG:4326). In case the same disturbance event is monitored through time, the evolution of the extents of the damaged forest should be tracked by separate polygon features, one for each observation date/year. Attributes of each disturbance should be provided in an associated table, stored in a .dbf file. In case data will be provided in raster format (e.g., output of classification of remote sensing data), the JRC will transform the data into vector format using conventional segmentation tools.
- **Descriptive attributes.** The selection of the descriptive attributes to be reported in the .dbf file is inspired by the National Insect and Disease Survey (IDS, http://foresthealth.fs.usda.gov) database of the United States Department of Agriculture (USDA). In summary, for each damaged forest patch four different damage types can be recorded (defoliation, discoloration, mortality, dieback). Each damage type can be characterized by a different severity/pattern of damage, by two dominant agents and by the two most affected host tree species. Furthermore, each forest patch can be characterized by the two dominant climate-driven triggering factors, by silvicultural practices and eventual sanitary interventions.

  The descriptive attributes are grouped in three sets, based on their importance for DEFID2:

  - Set 1: Essential information in order to include the record in the database
  - Set 2: complementary information mostly related to occurrences characterized by multiple agents or multiple hosts, climate-driven triggering factors and silvicultural practices.
  - Set 3: qualitative assessment of the damage.

The following table provides names and descriptions of each attribute, while the domain value of each variable are described in the subsequent sections.

| Attribute name | SHP File Field name | Description | Set | Field Type | Values |
|---|---|---|---|---|---|
| SURVEYdate | SURVEYdate | Date of observation | 1 | Date | |
| METHOD | METHOD | Data acquisition method | 1 | Short integer | -1, 1, 2, 3, 4 |
| PROVIDER | PROVIDER | Data provider | 1 | Text | |
| SEV_ DEF | SEV_ DEF | Severity of defoliation | 1 | Short integer | -1, 1, 2 |
| SEV _DIS | SEV _DIS | Severity of discoloration | 1 | Short integer | -1, 1, 2 |
| SEV _MOR | SEV _MOR | Severity of mortality | 1 | Short integer | -1, 1, 2, 3, 4, 5 |
| SEV _DIE | SEV _DIE | Severity of dieback | 1 | Short integer | -1, 1, 2 |
| AGENT1name | AGENT1name | Name of primary biotic agent causing defoliation/discoloration/mortality/dieback | 1 | Text | |
| HOST1name_DEF | HOST1n_DEF | Name of primary host tree species affected by defoliation | 1 | Text | |
| HOST1name_DIS | HOST1n_DIS | Name of primary host tree species affected by discoloration | 1 | Text | |
| HOST1name_MOR | HOST1n_MOR | Name of primary host tree species affected by mortality | 1 | Text | |
| HOST1name_DIE | HOST1n_DIE | Name of primary host tree species affected by dieback | 1 | Text | |
| AGENT2name | AGENT2name | Name of secondary biotic agent causing defoliation/discoloration/mortality/dieback | 2 | Text | |
| HOST2name_DEF | HOST2n_DEF | Name of secondary host tree species affected by defoliation | 2 | Text | -1, 1, 2 |
| HOST2name_DIS | HOST2n_DIS | Name of secondary host tree species affected by discoloration | 2 | Text | -1, 1, 2 |
| HOST2name_MOR | HOST2n_MOR | Name of secondary host tree species affected by mortality | 2 | Text | -1, 1, 2, 3, 4, 5 |
| HOST2name_DIE | HOST2n_DIE | Name of secondary host tree species affected by dieback | 2 | Text | -1, 1, 2 |
| TRIGGER1type | TRIGGER1ty | Type of primary climate-driven triggering factor | 2 | Short integer | -1, 1, 2, 3, 4, 5, 6 |
| TRIGGER2type | TRIGGER2ty | Type of secondary climate-driven triggering factor | 2 | Short integer | -1, 1, 2, 3, 4, 5, 6 |
| TRIGGER1date | TRIGGER1da | Date of occurrence of primary climate-driven triggering factor | 2 | Date | |
| TRIGGER2date | TRIGGER2da | Date of occurrence of secondary climate-driven triggering factor | 2 | Date | |
| FM_SILVItype | FM_SILVIty | Type of silvicultural system of the damaged forest patch | 2 | Short integer | -1, 1, 2, 3, 4 |
| FM_SANItype | FM_SANIty | Type of sanitary intervention of the damaged forest patch | 2 | Short integer | -1, 1, 2, 3 |
| FM_SANIdate | FM_SANIda | Date of the sanitary intervention of the damaged forest patch | 2 | Date | |
| PATTERN_DEF | PATTERN_DE | Defoliation pattern | 3 | Short integer | -1, 1, 2, 3, 4 |
| PATTERN_DIS | PATTERN_DI | Discoloration pattern | 3 | Short integer | -1, 1, 2, 3, 4 |
| PATTERN_MOR | PATTERN_MO | Mortality pattern | 3 | Short integer | -1, 1, 2, 3, 4 |
| PATTERN_DIE | PATTERN_DB | Dieback pattern | 3 | Short integer | -1, 1, 2, 3, 4 |

Table 1. List of relevant descriptive attributes

**3. Definition and value of attributes**

**SURVEYdate**
Shape File Field Name: SURVEYdate
Definition: Date of observation
Attribute value: -1 No data
YYYY/MM/DD

**METHOD**
Shape File Field Name: METHOD
Definition: Data acquisition method
Attribute value: -1 No data
1 Aerial photointerpretation
2 Satellite photointerpretation
3 Remote sensing classification
4 Field surveys

**PROVIDER**
Shape File Field Name: PROVIDER
Definition: Data provider
Attribute value: Text field (e.g. National Forest Centre, Forest Research Institute Zvolen, Zvolen, Slovakia)

**SEV_DEF**
Shape File Field Name: SEV_DEF
Definition: Severity of defoliation damage type
Attribute value: -1 No data
1 Low (Equal or less than 50% defoliation)
2 High (More then 50% defoliation)

**SEV_DIS**
Shape File Field Name: SEV_DIS
Definition: Severity of discoloration damage type
Attribute value: -1 No data
1 Low (Equal or less than 50% defoliation)
2 High (More then 50% defoliation)

**SEV_MOR**
Shape File Field Name: SEV_MOR
Definition: Severity of mortality damage type
Attribute value: -1 No data
1 Marginally affected (percentage of killed trees ≤ 20%)
2 Moderately affected (20% < percentage of killed trees ≤ 40%)
3 Substantially affected (40% < percentage of killed trees ≤ 60%)
4 Highly affected (60% < percentage of killed trees ≤ 80%)
5 Totally affected (80% < percentage of killed trees ≤ 100%)

**SEV_DIE**
Shape File Field Name: SEV_DIE
Definition: Severity of dieback damage type
Attribute value: -1 No data
1 Low (Equal or less than 50% defoliation)
2 High (More then 50% defoliation)

**AGENT1name**
Shape File Field Name: AGENT1name
Definition: Name of primary biotic agent causing defoliation / discoloration / mortality / dieback
Attribute value: -1 No data
Scientific name of damage causing biotic agent

**HOST1name_DEF / HOST1name_DIS / HOST1name _MOR / HOST1name _DIE**
Shape File Field Names: HOST1n_DEF / HOST1n_DIS / HOST1n _MOR / HOST1n _DIE
Definition: Name of primary host tree species affected by defoliation / discoloration / mortality / dieback
Attribute value: -1 No data
Scientific name of host tree species

**AGENT2name**
Shape File Field Name: AGENT2name
Definition: Name of secondary biotic agent causing defoliation / discoloration / mortality / dieback
Attribute value: -1 No data
Scientific name of damage causing biotic agent

**HOST2name_DEF / HOST2name_DIS / HOST2name _MOR / HOST2name _DIE**
Shape File Field Names: HOST2n_DEF / HOST2n_DIS / HOST2n _MOR / HOST2n _DIE
Definition: Name of secondary host tree species affected by defoliation / discoloration / mortality / dieback
Attribute value: -1 No data
Scientific name of host tree species

**TRIGGER1type / TRIGGER2type**
Shape File Field Name: TRIGGER1ty / TRIGGER2ty
Definition: Type of the primary / secondary climate-driven triggering factor
Attribute value: -1 No data
1 Droughts
2 Heatwave
3 Wind
4 Fires
5 Snow and ice
6 Pest

**TRIGGER1date / TRIGGER2date**
Shape File Field Name: TRIGGER1da / TRIGGER2da
Definition: Date of the primary / secondary climate-driven triggering factor
Attribute value: -1 No data
YYYY/MM/DD

**FM_SILVItype**
Shape File Field Name: FM_SILVIty
Definition: Type of silvicultural system of the damaged forest patch
Attribute value: -1 No data
1 Clear cut
2 Shelterwood
3 Selective logging
4 None

**FM_SANItype**
Shape File Field Name: FM_SANIty
Definition: Type of sanitary intervention of the damaged forest patch
Attribute Value: -1 No data
1 Clear cut
2 Selective logging
3 None

**FM_SANIdate**
Shape File Field Name: FM_SANIda
Definition: Date of the sanitary intervention of the damaged forest patch
Attribute value: -1 No data
YYYY/MM/DD

**PATTERN_DEF / PATTERN_DIS / PATTERN_MOR / PATTERN_DIE**
Shape File Field Names: PATTERN_DE / PATTERN_DI / PATTERN_MO / PATTERN_DB
Definition: Defoliation / Discoloration / Mortality / Dieback pattern
Attribute value: -1 No data
1 Host type or species is > 50% and the damage is contiguous
2 Host type or species is > 50% and the damage is patchy (concentrated in discrete pockets or individual trees)
3 Host type or species is < 50% and the damage is contiguous
4 Host type or species is < 50% and the damage is contiguous

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