

### 3. Damage survey

#### 3.1 Principles

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### 3. DAMAGE SURVEY

#### 3.1. Principles

The aim of the damage survey is to provide reliable information for further action and planning at local, regional and national level. This should cover the type and extent of the damage, the volume of affected trees, the expected product mix, and the geographical extent of the damaged areas.

**The three major applicable inventory methods are as follows:**

- ◆ terrestrial survey;
- ◆ remote sensing based survey;
- ◆ combinations of the above.

**Factors to consider in choosing the inventory method are:**

- ◆ the need for preliminary information about the scale and extent of the damage;
- ◆ the economic and ecological importance of the affected forest stands;
- ◆ the availability of resources (equipment, staff, organisations and funds);
- ◆ the available information base (inventory data, management plans, maps, aerial photographs);
- ◆ weather and light conditions;
- ◆ accessibility on foot and by vehicle;
- ◆ type of damage (avalanches and mudflows can hinder terrestrial methods);
- ◆ time horizon, schedule for inventory and for sanitary action;
- ◆ additional utilisation of survey results.

In choosing the best method the first step is to define the desired output of the survey, its content, accuracy and reliability and the time horizon. After designing the possible ways for reaching the output the final decision can be based on a proper cost-benefit evaluation.

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**A clear distinction should be made between 2 types of survey:**

**a: First assessment**

Aim: to identify the scale of problem  
Time frame: one week to one month

**b: Detailed survey**

Aim: to collect all relevant information on the damage  
Time frame: one month to 2 years

Only the first assessment need concern the Forest Damage Committee. Because of the need for early information this type of survey can rely on sampling. The more detailed assessment for operational purposes can be left to the individual ownership and their existing management and inventory staff.

Surveys should only be planned by professionals, especially when remote sensing techniques are applied. Survey crews can be either professionals or nonprofessionals under expert direction. In some cases unique or new survey techniques are necessary, but in general traditional methods should be preferred.

Since there is a strong time pressure on completing the first assessment every forester and forest owner should be made aware of the format of any information requirements and to whom it should be supplied. Detailed surveys having a wider time horizon can be tailored to meet the demands of each specific case. Therefore it is recommended that individual countries develop their own procedures for the initial assessment. For detailed survey only the principles need to be defined.

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#### 3.2 Survey methods

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##### 3.2.1. Terrestrial survey

This method can be used in cases of local damage of relatively small extent, or when high quality stands are damaged and the exploitable wood has high economic value. It should also be applied if the weather conditions are too bad for a remote sensing based survey. Up-to-date information in forestry data bases or in management plans can facilitate the work.

#### Procedures:

1. Obtain maps of a suitable scale (1:5 000 or 1:10 000).
2. Estimate resource requirements and expected costs.
3. Carry out systematic terrestrial survey at the compartment level using specially designed forms for recording data (see Appendix 3.1 and 3.2).
4. Process the inventory data to provide information on :
  - ◆ type of damage;
  - ◆ volume of damaged timber by species groups, size classes and ownership;
  - ◆ proportion of exploitable timber;
  - ◆ aggregate by ownership/district/region.
5. Reconnaissance flights by aeroplane or helicopter can help the preparatory work of the terrestrial survey. Such flights can also be used for verifying the extent of the damage.

With the help of the first assessment a flight-plan has to be developed on a largescale map indicating the route of the aeroplane above the surface. Easily identifiable objects have to be chosen in advance in order to help the orientation.

If data is available from previous inventories of the forest and this can be updated then the field work need only involve measuring the spatial extent and the intensity of the damage.

The necessary data for each compartment can be recalled from the database or calculated from management plans.

**These data are:** tree-species

age  
density  
DBH  
height  
volume

Assortments can be assessed with the help of DBH, height, stem quality for each tree species, but the type of damage that determines the quality of damaged stems should also be taken into consideration.

The volume in each size class or product type can be calculated using information on DBH, height and stem quality. Allowance must also be made for loss of volume and degrade due to the damage.

### 3.2.2 Reconnaissance flights

This survey method can be used to support and verify the terrestrial survey. Using a helicopter or a light aircraft information can be quickly collected for planning the terrestrial survey. In some cases when neither terrestrial nor remote sensing survey is possible this method can be used, but the results have to be treated very carefully. Additional terrestrial control measures improve the reliability.

**During reconnaissance flights the following materials are necessary:**

- ◆ maps;
- ◆ photos;
- ◆ note pad;
- ◆ tape recorder;
- ◆ video camcorder or photo camera.

**The crew has to consist of:**

- ◆ pilot;
- ◆ foresters of the affected area;
- ◆ cameraman.

If the aim of the flight is to prepare for the terrestrial survey, sketches and some photos provide enough information for planning further activities. For preparing flight plans see also Chapter 3.2.1.

Flight plans for reconnaissance flights do not have such strict rules as those required for remote sensing, but it is wise to ask for the help of experienced professionals.

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##### 3.2.3 Remote sensing based survey

This method is relatively expensive, but in case of damages affecting large areas this can be the only way to provide information within an acceptable period of time. The most frequent way of using remote sensing is the application of stereoscopic photos taken from aeroplanes or satellite images.

**Application of any remote sensing technique can be chosen on the basis of detailed feasibility study which takes into account the following factors:**

- ◆ information, the survey should provide (area, volume, tree species composition, etc.)
- ◆ assessment of other possible utilisation of the photos or looking for potential partners for the venture
- ◆ assessment of the total costs for the survey
- ◆ cost - benefit evaluation.

##### **Choosing photo type and scale**

The type of the photos and the way of interpretation depend on the scale of the damage and the additional aims of the survey.

In general, black and white photos provide enough information for surveying damages caused by abiotic factors such as storm, snowfall, avalanche, earthquake, fire and by some biotic factors, such as occasional insect invasion.

The scale of the photos depends on the type and extent of the damage. For large scale survey scale 1 : 15 000 - 1 : 30 000 are suggested. Photos with scale 1 : 5 000 - 1 : 15 000 can be used almost in every cases and with a help of subsequent optical exaggeration they can meet special demands too.

In those cases where tree level survey is necessary at least scale 1 : 5 000 or larger is required.

**Before the survey a proper flight-plan should be developed.**

**This plan should consist of the following information:**

- ◆ flight identifier
- ◆ No. of rows
- ◆ length of rows
- ◆ overlay factor
- ◆ flying height
- ◆ film type

A map illustrating the route of the aeroplane should be an Appendix to the plan. Flight-plans can be developed only by professionals.

### **Photointerpretation**

The application of STEREOCORD or similar equipments and GIS can shorten the period of interpretation and can save labour. On the other hand GIS helps to create interrelations between geographical data and existing inventory data so the volume of damaged wood and other related informations can easily be calculated.

**The total cost is the sum of the following items:**

- ◆ cost of the flight
- ◆ cost of taking photos
- ◆ cost of photointerpretation.

For the cost of remote sensing survey it is adequate to consult professionals who will advise.

In order to decrease the relatively high costs of the flights the possibility of free of charge services has to be explored. Cooperation with military authorities can be an effective way for reducing prices.

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#### 3.3 Activities for damage survey

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##### Activities of the first weeks

The basis for planning the inventory activities is the first assessment of the damage. Therefore the speed of info collection and the similar structure of the reports coming from different sources are relevant. These informations have to provide reliable basis not only for inventory planning but also for informing authorities and public, and also for draft planning of necessary sanitary actions.

To meet these demands the application of a unified data collection form is necessary. The content of this form can vary from country to country depending on the structure and the characteristics of the forestry system, but must contain the following informations:

- ◆ owner of the area
- ◆ district (if any)
- ◆ list of damaged compartments (with proper ID-s)
- ◆ extent of damage within the compartment
- ◆ estimation of damaged volume by species or species-groups
- ◆ expected assortments
- ◆ other relevant informations in free form (remarks)

Appendices 3.I and 3.II show examples for designing forms for the first assessment and for the detailed survey of an acute forest damage.

Data should be collected by foresters/forest owners and forwarded to the local forestry office as soon as possible.

Local forestry office compile the first assessments and informs the regional/x-level forestry office etc.

Information flow is same as described by alarm chart in chapter 2.

**Every forester must know the desired form and the way of reporting damages to complete the work within the time frame.**

To facilitate their work destination of the report should be indicated on the form.

### **Activities of the first months**

**The activities of the first month are as follows:**

- a. survey design on the basis of the first assessment
- b. preparation for the field work
- c. field work of the survey
- d. data processing
- e. compilation of results and reporting.

For designing a survey see also Chapter 3.2.3. Surveys should be designed on the lowest possible level that has full authority and responsibility over the damaged area. After choosing the survey method, labour force, necessary equipments, potential partners should be assessed.

During preparatory works maps, management plans, photos or other information sources should be collected. Field training of the survey crew can also be a part of preparation.

Field work of the survey should preferably be carried out and always be directed by an expert person.

Data processing and compilation of the results also demands professionals. These activities and the field work always should be designed together.