

## 2.4 Expenditure of the Terrestrial Inventory

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The time and financial expenditures of the field work for large-scale inventories are usually not known, or only inadequately known. For the planning and the execution of inventories, the knowledge about the required time for important working stages is indispensable. If these basics are not available, it is difficult to employ personnel and material in a cost efficient way. In the following, the actual expenditures for the terrestrial survey and inquiries are presented in person-hours. The database was based on regular reports (working reports) by the survey team; salary and expense statements; as well as the time that it took to perform the most important working tasks at the sample plots. The time was recorded using a handheld computer. A detailed account of the time and financial expenditures in the second NFI can be found in ZINGGELER and HEROLD (1997).

### 2.4.1 Time Expenditure

#### 2.4.1.1 Expenditures According to Stages of Work

The stages of work distinguished in the second NFI are presented and described in Table 1. The average time for recording one sample plot for the entire country was 9.0 person-hours (Table 2).

In the Jura and Plateau regions, the time for recording one sample plot was slightly more than 7 person-hours. In the Pre-Alps and Alps, the time increased to little less than nine and ten hours, respectively. With 11.7 person-hours used per sample plot, the Southern Alps had the highest time expenditure.

The time expenditure for the recording of one sample plot in the Southern Alps was about 4.5 hours, or close to 40% higher as compared with the Jura. The walking rates in the Southern Alps were two to three times as long as in other regions because of the poorer forest transportation system, as well as the more difficult topographic conditions. Consequently, the total expenditure increased drastically (Fig. 1).

#### 2.4.1.2 Productive Working Time

The proportion of the productive working time, which equaled the expenditure for the actual data gathered at the sample plot, amounted to a total of 35% of the entire working time (without the time for training and control).

With the help of additional time studies at 62 sample plots, it was possible to break down the productive working time even further (Table 3).

The most time expensive tasks were the measurements and observations of an individual tree, with an average of one person-hour used. For measurements at a tariff sample tree (sample tree for which the tree height and stem diameter at a height of 7 meters were measured), an average of 15 minutes was used. The survey of the young growth took about half a person-hour.

The ground and stand assessment together needed approximately the same working time as the survey of the young growth; whereas, describing the stand stability alone took 12 minutes.

The structure of the attribute group "basic decisions and forest edge" was very heterogeneous and included the forest/non-forest decision; the measurements of the sample plot slope; the survey of the accessibility and stocking boundary; and the forest edge boundary.

Permanently marking the sample plot center took little less than half a person-hour, but was not considered productive working time.

Table 1. Subdivision and definitions of the work phases

Phases of the work	Activity	Remarks
Official Trip	Drive from the place of residency, the WSL, the army car depot, the train station, etc. to the survey area and back.	
Drive and preparation	Changing daily accommodations in the survey area as well as driving from one sample plot to another. Expenditure for the daily work plan (sequence of the sample plots visited, best way to the sample plots), final drawing of the sample plot layout sketches and other final work.	
Walk	All of the times needed to walk from the vehicle to the sample plot and return. The rare case of walking directly from one sample plot the next. In the case of measuring the sample plot, the walk to the reference point.	If no measurements were carried out, this phase also includes the work to permanently mark the sample plot center.
Measuring	Measuring the sample plot center, starting from a reference point, whose coordinates were determined in the aerial photograph.	Starts with reaching or finding the reference point and ends with permanently marking the sample plot. Necessary for the first survey. For subsequent inventories, it is necessary only in certain exceptions.
Inventory	Data gathering on the sample plot.	Starts at the end of permanently marking the sample plot center and ends after the attributes have been all assessed.
Enquiry	Data gathering at the local forest service.	Including making appointments with the forester, driving to and from the forester.
Other work time and inactive time	Preparation to survey the sample plot (week plan and month plan), data transfer, keeping up the material, visiting the district forester, public relations.	“Inactive times” are those times, in which, due to bad weather or technical problems, no sample plots were measured.

Table 2. Time expenditure (without expenditure for the headquarters, without control and training) in person hours per sample plot, divided by work phase and region.

Region	Enquiry	Inven- tory	Measure- ment	Walk	Drive and preparation	Official trip	Other and inactive time	Total/ sample plot
Jura	0.5	2.5	0.2	1.1	1.5	0.9	0.5	7.2
Plateau	0.7	2.6	0.3	1.1	1.5	0.7	0.5	7.3
Pre-Alps	0.5	2.7	0.3	1.7	2.1	1.0	0.5	8.9
Alps	0.4	2.7	0.4	2.1	2.1	1.5	0.6	10.0
Southern Alps	0.3	2.4	0.5	3.5	2.3	2.0	0.8	11.7
Switzerland	0.5	2.6	0.4	1.8	1.9	1.2	0.6	9.0

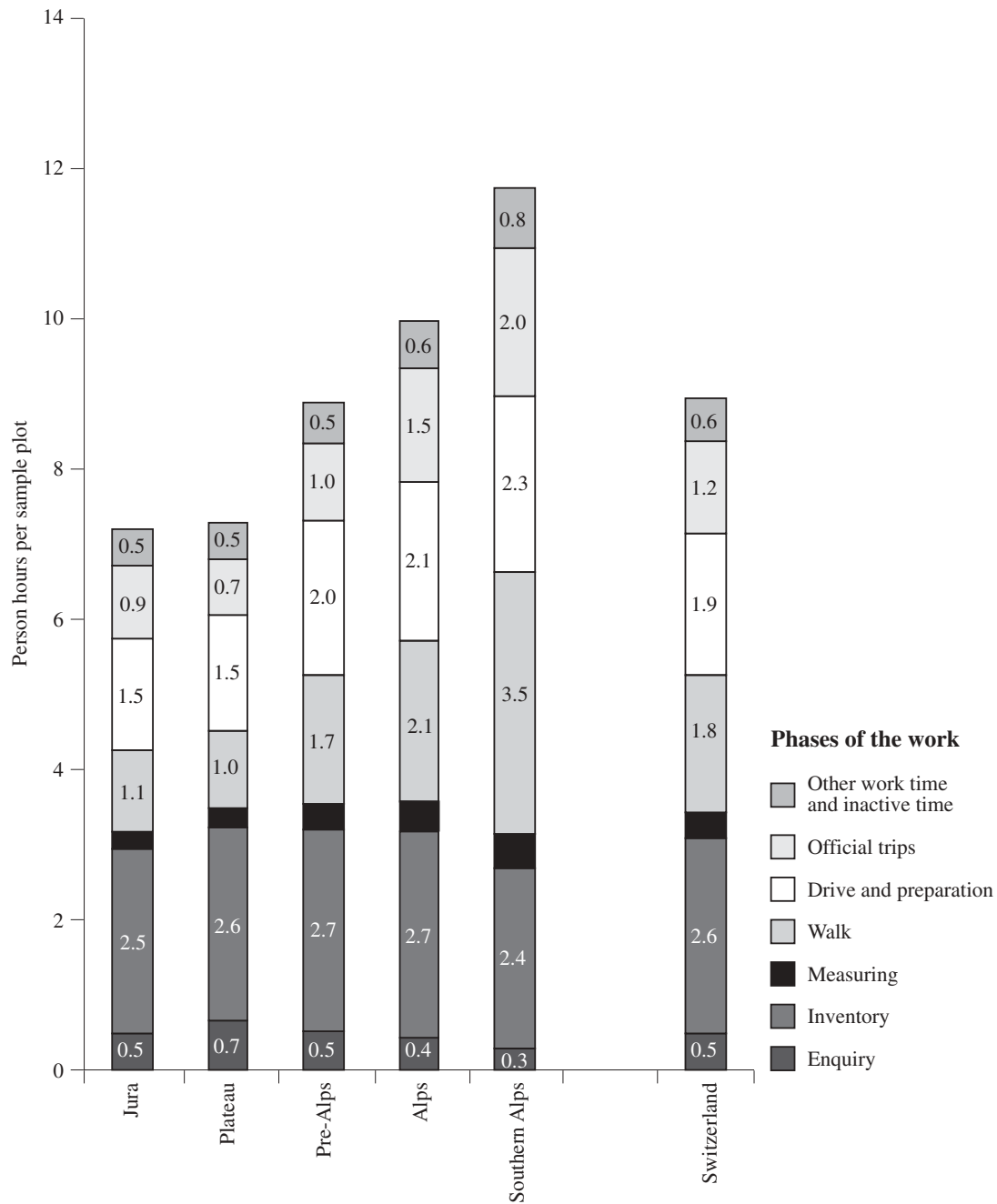


Figure 1. Time expenditure by stages of work in person hours, per sample plot and region (without expenditure for the personal at the headquarters).

Table 3. Time study in respects to the expenditure by attribute group in person work minutes per terrestrial assessed sample plot.

Attribute groups	Person work minutes
Permanent marking of the sample plot	26
Basic decisions and forest edge	14
Individual tree measurements	60
Tariff sample trees	15
Young growth survey	33
Area assessment	10
Stand assessment	9
Stand stability	12

### 2.4.1.3 Training Expenditure

Training the survey team well forms an important basis for the quality of data for the inventory. At the beginning of the field operation, the staff was intensively trained in a course which lasted several days. These instruction courses were supplemented with four to five training courses per year. During the second NFI approximately 6,780 person-hours, or 9.3% of the entire working time, was spent on this type of training.

### 2.4.1.4 Control Survey

The control survey was an independent second survey of the sample plot, which was already measured by the regular survey team. With the help of the control survey (Chapter 2.8, 2.9), it was possible to uncover random and systematic differences between the measurements and the descriptions of individual attributes that were taken between the control team and the survey team.

A total of 6,702 person-hours (=9.2% of the entire working time) were required in order to assess the 752 controlled sample plots, which equalled an average of 9.0 hours per sample plot. The expenditures for the control were, therefore, comparable to those of the regular survey.

## 2.4.2 Ground Survey Expenditures

The expenditures were composed of personnel expenditures (salary and expense reimbursement) of the field staff, their official travels, and the purchase cost of the ground survey equipment that was required.

### 2.4.2.1 Personnel Expenditures

The terrestrial survey of the 6,615 regular sample plots, as well as the additional 752 control sample plots, cost a total of 3.54 million Swiss Francs in the second NFI (only the expenditure for the survey teams, without the board, and including training). The terrestrial survey of one sample plot, therefore, cost 480 Swiss Francs.

The proportion of the labor costs amounted to 83% of the personnel expenditure, and the expense reimbursements amounted to about 17%. Table 4 shows the details of the terrestrial survey expenditures for one sample plot within each of the different survey regions. The average hourly base cost of 47.75 Swiss Francs corresponded to the average of all hourly wages and expense reimbursements of the field staff between the years 1993 and 1995. The fixed expense reimbursements amounted to approximately 10 Swiss Francs per person-hour.

In all of Switzerland the average sample plot expense (without training) consequently added up to 427 Swiss Francs. Compared to the cost presented above of 480 Swiss Francs per sample plot, the difference amounted to 53 Swiss Francs, which corresponded to the training expenditure of the second NFI.

Table 4. Costs of the terrestrial survey for one sample plot without instruction course, training days, and check assessment by regions. Average hourly wage: sFr. 47.75

	Jura	Plateau	Pre-Alps	Alps	Southern Alps	Switzerland
People hour/sample plot	7.2	7.3	8.9	10.0	11.7	9.0
Cost/sample plot (sFr)	Fr 343	Fr 348	Fr 424	Fr 475	Fr 560	Fr 427

#### 2.4.2.2 Equipment of the Teams and Vehicles

For the survey of the sample plots, extensive survey equipment (STIERLIN et al. 1994) was needed. The field survey team was provided equipment with a total value of 20,000 Swiss Francs per team. For the survey of the 7,367 sample plots (including the control sample plots), a total of 280,000 kilometers were driven. Adding all reported partial expenditures (salaries, expense reimbursement, education, training, equipment, and vehicles), the expense of the survey for one NFI sample plot came to 550 Swiss Francs.

#### 2.4.3 Conclusions

The proportion of the productive working time came to only 35% of the overall total working time in the second NFI. This means that about two thirds of the working time was spent on official travel, walking to and from the sample plot, permanently marking new sample plots, as well as the inquiries. From this it is very clear that giving up measuring particular attributes on the sample plot will reduce the time needed only slightly.

Reduction in the time expenditure can be achieved, especially regarding organizational aspects, by reducing the proportion of official travel through employing local field staff. Furthermore, reducing the extensive training can save a substantial amount of time and expense. However, this would mean a decrease in data quality. Whether or not this is acceptable depends on the goals of the inventory, the desired precision, the total budget, as well as other factors.

#### 2.4.4 Literature

- STIERLIN, H.R.; BRÄNDLI, U.B.; HEROLD, A. and ZINGGELER, J. 1994. Schweizerisches Landesforstinventar: Anleitung für die Feldaufnahmen der Erhebung 1993–1995. Birmensdorf: Eidgenöss. Forsch.anst. Wald Schnee Landsch.
- ZINGGELER, J.; and HEROLD, A. 1997: Zeitlicher und finanzieller Aufwand für die terrestrische Probenahme im zweiten Schweizerischen Landesforstinventar. Schweiz. Z. Forstwes. 148 (12): 939–959.