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DEMONSTRATION OF THE APPLICABILITY OF  
SATELLITE DATA TO FORESTRY

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| 15. Abstract<br>Satellite pictures under study include two areas of 180 x 180 km. For both of them an area of 16 x 96 km has been delineated to be studied more in detail. Preliminary tests have been performed to measure tone values on various bands by densitometry. Correlation between tone values and field data can be studied in the fall of 1973 when the field work and calculations have been completed. |                         |   |

Discipline and subdiscipline:

Forestry, timber survey and classification

Summary of the reports

Satellite pictures covering an area of 2 x (180 x 180 km) in Finnish Lapland (latitude 66 ... 69° N) were received in October 1972. The quality of these pictures proved to be good and distinct correlation was found between tones of the pictures and the forest growing stock studied with the aid of aerial photographs. Correlation between field measurements and densitometry measurements from satellite pictures can be studied in the fall of 1973 when the field work and calculations have been completed.

## Progress Report number 1, type II

### Imagery

The area requested for coverage by ERTS imagery was 180 x 180 km consisting of the area of one picture. Because of a dense cloud cover the imagery taken was somewhat more westward and consisted of two successive areas of 180 x 180 km. The imagery was taken with four MSS bands. The eight pictures have been under study until the time of this report. (Fig. 1.).

In order to gain experience about the potentials of various means for photographic processing procedures, the pictures were enlarged to 1 : 400 000, the use of equidensitet films were applied and three bands were multiexposed on color film. The color processing proved quite successful (scale 1 : 1 million), and it was shown that the enlargements are of good quality. Enlargement of the pictures to scale 1 : 60 000 in order to fit the scale of aerial photography is currently under experiment.

### Selection of study areas

Two areas of 16 x 96 km were selected in order to study the regression between characteristics obtainable from the satellite pictures and those to be measured in the field (Fig. 1.). The factors affecting the selection were: both satellite areas (180 x 180 km) came under study, the areas had to be totally uncovered by clouds, the areas selected contained large variation in geological features, and a relatively recent aerial photography at scale 1 : 60 000 was available for both of the areas. The areas were finally located according to a special, "uniform coordination" system applied also to national forest inventory in Finland.

### Measurements with densitometry

The two study areas have been divided into squares of 8 x 8 km. The total number of squares is  $2 \times 24 = 48$  (Fig. 2.). Measurements with densitometry are made on 8 squares (marked by crosses). Each square has been divided into 8 x 8 squares of 1 x 1 km (Fig. 2.). Those squares marked by crosses were chosen for further study.

Into each square of 1 x 1 km 100 points are placed. The clusters to be used as sampling units are defined on the basis of the points, as indicated by the circles (Fig. 2). The densitometry measurements are taken for each plot of a cluster (plots are 100 metres apart) representing the field measurements. As the densitometry measurements refer to substantially larger plot than the original field plots, it may be necessary to enlarge the size of each field plot by ocular estimation and substitute photo interpretation for some field work. As in Finnish national forest inventory the plot to be measured in the field is a variable one defined by relascope technique. The bigger the tree to be measured, the farther it may be from the plot center.

Diapositives at 1 : 400 000 or larger will be used. The plots are first located on aerial photographs (1 : 60 000) and then transferred to satellite pictures. Exact location of the plots entails difficulties which are now under study. It is probable that there are only three bands of MSS to be used for regressions: MSS 4, 5 and 6 or 7. In preliminary measurements with densitometry the bands 6 and 7 showed to be in very strong correlation with each other.

#### Significant results

The experiments made with aerial photos (1 : 60 000) and satellite pictures showed that there are distinct correlations between tone values of satellite pictures and the volume of forest growing stock. Field work is regarded as necessary in order to draw more detailed conclusions.

#### Proposed program for the next reporting period

Aerial photographs (1 : 60 000) will be acquired to cover stereoscopically the two study areas. The clusters distributed evenly over the areas, 1152 in number, will be interpreted from aerial photographs. A computer program to stratify the clusters into homogeneous groups will be completed. The system for measuring the tone values of clusters (48 in number) will be developed.

Helsinki February 20, 1973.

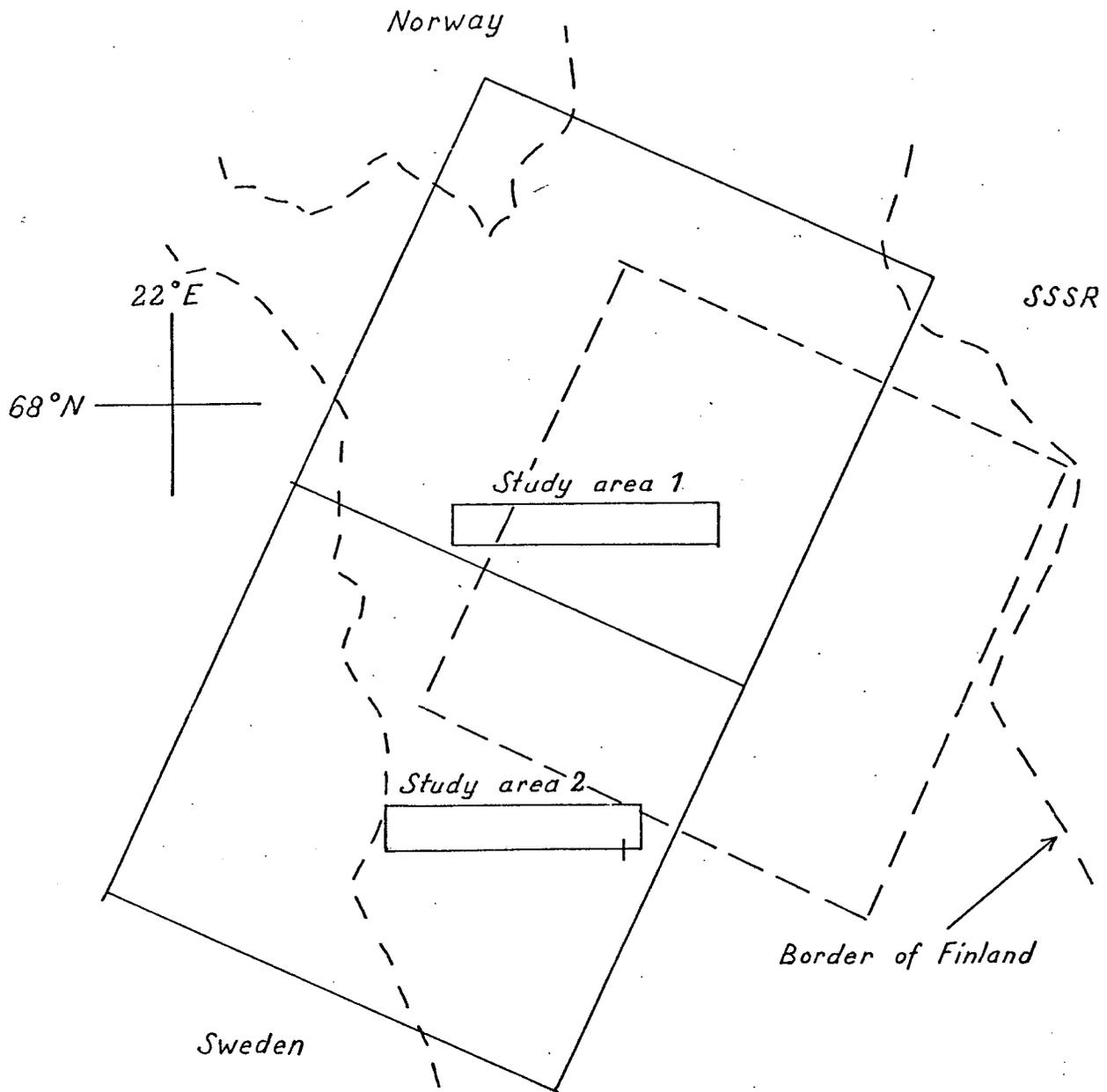


Fig. 1. Location of the ERTS imagery (Aug. 31.1972, solid line), originally suggested area (square with broken line), and the study areas of more intensive study (rectangles) with solid line).

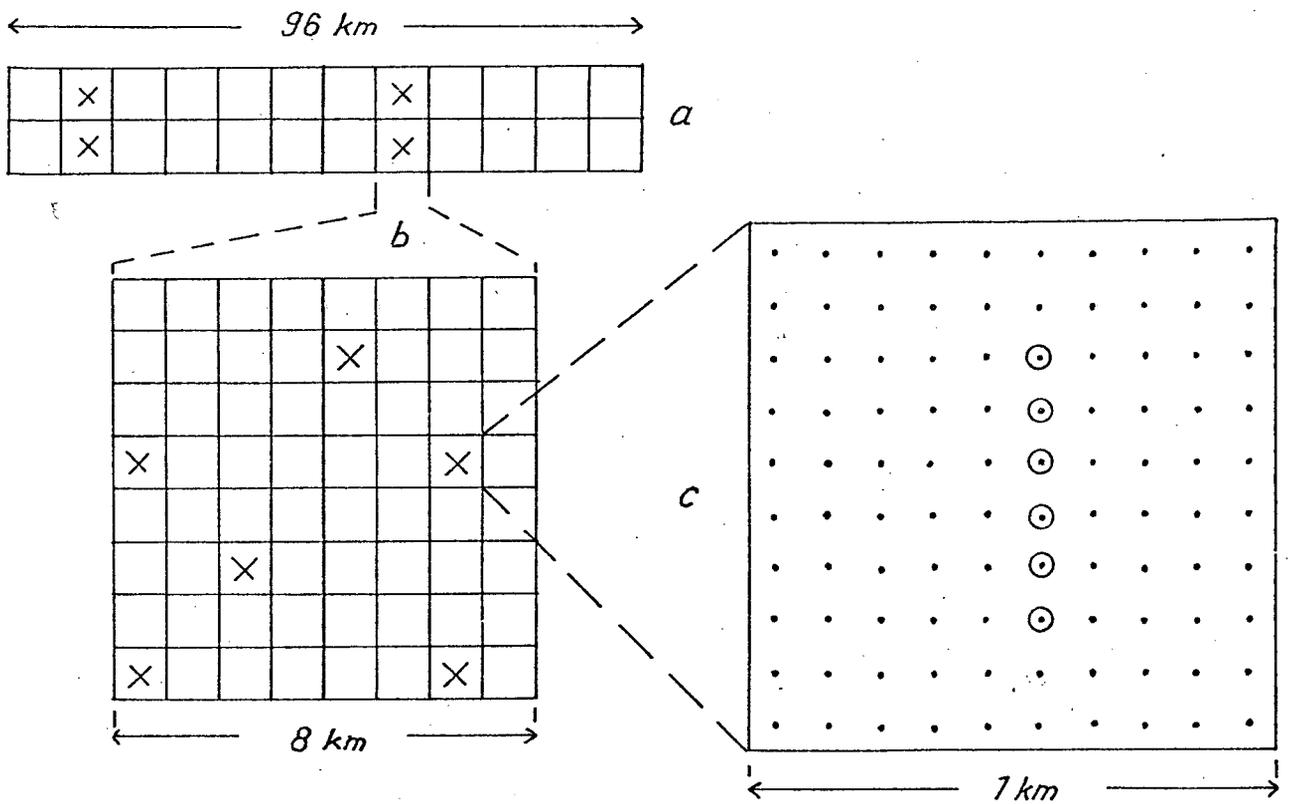


Fig. 2. Schematic description of the location of sampling units (clusters) on the study area:  
*a*, a study area, *b*, a square of 8x8 km,  
*c*, a square of 1x1 km.