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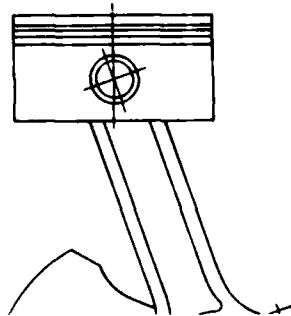
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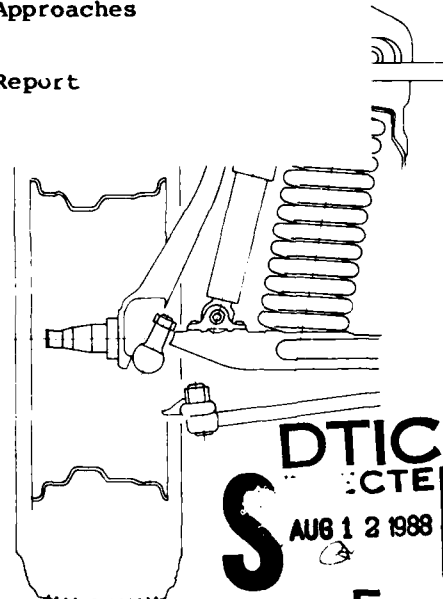
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Fahrzeugtechnik GmbH



Contract-Number: DAJA 45-87-C-0012

Agricultural and Forestry Data
Refinement Approaches

Final Report



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AGRICULTURAL AND FORESTRY DATA REFINEMENT APPROACHES

Final Report

by

Peter Jessl

February 1988

EUROPEAN RESEARCH OFFICE OF THE U.S. ARMY

London, England

Contract-Number: DAJA 45-87-C-0012

Battelle Motor- und Fahrzeugtechnik GmbH
Frankfurt/Main, FRG

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FOREWORD

The study reported herein was conducted by Battelle Motor- und Fahrzeugtechnik GmbH (BMF, Battelle Vehicle Technology) Frankfurt, FRG, under a contract from the US Army European Research Office, London. It is part of joint efforts by the US Army Engineer Waterways Experiment Station (WES) and BMF in the field of terrain data acquisition methods activities within the German theater of operations.

The forestry and agricultural data were collected by the ministries for nourishment, farming and forestry in the Federal Republic of Germany (FRG). Data collection and soil sampling were done under the supervision of P. Jessl (BMF). The report was written by P. Jessl; W. Köppel was the principal investigator.

ABSTRACT

This report contains forestry and agricultural data for a total of 22 cells of 10 x 10 km size, the high-resolution mobility terrain data base Hünfeld (L 5324) and the seven 1:50,000 quad sheet areas L 5122, L 5124, L 5320, L 5322, L 5520, L 5522 and L 5524 of the HIMO-area /1/. Due to the amount of data involved all forestry data have been stored on computer tape.

PART I: INTRODUCTION

Background

Based on the WES generic mobility-terrain description established for FRG conditions as well as the need for improved detailed mobility terrain data bases for selected areas the following major data areas call for further refinement: Agricultural and forestry terrain data are extremely subjected to local management practices and therefore suitable algorithms need to be developed, e.g. the modeling of crop rotation and tillage practices.

Purpose and Scope

The purpose of the study was to obtain basic forestry- and agricultural-terrain data for selected areas in the FRG with special regard to a potential refinement of the WES generic mobility-terrain description; therefore, for a selected quantity of 22 cell areas of 10 x 10 km size the improvement of basic terrain data descriptors was envisaged. The derivation of standard soils data (strength, wetness, etc.), visibility data, and other AMM relevant terrain data as well as their refinement will then be achieved much easier.

Forestry Data

Within the scope of this study, the following data for each department and sub-department were obtained as much as possible from the respective ministries of the six federal states concerned:

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|-------------------|-------------------------------------|
| Account No. | |
| UNITED CHARGE | ☒ |
| BANK TAG | ☐ |
| Unreconciled | ☐ |
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| A-1 | |



All in all, up to 50 different tree species can be found in the forest areas of the individual federal states. These 50 species can be broken down into the 4 dominant species of trees (oak, beech, pine, spruce) according to Table 2.

For the geographical location of the above-mentioned data, the relevant forest office maps which are available at a scale of 1:25,000 were obtained. In some cases, only the data for the municipal forests were available for reasons of data security.

As computer-aided data processing has not yet been fully implemented in all the federal states, the above-mentioned forest office data are not complete for all 45 forest office divisions (see Table 1).

Figures 2 to 23 present the excerpts from the topographical maps at a scale of 1:50,000 for the 22 cell areas under investigation. The forest office boundaries were added to elucidate the various forest office divisions in the study area.

Agricultural data

Crop Type Distribution

Data available at district level¹⁾ were used to determine the crop type distribution. The 22 areas to be examined are covered by 35 different state districts. Table 3 shows the districts within which each of the 22 areas lies. Every 4 years, the federal statistics office in Wiesbaden publishes the crop type distribution of the main field crops of the individual federal states on a district basis /2/.

1) The data are available at community level

With respect to the relevant statistics for mobility terrain data bases, the field crops were classed into the following 5 categories:

- grain (summer- and wintergrain),
- corn (grain- and silo corn),
- green fodder (rape, peas, beans usw.)
- sugar beets, turnips and
- potatoes

The above-mentioned publication /2/ also indicates the distribution of agricultural areas by farm land and meadows, pastures.

With the aid of the topographical maps,

the proportion of

- urban area,
- forest area,
- agricultural area,
- wet linear features

and also the proportion of

- administrative districts

were determined for each of the 22 areas.

Based on the individual part areas, the above-mentioned data on percentual distribution were added together (Table 4). Figures 2 to 23 show sections of the investigated topographical maps at a scale of 1:50,000. The boundaries of the districts were added to give a clear presentation of the various district areas in the areas to be examined.

Tillage Practices

With the arrival of spring comes the start of soil tilling, which covers a period of some four weeks in the Federal Republic of Germany. If one takes the highest hill land into consideration, this period may cover as much as 7 - 9 weeks. Depending on the degree of latitude, from the South-West to the North-East, and for every 100 m difference in height, field work starts 4 days later; in the case of the corresponding East-West distance, however, the delay is only about 1 day. In the course of the year, the date for the earliest areas moves from South-West via South and South-East towards the East. This means that the South-West has a higher number of days available for ripening than the North-East. Soil tilling in autumn therefore has to be finished earlier in the North-East and East than in the South-West, due to the earlier onset of winter (Figs. 2 and 3).

In spring

- summer cereals (oats, barley, wheat)
- root crops (sugar beet, turnips, potatoes)
- corn (grain corn, silage corn)
- pulses (peas, beans)

are sown. For this purpose, the soil which is ploughed in winter is generally grubbed to a depth of only 4 inches and then harrowed before the seed is sown.

The planting dates for summer cereals and root crops depend on climatic conditions and are shown in Table 5.

The winter cereal (grain) and rape (green fodder) are sown as early as autumn, after the harvest. Before planting, the soil is ploughed and grubbed.

The planting dates are shown in Table 6.

The harvest dates and growth heights of the main agricultural crop types are shown in Table 7. The growth heights of some types

of cereal are influenced by spraying in areas with good growth properties. This causes a reduction in the length of the straw. About 90% of rye, 80% of wheat and 40% of barley do not reach their original growth heights because of this.

Soil is generally cultivated after the harvest date. The grain fields are first either tilled using a multi-bladed rotary plough, grubbed or harrowed.

This loosening of the soil is carried out to a depth of only approximately 4 in. When the soil is subsequently ploughed, the soil is then turned, depending on the existing layer of topsoil, to a depth of 6 - 12 in. On the basis of farmer polls, a ploughing depth range was determined for each of the 22 areas (Tables 10-31).

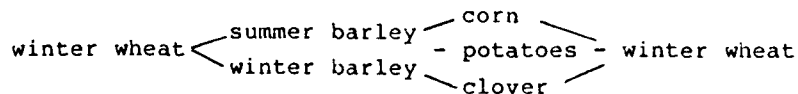
Crop Rotation

Crop rotation is one of the most important basic principles of arable farming, as it not only influences the yield of the individual crops, but also the fertility of the soil itself.

An interim crop is designated here as a fodder crop. These are generally planted after harvesting the winter barley (sown in early August and generally reaped in October).

As the cultivation of winter rye and root crops is of significance only in certain areas, the crop rotation for the areas under investigation can be divided into two different types. Type I is primarily used in areas with a high proportion of livestock farming. In such cases, the following crop rotation is mainly practiced

Type I:



In grain farming, on the other hand (Type II), market crops replace the fodder crops

Type II:

	winter barley - peas	
winter wheat	- oats - rape	winter wheat
	- winter rye - beans	

It is a known fact that one single crop cannot always be cultivated on the same arable land. Even on the best wheat-growing soil, one cannot plant only wheat, and on the best beet soil, one cannot plant only sugar beets. As long as livestock is kept and there is not enough pasture land, there has to be, alongside the commercial crops (such as cereals), cultivation of fodder crops; and in the interests of balanced feeding, these should vary. However, even if there is an adequate amount of pasture land, there has to be a certain variety in the crop cultivation. This is necessitated by the fact that yields are endangered by changing seasonal climates, storms, plant disease, pests or generic tendency towards weed development, amongst other things. Hardly a year goes by in which all the crops are damaged to the same extent, and so a balanced yield is more likely to be expected the more varied the crop cultivation and the higher the proportion of "safe" crops is. It is only since arable farming has been extended to include leaf crops and truck crops (sugar beets, turnips and potatoes) that famine, which was so common in earlier times, has become impossible.

Controlled crop rotation constitutes a balancing factor for natural arable farming by creating an ordered sequence of cultivation in place of the natural mixture or side-by-side growth of plants. Such control is based on ancient agricultural experience and local empirical experience.

There is no universally ideal crop rotation, but there are certain unalterable basic rules.

Tables 8 and 9 show possible crop rotating depending on the ratio of grain cultivation to leaf crop cultivation (truck crops, pulses, fodder).

Area Description

For the 22 areas to be examined, the following data are given in Tables 10 to 31:

- altitude above sea level range	m
- urban areas	%
- forest areas	%
- agricultural areas	%
- wet, linear feature	%
- agricultural area	km ²
- farm land	%
- meadows, pastures	%
- crop type (total area)	km ²
- grain, summer + winter	%
- winter grain	%
- summer grain	%
- corn	%
- green fodder	%
- sugar beets, turnips	%
- potatoes	%
- ploughing depth range	in
- approx. date of planting for summer grain	
- approx. date of planting for winter grain	
- soil types	USCS

The 22 areas are broken down into 5 different regions according to the WES generic terrain data classification system (1A, 21, 26, 48, 48A). Table 4 shows that there is a marked difference in the percentual proportion of farmland and meadows/pastures in relation to the agricultural area.

The following average percentual distribution was noted for the regions:

<u>Region</u>	<u>Farmland (%)</u>	<u>Meadows/Pastures (%)</u>
1A	84.8	15.2
21	64.2	35.8
26	54.0	46.0
48A	52.8	47.2
48	61.7	48.3

According to this, area no. 2 (region 1A) has the lowest proportion of meadows/pastures with 10 %. In areas no. 9 and no. 10 (region 26) situated near the Belgian border, the percentual proportion of meadows and pastures is highest, with 52 % and 53 % respectively. These high proportions can also be found in area no. 13 (region 48A) and area no. 21 (region 48).

The crop type distribution shows that in all 22 areas, the primary crop is grain. All in all, the proportion of grain in relation to the agricultural area varies from 50 to 83 %.

Corn is grown mainly in region 48. In each of these areas, the percentual proportion is ≥ 10 %. For all 22 areas, the proportion of corn varies between 1.5 and 39 %.

Green fodder is grown mainly in region 48A. The mean value is 19 %. In region 26, on the other hand, an average of only 5 % green fodder is grown. Sugar beets and turnips generally account for up to only 5 % in all 22 areas. In region 48A, the percentage for each area is as low as 1 %. A relatively high proportion of sugar beets and turnips is grown in areas no. 1 and no. 2 (10 and 17 % respectively) and in areas no. 10 and no. 9 (12.5 and 30 % respectively).

Potatoes are grown in all areas at a proportion of between 1 and 8 %. There are no areas in which potatoes are the primary crop. It is noteworthy that in region 21, only 1.7 % of the entire farmland is used for potatoes.

The tilling periods are mainly in autumn and spring. In autumn, the entire arable land is ploughed and part of it is planted with either winter grain or green fodder. The other part remains ploughed throughout the winter months. In spring, the summer grain, corn, sugar beets and turnips and potatoes, are planted.

In region 1A, the tilling period runs from mid to late March and in autumn from early to mid October. The ploughing depths range from 10 to 12 in.

In region 21, the soil is tilled in spring from the end of March to the beginning of April and in autumn from the end of September to the beginning of October. The ploughing depths range from 8 to 12 in.

In region 26, spring soil tilling begins at the end of March and continues until the end of April. In autumn, the soil tilling period continues throughout the month of October. The ploughing depth is between 6 and 10 in.

In regions 48A and 48, the tilling periods are the same in both spring and autumn. In spring, the soil is tilled from the beginning to the end of April and in autumn from the end of September to the end of October. The ploughing depths are between 6 and 10 in. In the higher areas, the ploughing depth is only 6-8 in. In spring, the soil which has been ploughed in autumn is grubbed in preparation for sowing. This is also done in autumn, prior to sowing the winter grain. The ploughing depth is only 4 in.

As shown in Tables 8 and 9, the possible crop rotation is chosen depending on the percentual relationship between cereals and leaf crops. Thus, for example, in the areas with a cereal proportion of $\geq 75\%$ (areas nos. 5, 6, 7, 8 and 10) the four-field farming system is used. This would mean the following crop rotation:

Four-field farming

sugar beet
winter wheat
oats
winter rye
fodder crop
oats
winter wheat
winter rye.

If the proportion of cereals is between 60 and 70 % (areas nos. 2, 3, 4, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21) the three-field farming system should be used. This would result in the following crop rotation:

Three-field farming

sugar beet
winter wheat
winter rye
fodder crop
oats.

At a cereal proportion of between 50 and 60 % (areas nos. 1 and 22), the two-field farming system is used, with the following crop rotation:

Two-field farming

sugar beet
winter wheat
potatoes
winter rye
fodder crop
oats.

PART III: HIGH-RESOLUTION MOBILITY
TERRAIN DATA BASE HÜNFELD

Forestry Data

The area covered by topographical map L 5324 is under the administrative authority of 8 different forest offices (Fig. 36). The data obtained, including the forest office maps, were recorded on tape at a format as described in PART II (Forestry Data).

Fig. 27 shows a section of the Hünfeld forest office map, with typical forest areas (604, 608, 609, 610) including the pertinent description of forest office data recorded on tape.

In the following, department 604 A3 (1) is elucidated as a reading example pursuant to Fig. 5. The boundary of lower area A3 is dotted on the map inside department 604 A. The size of the vegetated area is given as 1.2 ha (2). The following 6 species of trees can be found in this area:

HBU	= grove beech	(carpinus betulus)
WEI	= white oak	(quercus alba)
AS	= aspen	(populus tremula)
BU	= beech	(fagus silvatica)
EI	= oak	(quercus)
FI	= spruce	(picea)

(The abbreviations are derived from the German names Hainbuche, Weisseiche, Aspe, Buche, Eiche and Fichte)

The stock proportion (3) is given as 60 % for beech trees, i.e. within the total area of 1.2 ha. there are 60 % grove beech trees, 7 % white oaks, 5 % aspen, 10 % beech trees and 8 % spruce trees.

The age (5) of the trees ranges from 35 years for spruce to 45 years for beech.

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The average height (6) is between 12 and 15 m. The quality (locality class), (7) describes the yield category of the trees, 0.5 being the poorest and 5.0 the best results. In other words, the tree has developed well in terms of height and span. In this example, the 15-year-old spruce with a yield of 2.5 can be classed in the medium yield category.

The relationships between height and span growth and yield category are presented in /3/.

The stock area (9) is a theoretical area. In other words, if all the grove beeches distributed to 60 % over the entire area of 1.2 hectares were to be taken together, they would cover an area of 0.7 hectares. The canopy closure (8) can be derived as 0.7 or 70 % for this vegetated area. There are no excess areas in this forest department. The location code (11) is formed by a 6-digit number.

In this example, the number is 384341. The first digit (3) refers to the designation of the growth area. In Hesse, there are 9 different growth areas. The second digit (8) indicates the growth district. Each growth area is subdivided into 4 growth districts. This adds up to 36 different growth districts in Hesse. The third digit (4) indicates the growth zone. The growth zones are divided into 8 steps, in ascending order according to their height above sea level. The lower lying areas are the oak zones and higher areas the beech zones. The fourth digit (3) refers to the air humidity. This is subdivided into four steps. The fifth digit (4) indicates the ground water of the terrain, classed in 9 categories ranging from wet to dry. The last digit (1) indicates the type of soil.

A simple differentiation is made between silty soils, sandy soils and sands.

Agricultural data

Fig. 6 shows quad sheet L 5324 is covered by 2 districts (Fulda and Hersfeld-Rotenburg). The overall area amounts to 424 km, excluding the territory of the GDR. In order to achieve the highest possible resolution of data on the one hand and as precise a description of the agricultural features as possible on the other hand, the data were not obtained as previously at district level, but from the major communities. This resulted in the following land use description (Table 9).

According to this, 65 % of the area is agricultural area and 28 % forested. 5 % is urban area and 2 % wet linear features. 39 % of the agricultural area is indicated as meadows and pastures and 61 % as farm land. On the farm land, mainly grain (75 %) is grown. Approximately 90 % of this is winter grain and 10 % summer grain. 8 % corn, 11 % green fodder, 4 % sugar beets and turnips, and 2 % potatoes is grown.

In this area, the tilling period begins in spring in two intervals. West of the Unterweissenborn/Nüstal line, oats are sowed from the end of March (26/3) and east of this line, sowing begins in early April (5/4). The tilling date for winter grains is set from 17th September (Figs. 24, 25). The ploughing depths range from 6 to 10 inches, depending on height above sea level. Given the percentual grain proportion in relation to the agricultural area (Table 32), the principle of three-field and four-field farming is primarily used in quad sheet L 5324. In other words, the crop rotation is set as follows (cf. PART II, Area Description):

Three-field farming

sugar beet
winter wheat
winter rye
fodder crop
oats

Four-field farming

sugar beet
winter wheat
oats
winter rye
fodder crop
oats
winter wheat
winter rye

USCS Soils Classification

As already mentioned in the forestry data chapter, the penultimate digit of the six-figure location code refers to the ground water and the last digit gives a rough classification of the type of soil. The ground water is classified as follows:

Class	Condition
1	fresh
2	extremely fresh
3	moderately fresh
4	moderately dry
5	wet
6	alternating wet
7	extremely wet
8	percolating wet
9	dry

The type of soil is presented by the forestry authorities simply in three categories and may be related to USCS soil types as follows:

class	Forestry Data / Soil Type	USCS Soil Type
1	loess, loam, silt	(ML)
2	sandy silt	(SM)
3	sandy soils	(SP)

The aim of this part of the study was to examine the extent to which the ground water data and the soil data provided by the forest offices can be applied for mobility purposes. For this purpose, an initial test was carried out within the scope of this study. Within the terrain area of the Hünfeld forest office area, soil tests were carried out at a total of 13 sites identified by WES. On 16th and 17th October 1987, soil samples were taken in the various departments of the wooded area and cone index (CI) values were determined (Photographs 1 to 13). Table 13 shows the geographical description of the 13 sites. Figures 29-34 show sections of the forest office map of Hünfeld (scale 1:25,000) with the above-mentioned localised sites.

The samples were used to determine the following soil parameters:

- specific gravity (g/cm^3),
- density (t/m^3),
- moisture content (%),
- organic ingredients (%) and
- USCS soil type

The Atterberg limits could not be determined as the proportion of organic ingredients of the samples was too high.

Table 34 shows the results of the soil tests for the 13 sites. According to this, the specific gravity ranges from 2.38 to 2.61 g/cm^3 . The values for the bulk density range between 1.08 and 1.92 t/m^3 . For the moisture content of the soil, values of between 18.1 % and 52.8 % were observed. The organic ingredients vary between 3.7 and 24.2 %. In the Hünfeld forest office area, the main soil type is coarse clay sand soil with a more or less pronounced natural layer of organics which can reach from the surface to a depth of as much as 1.5 inches.

The moisture content data measured was compared with the humidity classes (moisture content areas) determined by the forest office and indicated viable results, based on a very low number of tests.

However, within one humidity class, there can be a relatively high fluctuation of the moisture content measured (Table 35). For example, in humidity class 1 (fresh), moisture contents of between 25.4 and 36.8 % were noted, and in class 6 (alternating wet), moisture contents of between 37.9 and 52.8 % were measured.

The CI values in comparison with the moisture content data and measurements indicate an average moisture content of 25.8 % for class 4 (moderately dry) and an average CI value of 207 psi. For class 1 (fresh), an average moisture content of 30.4 % and an average CI value of 122 psi were measured. For class 3 (moderately fresh), the average moisture content was 23.3 % and the average CI value was 139 psi. For class 6 (alternating wet), an average moisture content of 45.3 % and an average CI value of 95 psi were measured (see table 35).

The inadequate number of tests does not permit any conclusive statements to be made regarding the precision of the moisture content data in relation to the CI values and the soil classification. However, these few tests did indicate that it would be advisable to carry out further tests in order to verify the above-mentioned results. In general, it can be said that the available forest office data can considerably facilitate the derivation of refined mobility terrain data.

PART IV: MOBILITY TERRAIN DATA BASES HIMO-AREA

A total of 7 quad sheets (scale = 1:50,000) L 5122, L 5124, L 5320, L 5322, L 5520, L 5522 und L 5524 were to be examined. In addition, the area of quad sheet L 5120 was included in the study. In the following, the area is combined with quad sheet L 5324 mentioned in the previous chapter and summarised.

Forestry Data

The above-mentioned area (9 quad sheets) is under the administrative authority of 37 forest offices (Table 36). As described in Part III, all data obtained were recorded on computer tape and completed by forest office maps. Figures 35 to 43 show the 9 topographical maps (scale = 1:50,000). The boundaries of the various forest office areas have been added by hand to make the presentation clearer.

Agricultural Data

The HIMO study area /1/ is covered by 10 different districts (Table 37). For the presentation of the results, the data as described in PART II were used. The crop type distribution described in Table 38 is derived from this. Figures 35 to 43 show the 9 topographical maps. The boundaries of the various district area have been added by hand to make the presentation clearer.

Area Description

For the 9 quad sheets to be examined, the following data are given in Tables 39 to 47:

- altitude above sea level range	m
- urban areas	%
- forest areas	%
- agricultural areas	%
- wet, linear feature	%
- agricultural area	km ²
- farm land	%
- meadows, pastures	%
- crop type (total area)	km ²
- grain, summer + winter	%
- summer grain	%
- winter grain	%
- corn	%
- green fodder	%
- sugar beets, turnips	%
- potatoes	%
- ploughing depth range	in
- approx. date of planting for summer grain	
- approx. date of planting for winter grain	
- soil types	USCS

Table 38 shows that the percentual proportion of farm land and meadows/pastures in relation to the agricultural area averages 59 % farmland and 41 % meadows/pastures for all 9 areas. The lowest proportion of meadows/pastures is in area L 5122 with 29 % and the highest proportion in area L 5524 with 52 %.

The percentual crop type distribution is virtually the same in all areas. On average, up to 79 % grain, 8 % corn, 6 % green fodder, 5 % sugar beets and turnips and 2 % potatoes are grown. Only in area L 5324 there is a small discrepancy to the above-mentioned crop type distribution. In this area, only 75 % grain, but 11 % green fodder, is grown.

The spring tilling period is from late March until early April. In the lower-lying areas (≤ 500 m above sea level) the work is already completed by mid March. In autumn, on the other hand, tilling tends to begin earlier in the higher areas (mid September). The tilling period in the lower-lying areas continues until mid October. Ploughing depths range between 6 and 10 inches. Given the high percentage of grain (≈ 75 %) in relation to the arable area (Table 38), the four-field farming system is used in these 9 quad sheets. Accordingly, the following crop rotation is to be chosen:

Four-field farming

sugar beet
winter wheat
oats
winter rye
fodder crop
oats
winter wheat
winter rye

PART V: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study shows that, for the areas of the FRG examined in this study, fine resolution of mobility terrain data can be carried out both for the agricultural area and, in particular, for the forestry area, thus allowing data refinement in respect of mobility terrain data bases. Further resolution of the forest office data is not possible. The data are available for the smallest forest unit (department). As data protection regulations differed in the various federal states, it was possible to cover only a relatively small proportion of state forest in Bavaria. In North Rhine Westfalia, on the other hand, the data for state and corporation forests were available.

Recommendations

Given the increasing need to establish updating routines for mobility terrain data bases for use as tactical decision aids, soil moisture/strength must be given special consideration. Agricultural and forestry land use practices have to be sufficiently modelled in order to enable quantification of their impact on military vehicle performance within such terrain areas.

A further reconnaissance and data base updating instrument to be considered seems to be remote sensing by satellite.

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- Fig. 24 Date of Planting for Oats in West and
 East Germany
- Fig. 25 Date of Planting for Winter Rye in West and
 East Germany
- Fig. 26 Forest Office Map for Quad Sheet L 5324 Hünfeld
- Fig. 27 Part of the Hünfeld Forest Office Map with
 Detailed Forest Areas (604, 608, 609, 610; Private
 Forest) Including the Forestry Office Data
- Fig. 28 District Map for Quad Sheet L 5324
- Figs. 29 - 34 Location of 13 Sites within the Forest Office Area
 Hünfeld
- Figs. 35 - 43 Quad Sheets L 5120, L 5122, L 5124, L 5320,
 L 5322, L 5324, L 5520, L 5522, L 5524

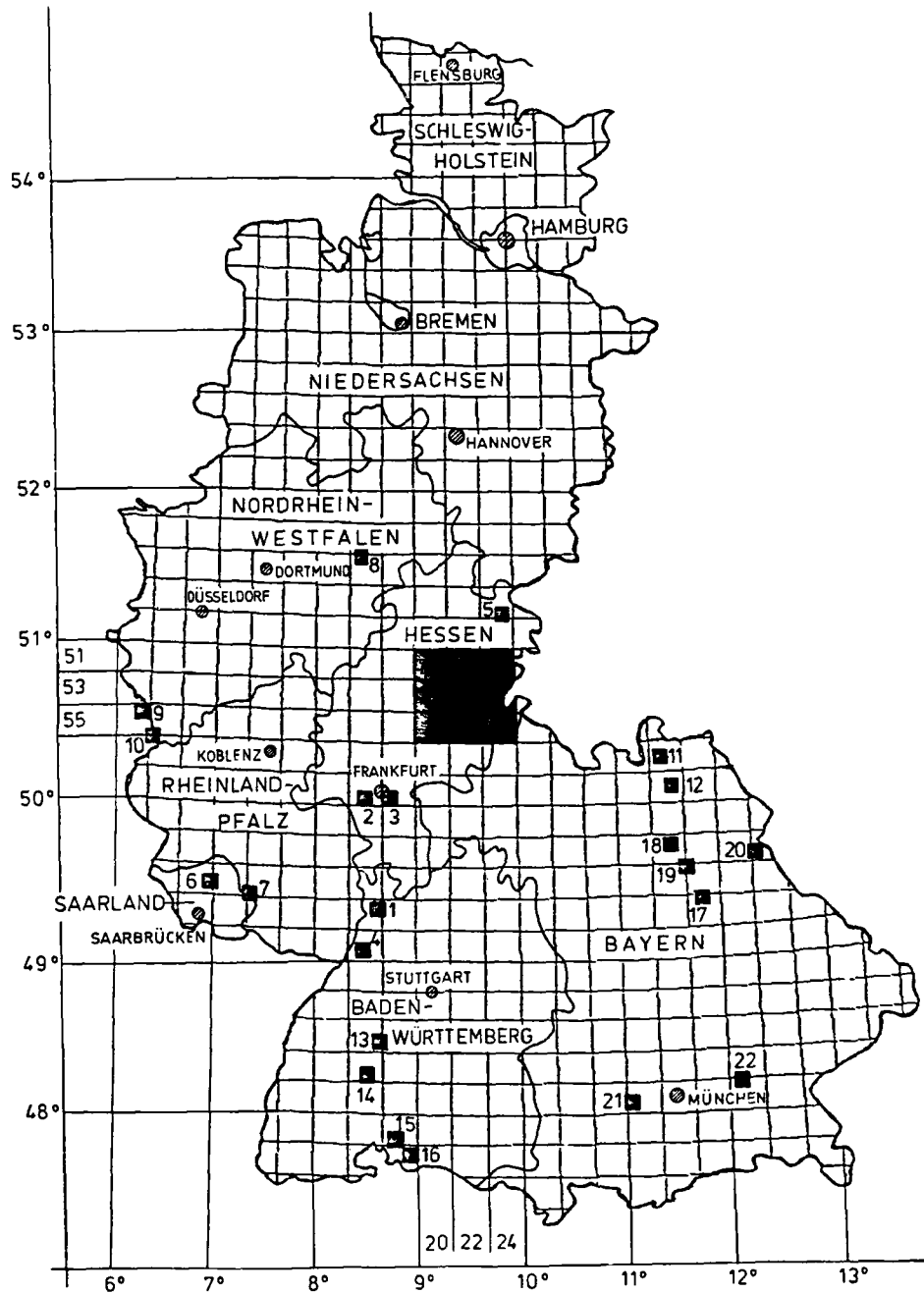


Fig. 1: Selected Generic Study Areas Within the Federal Republic of Germany

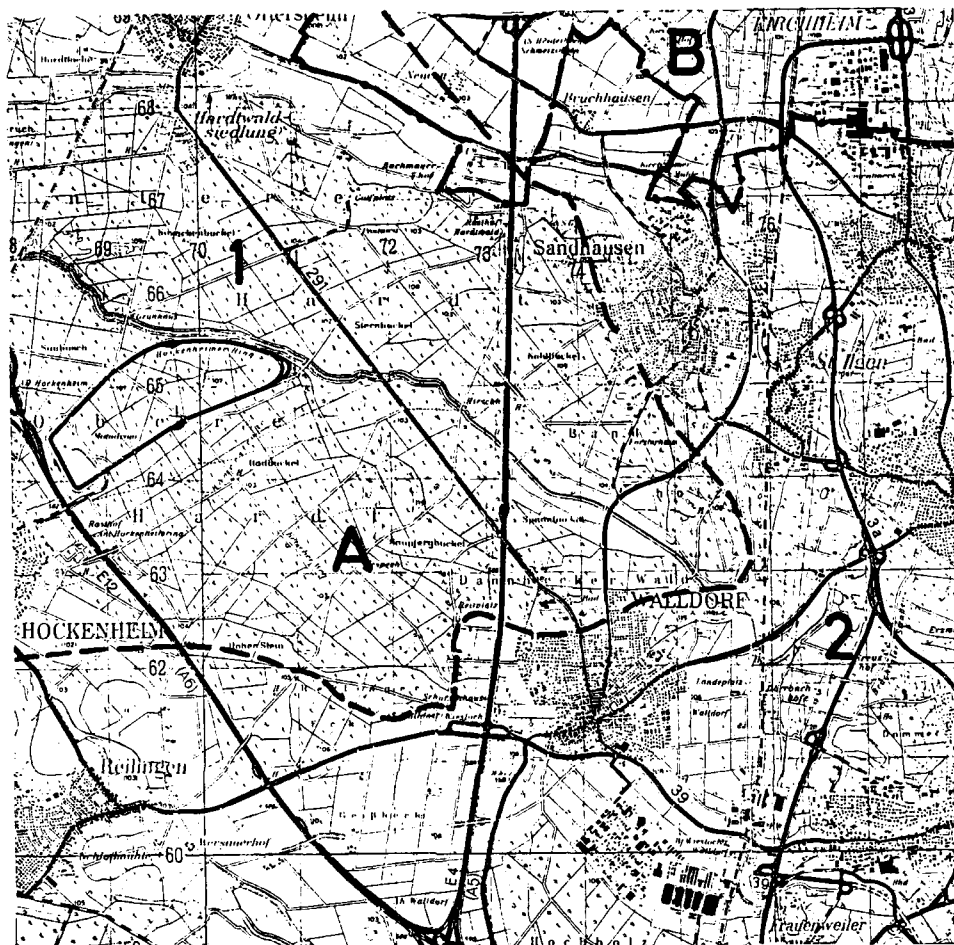


Fig. 2: Cell Areas Investigated,

Area No.: 1, Region No.: 1A, Cell No.: 1

Quad Sheet No.: L 6716, L 6718

Forest Office: 1 Schwetzingen, 2 Wiesloch

District Name: A Rhein-Neckar, B Stadt Heidelberg

Federal State: Baden Württemberg,

--- Forest Office Border

--- District Border

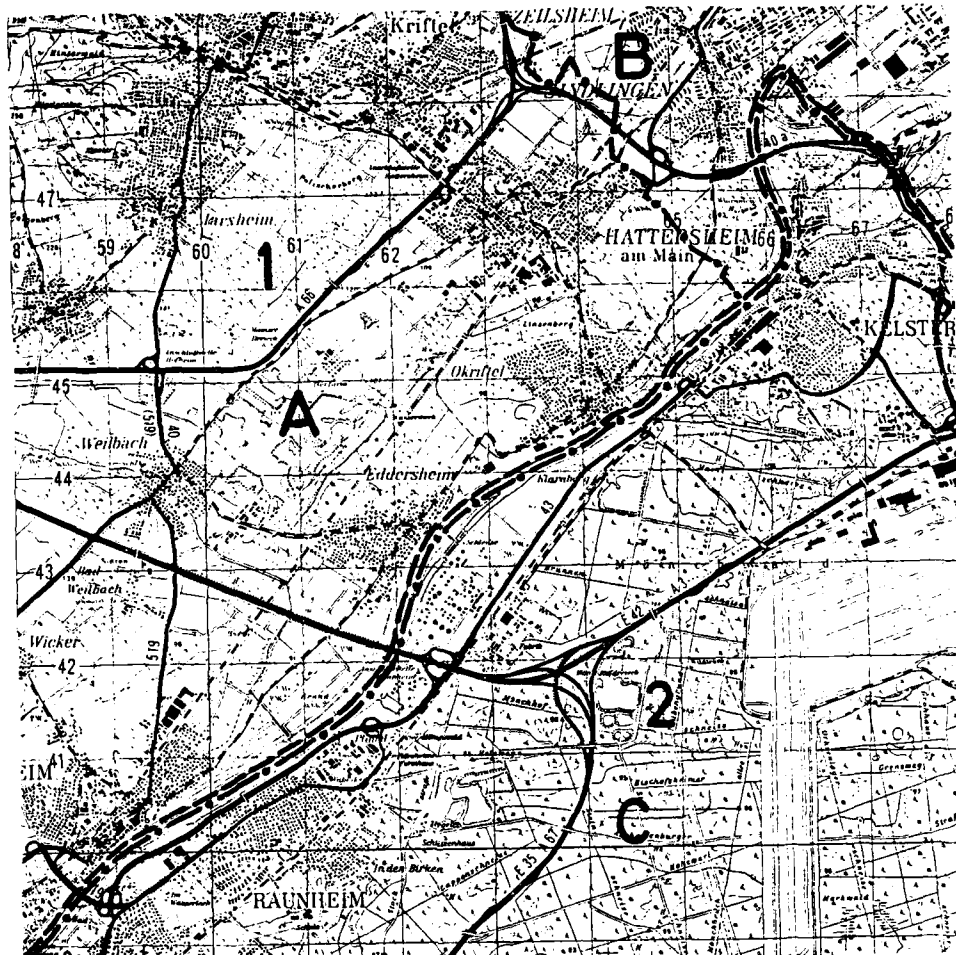


Fig. 3: Cell Areas Investigated,

Area No.: 2, Region No.: 1A, Cell No.: 2

Quad Sheet No.: L 5916

Forest Office: 1 Mörfelden-Walldorf, 2 Hofheim

District Name: A Main-Taunus, B Stadt Frankfurt,

C Groß-Gerau

Federal State: Hesse

--- Forest Office Border

— District Border

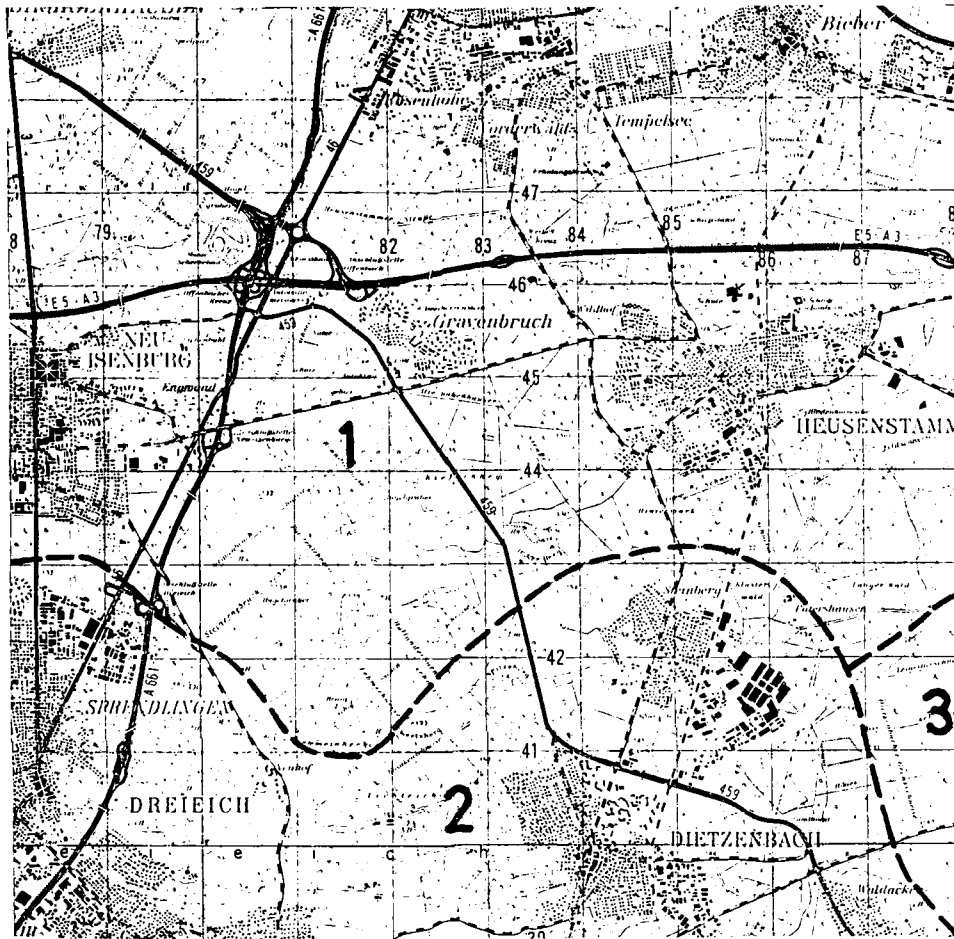


Fig. 4: Cell Areas Investigated,
Area No.: 3, Region No.: 1A, Cell No.: 3
Quad Sheet No.: L 5918
Forest Office: 1 Neu-Isenburg, 2 Langen
3 Seligenstadt
District Name: Offenbach
Federal State: Hesse
--- Forest Office Border

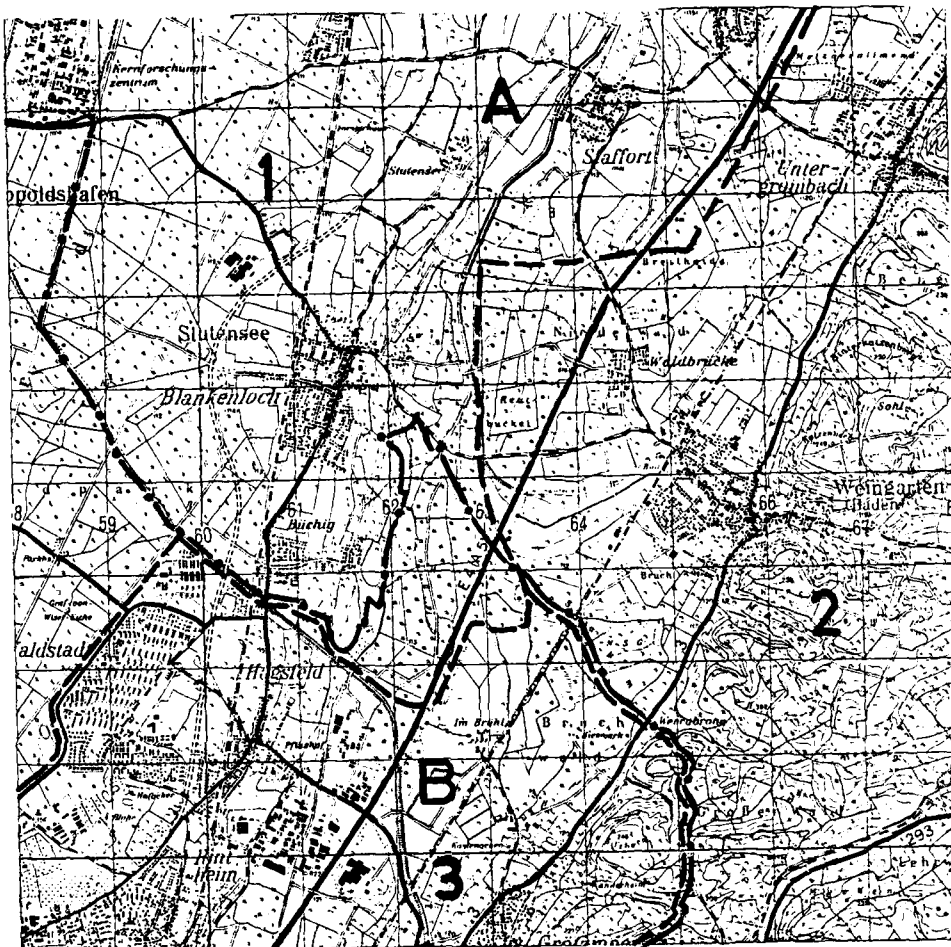


Fig. 5: Cell Areas Investigated,
 Area No.: 4, Region No.: 1A, Cell No.: 4
 Quad Sheet No.: L 6916
 Forest Office: 1 Karlsruhe-Hardt, 2 Bruchsal,
 3 Karlsruhe
 District Name: A Karlsruhe, B Stadt Karlsruhe
 Federal State: Baden Württemberg
 --- Forest Office border
 — District Border

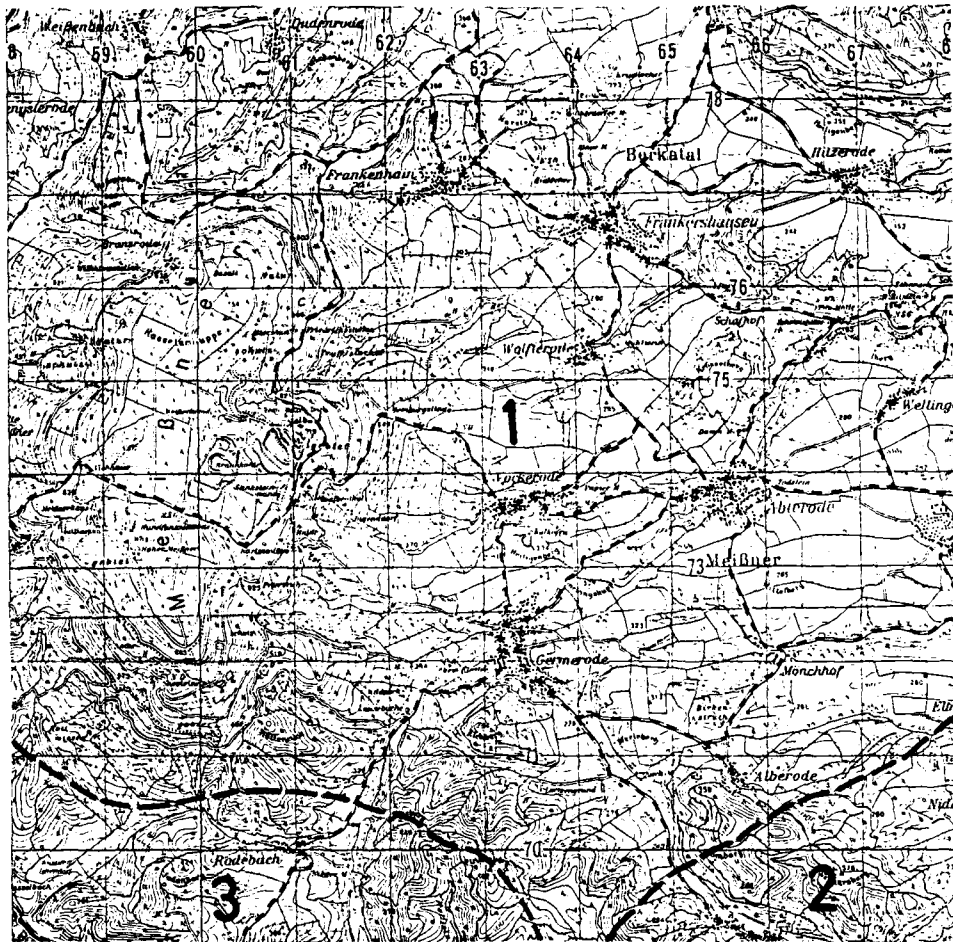


Fig. 6: Cell Areas Investigated,
Area No.: 5, Region No.: 21, Cell No.: 1
Quad Sheet No.: L 4724; L 4924
Forest Office: 1 Bad Soden-Allendorf, 2 Wanfried
3 Hess. Lichtenau
District Name: Werra Meißner
Federal State: Hesse
--- Forest Office Border

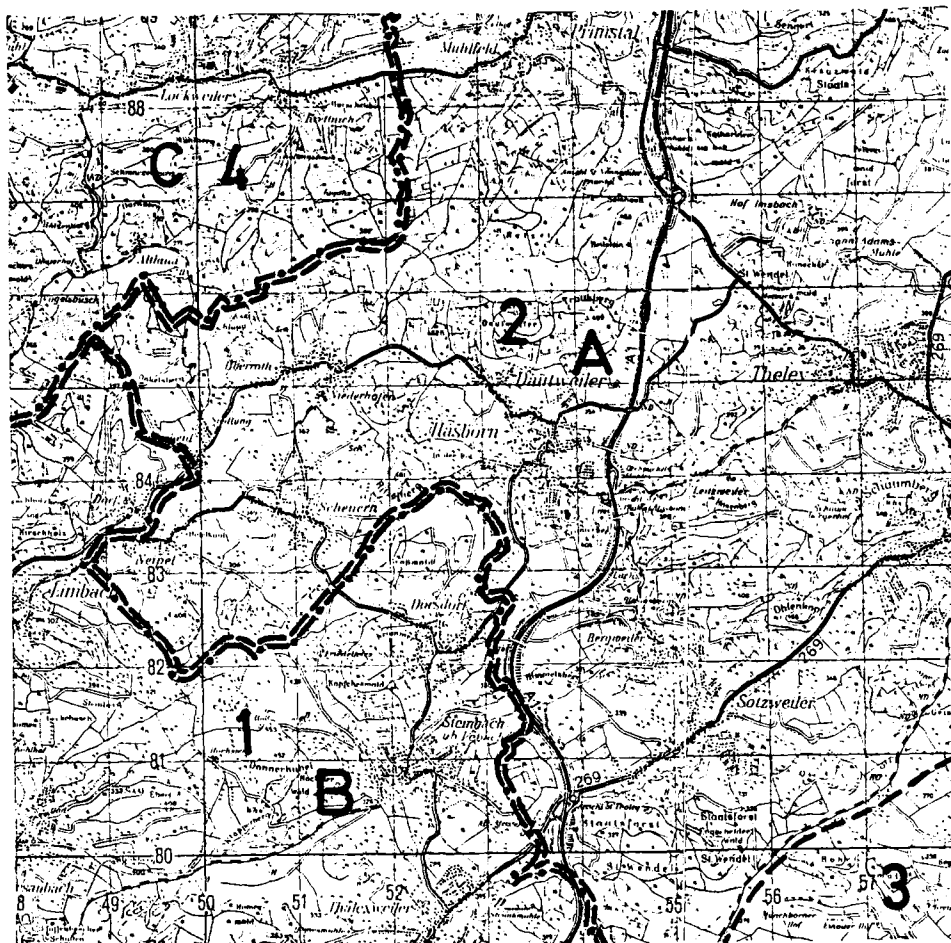


Fig. 7: Cell Areas Investigated,

Area No.: 6, Region No.: 21, Cell No.: 6

Quad Sheet No.: L 6506, L 6508

Forest Office: 1 Schmelz, 2 Sotzweiler,
3 Krexweiler, 4 Lockweiler

District Name: A St. Wendel, B Saarlouis,
C Merzig-Wadern

Federal State: Saarland

--- Forest Office Border

--- District Border

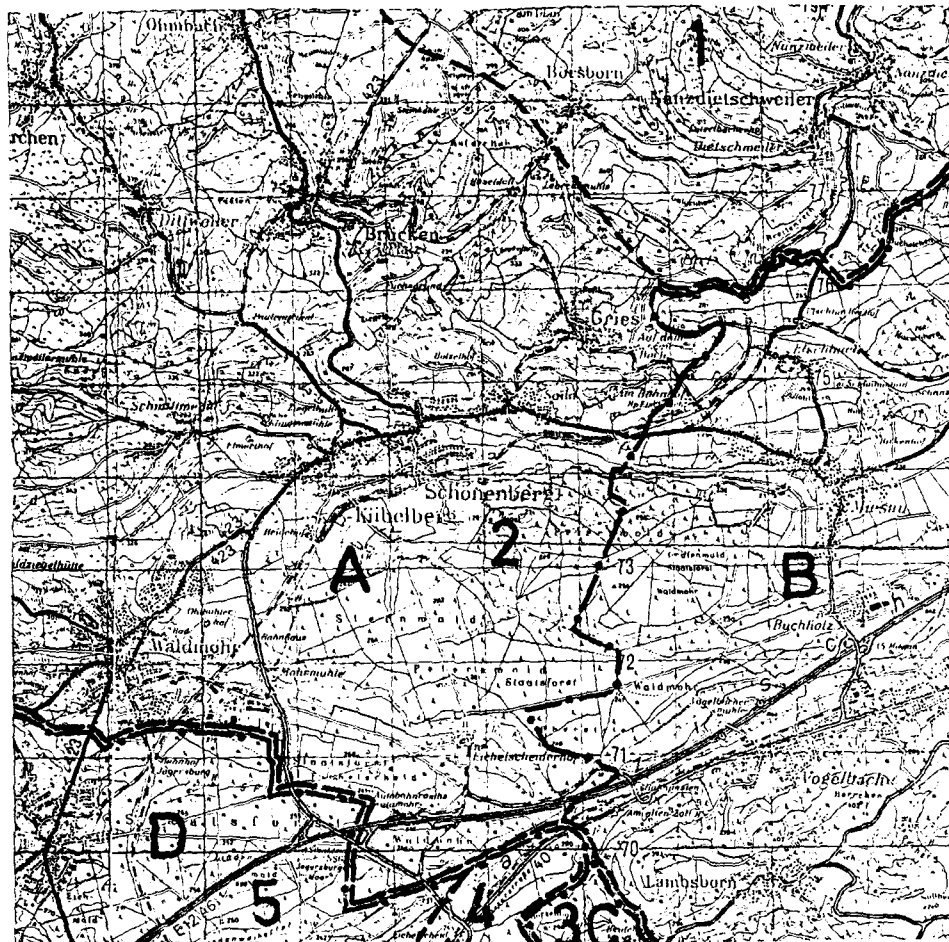


Fig. 9: Cell Areas Investigated,

Area No.: 8, Region No.: 21, Cell No.: 9

Quad Sheet No.: L 6508, L 6510, L 6708, L 6710

Forest Office: 1 Kusel, 2 Waldmohr, 3 Zweibrücken

4 Karlsberg, 5 Jagersburg

District Name: A Kusel, B Kaiserslautern,

C Pirmasens, D Saar-Pfalz

Federal State: Rhineland Palatinate, Saarland

--- Forest Office Border

— District Border

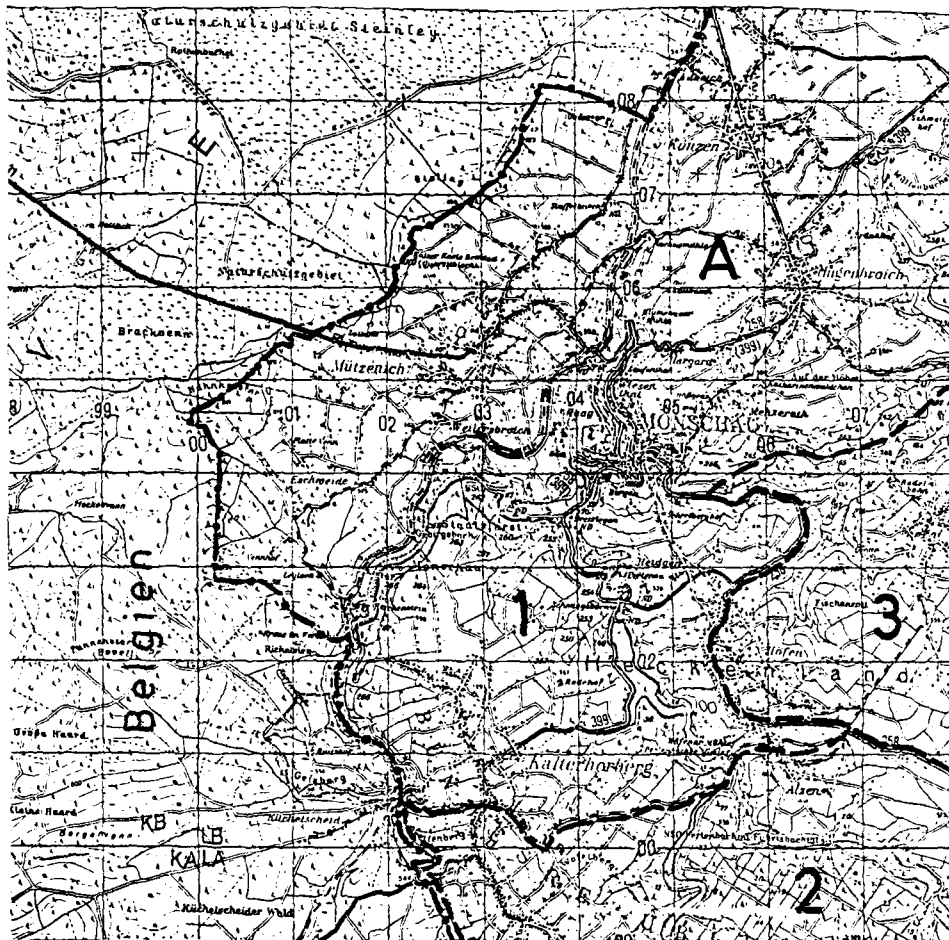


Fig. 10: Cell Areas Investigated,

Area No.: 9, Region No.: 26, Cell No.: 1

Quad Sheet No.: L 5502

Forest Office: 1 Monschau (Simmerath), 2 Wahlerscheid
3 Dedenborn

District Name: A Aachen

Federal State: Northrhine-Westfalia

--- Forest Office Border

District Border

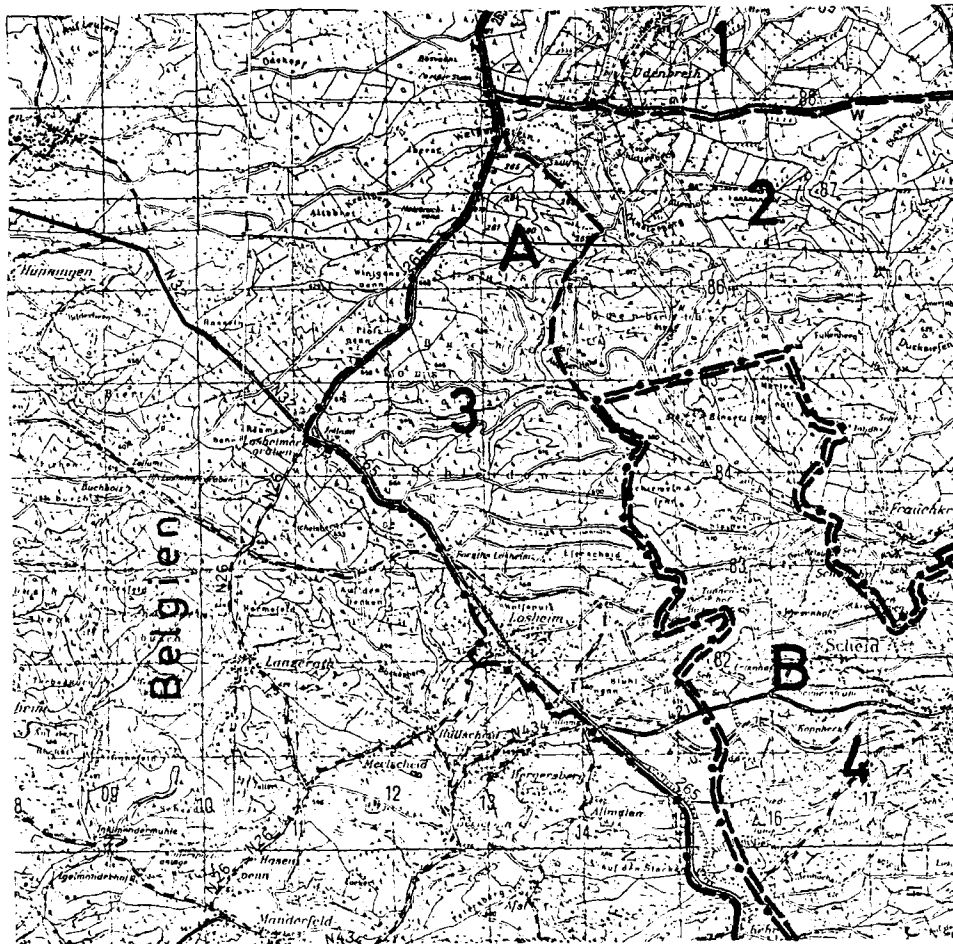


Fig. 11: Cell Areas Investigated,

Area No.: 10, Region No.: 26, Cell No.: 2

Quad Sheet No.: L 5502, L 5504, L 5702, L 5704

Forest Office: 1 Hollerath, 2 Udenbreth,

3 Losheim, 4 Prüm Nord-

(Rhineland-Palatine)

District Name: A Euskirchen, B Daun

Federal State: Northrhine Westfalia,

Rhineland-Palatine

--- Forest Office Border

--- District Border

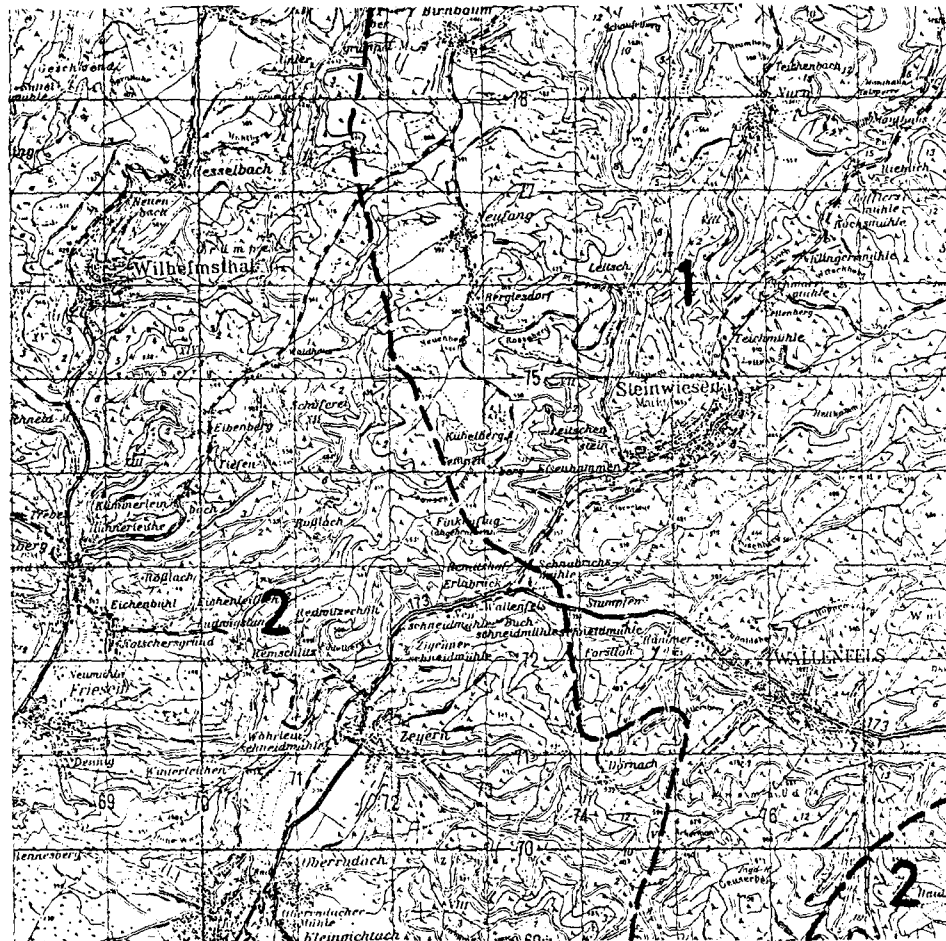


Fig. 12: Cell Areas Investigated,
 Area No.: 11, Region No.: 26, Cell No.: 4
 Quad Sheet No.: L 5734
 Forest Office: 1 Nordhalben, 2 Kronach
 District Name: Kronach
 Federal State: Bavaria
 --- Forest Office Border

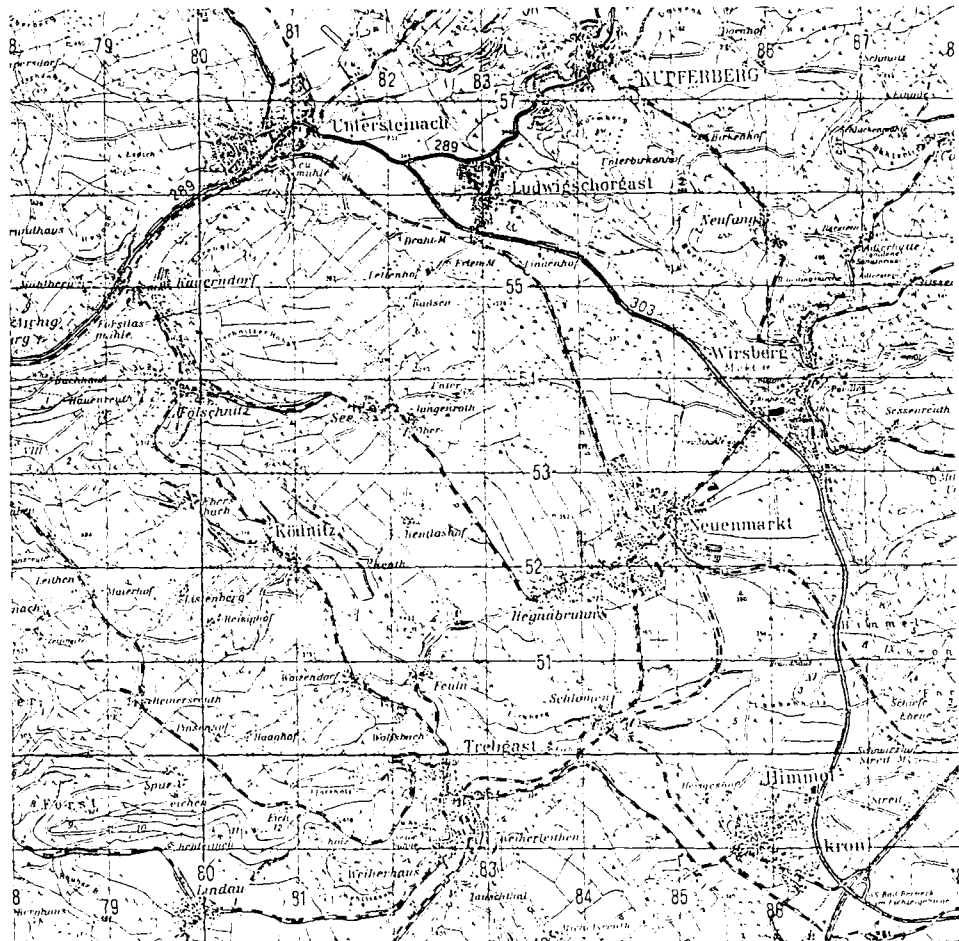


Fig. 13: Cell Areas Investigated,

Area No.: 12, Region No.: 26, Cell No.: 8

Quad Sheet No.: L 5934

Forest Office: Stadtsteinach

District Name: Kulmbach

Federal State: Bavaria

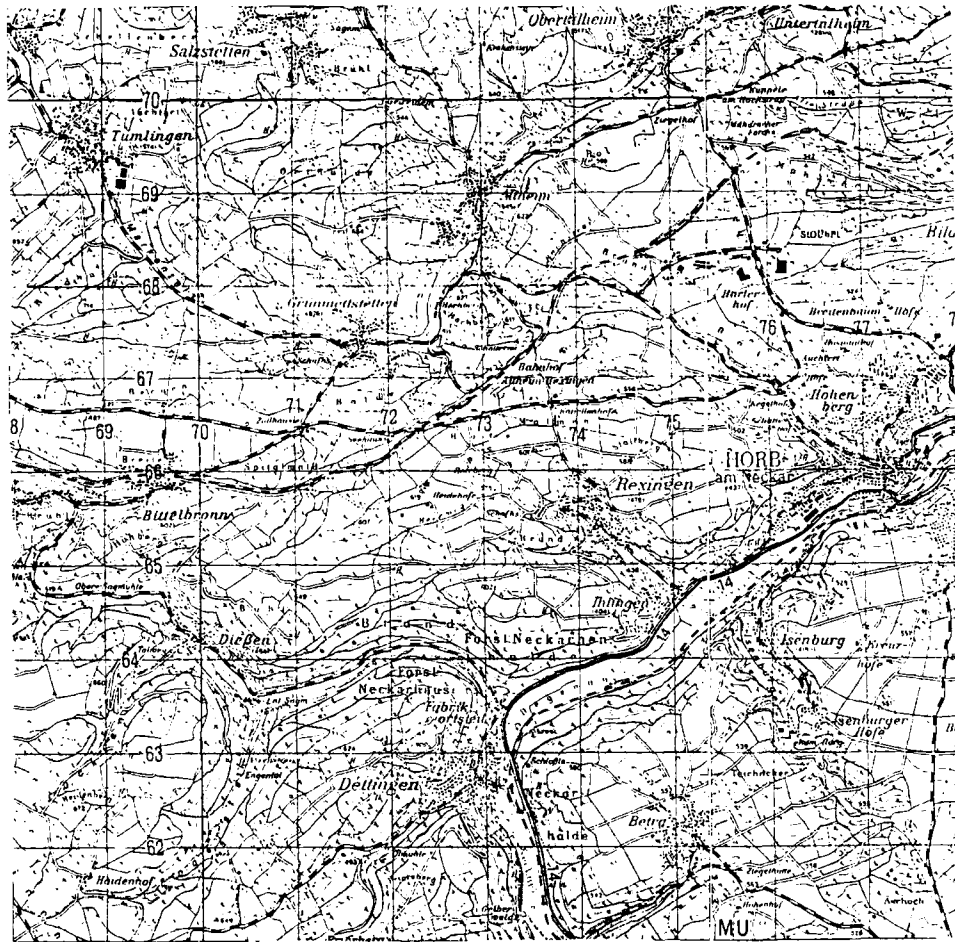


Fig. 14: Cell Areas Investigated,
 Area No.: 13, Region No.: 48A, Cell No.: 1
 Quad Sheet No.: L 7516, L 7518
 Forest Office: Horb
 District Name: Freudenstadt
 Federal State: Baden Württemberg

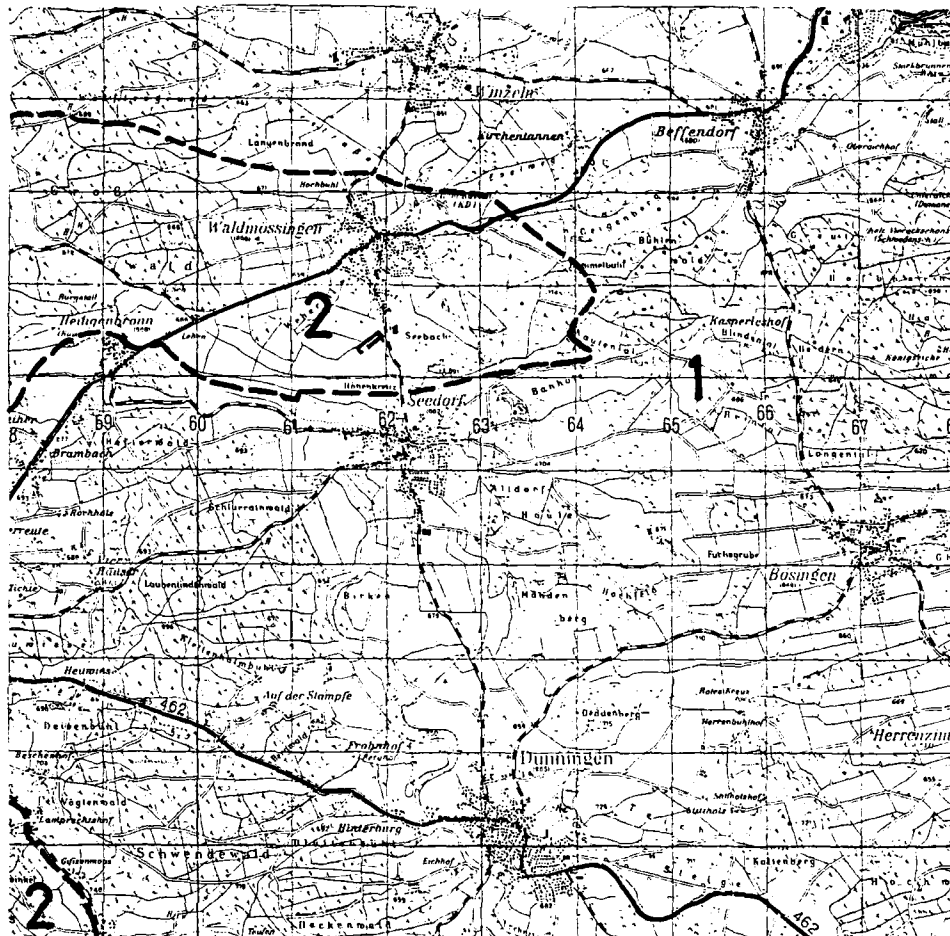


Fig. 15: Cell Areas Investigated,
 Area No.: 14, Region No.: 48A, Cell No.: 2
 Quad Sheet No.: L 7716
 Forest Office: 1 Oberndorf, 2 Schramberg
 District Name: Rottweil
 Federal State: Baden Württemberg
 --- Forest Office Border

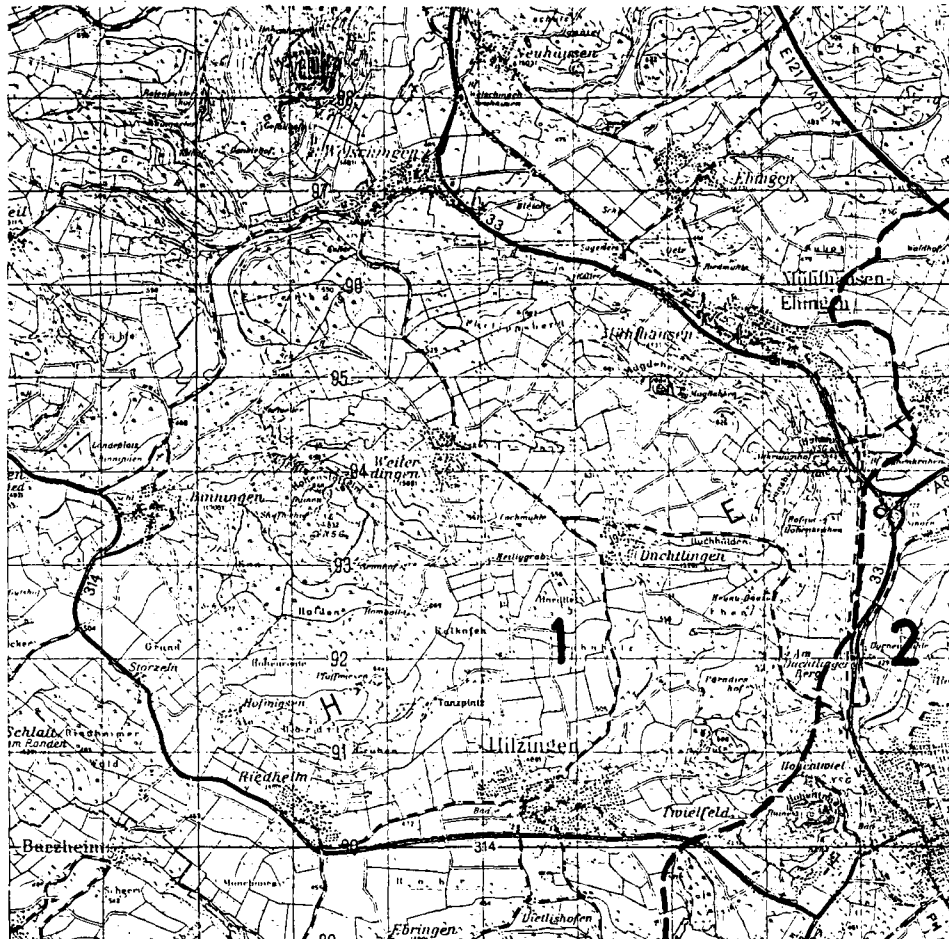


Fig. 16: Cell Areas Investigated,
Area No.: 15, Region No.: 48A, Cell No.: 3
Quad Sheet No.: L 8118, L 8318
Forest Office: 1 Engen, 2 Radolfzell
District Name: Konstanz
Federal State: Baden Württemberg
--- Forest Office Border

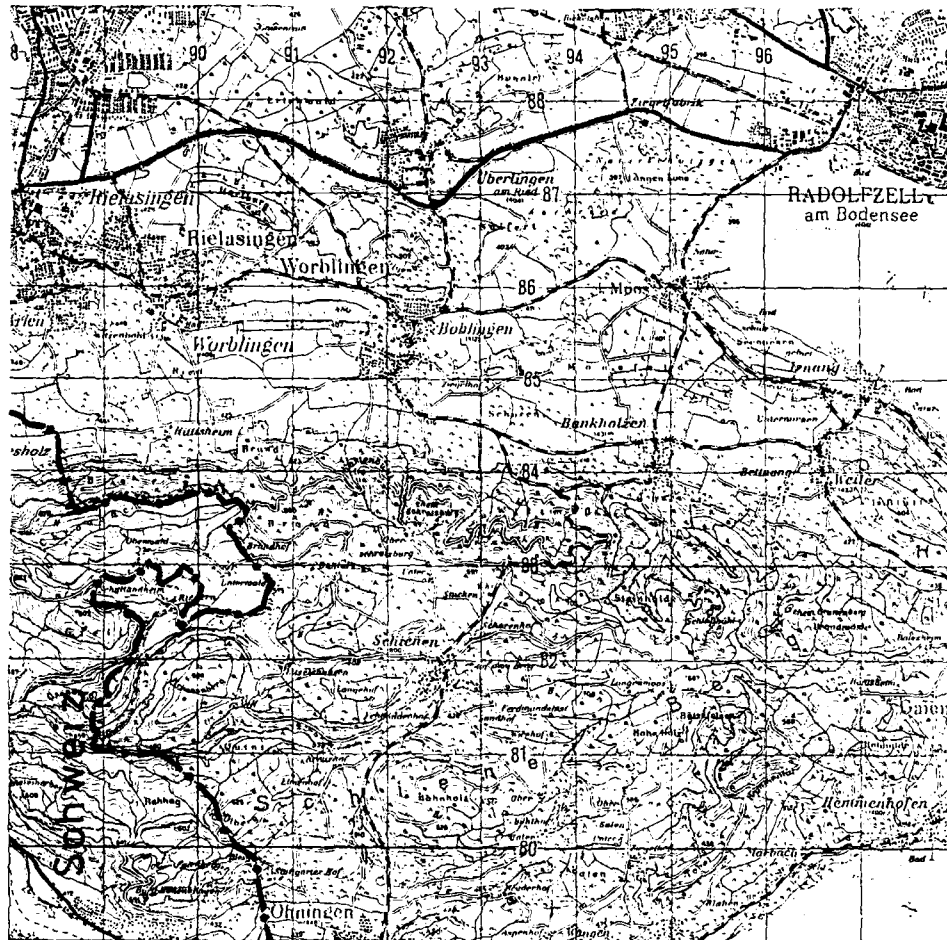


Fig. 17: Cell Areas Investigated,
 Area No.: 16, Region No.: 48, Cell No.: 4
 Quad Sheet No.: L 8318
 Forest Office: Radolfzell
 District Name: Konstanz
 Federal State: Baden Württemberg
 --- District Border

Fig. 18: Cell Areas Investigated,
Area No.: 17, Region No.: 48, Cell No.: 1
Quad Sheet No.: L 6536, L 6736
Forest Office: Amberg
District Name: Amberg-Sulzbach
Federal State: Bavaria

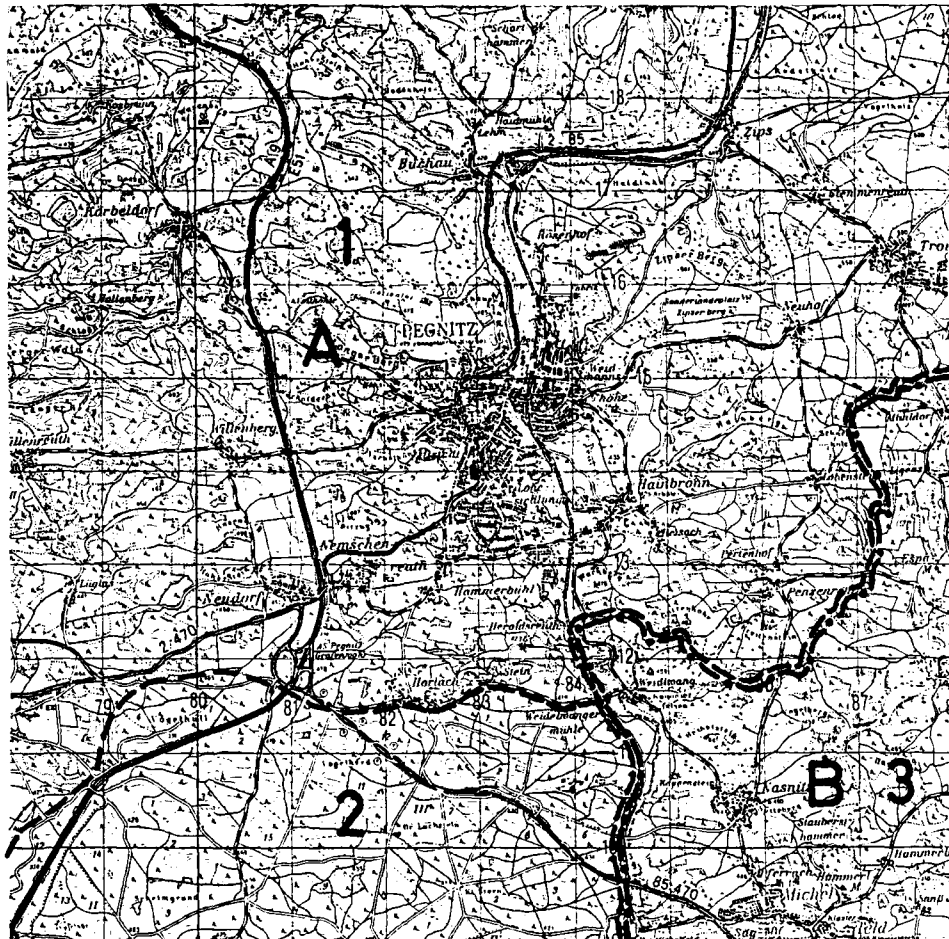


Fig. 19: Cell Areas Investigated,
Area No.: 18, Region No.: 48, Cell No.: 2
Quad Sheet No.: L 6334
Forest Office: 1 Betzenstein, 2 Pegnitz,
3 Sulzbach-Rosenberg
District Name: A Bayreuth, B Amberg-Sulzbach
Federal State: Bavaria
--- Forest Office Border
--- District Border

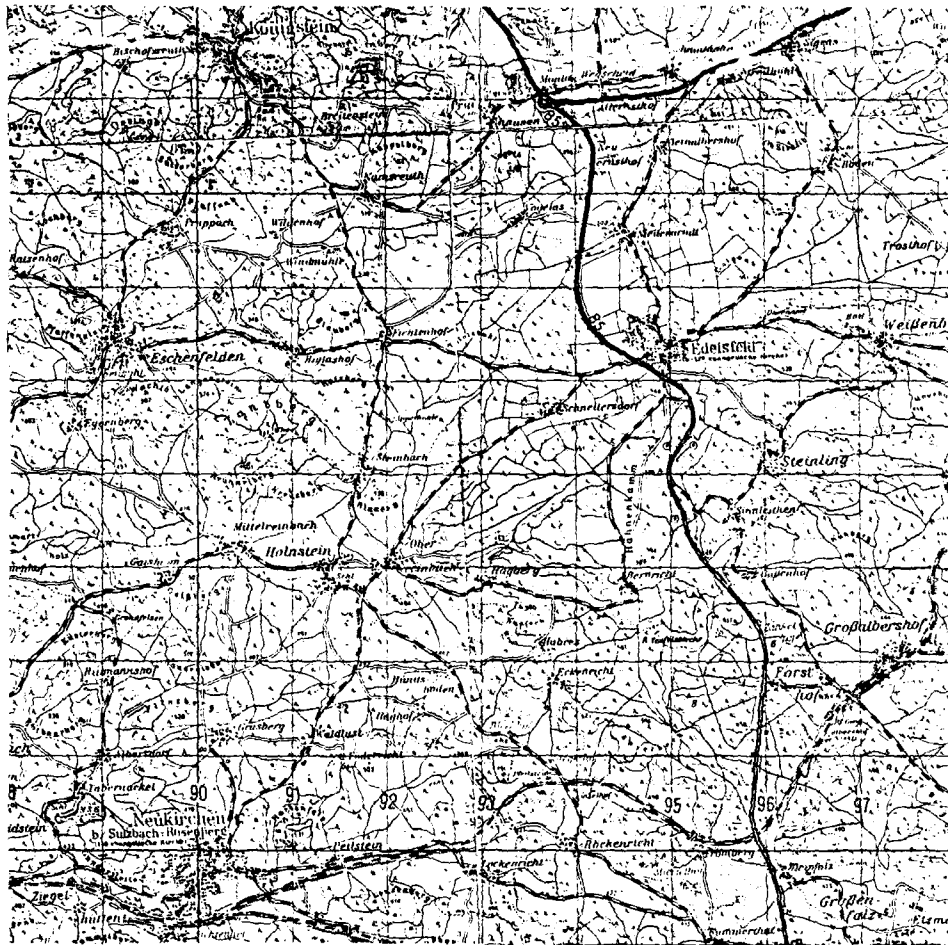


Fig. 20: Cell Areas Investigated,

Area No.: 19, Region No.: 48, Cell No.: 3

Quad Sheet No.: L 6334, L 6336, L 6534, L 6536

Forest Office: Sulzbach-Rosenberg

District Name: Amberg-Sulzbach

Federal State: Bavaria

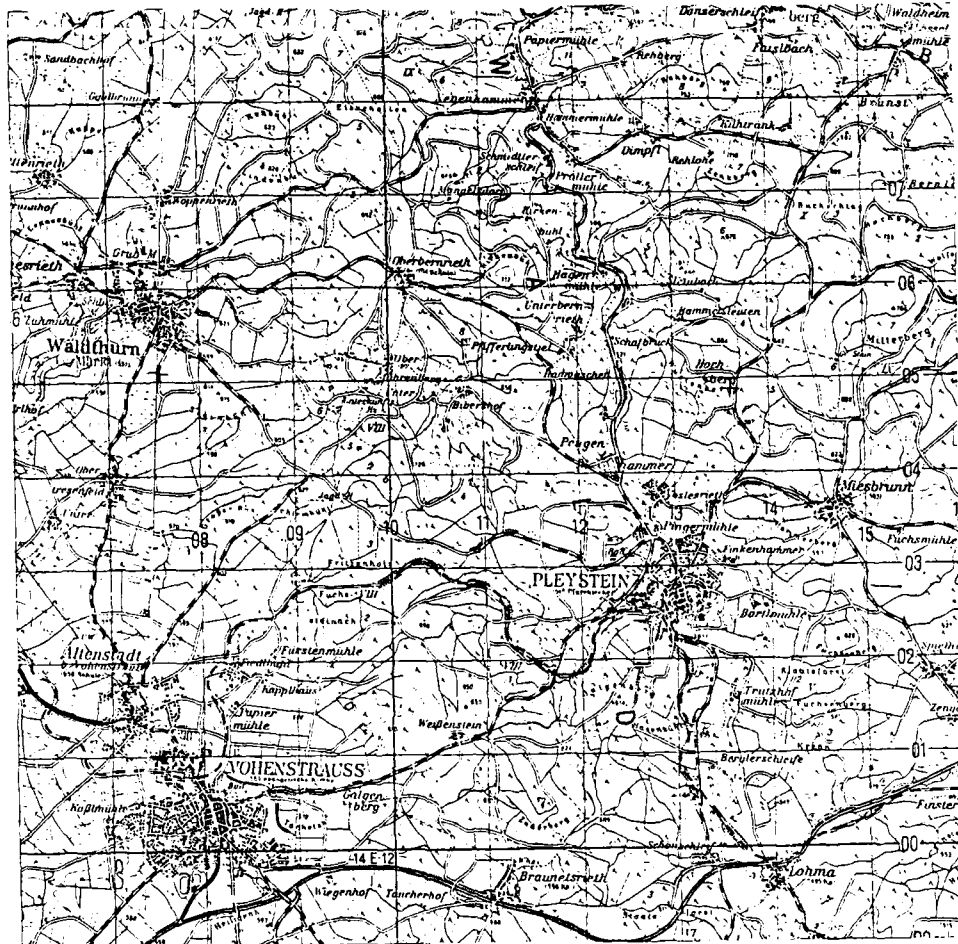


Fig. 21: Cell Areas Investigated,

Area No.: 20, Region No.: 48, Cell No.: 4

Quad Sheet No.: L 6338, L 6340

Forest Office: Vohenstrauß

District Name: Neustadt a.d. Waldnaab

Federal State: Bavaria

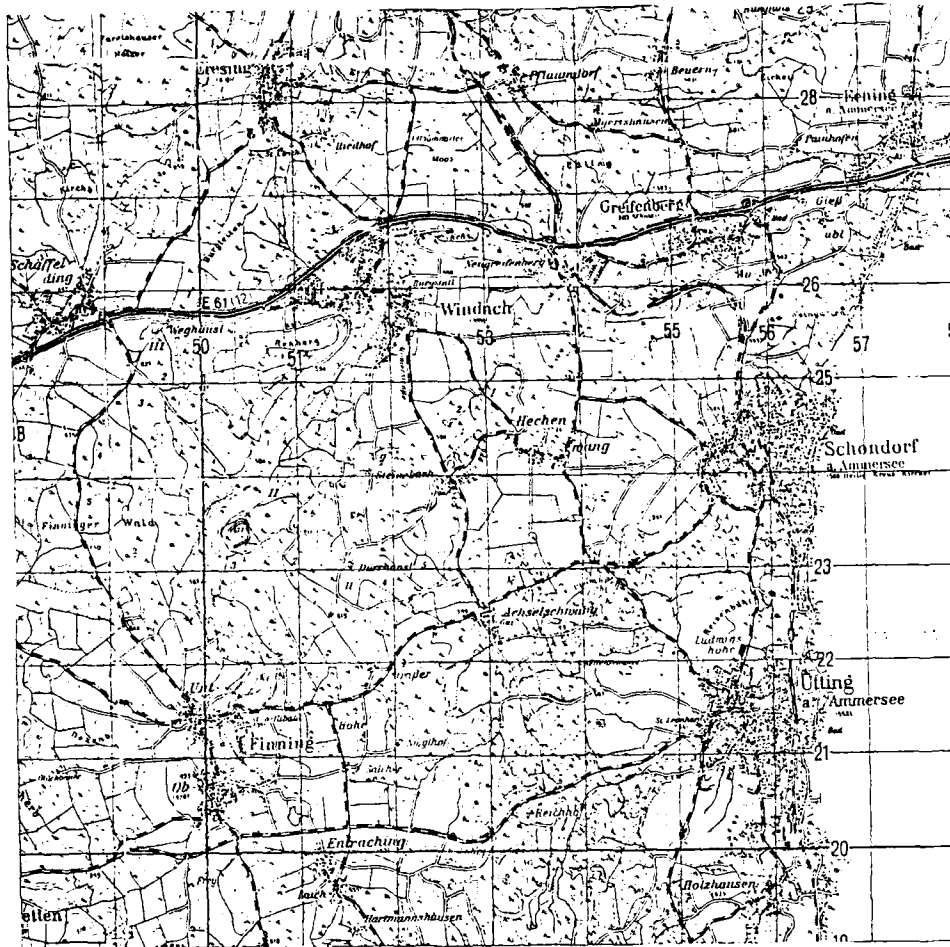


Fig. 22: Cell Areas Investigated,
Area No.: 21, Region No.: 48, Cell No.: 8
Quad Sheet No.: L 7930, L 7932
Forest Office: Landsberg
District Name: Landsberg a. Lech
Federal State: Bavaria

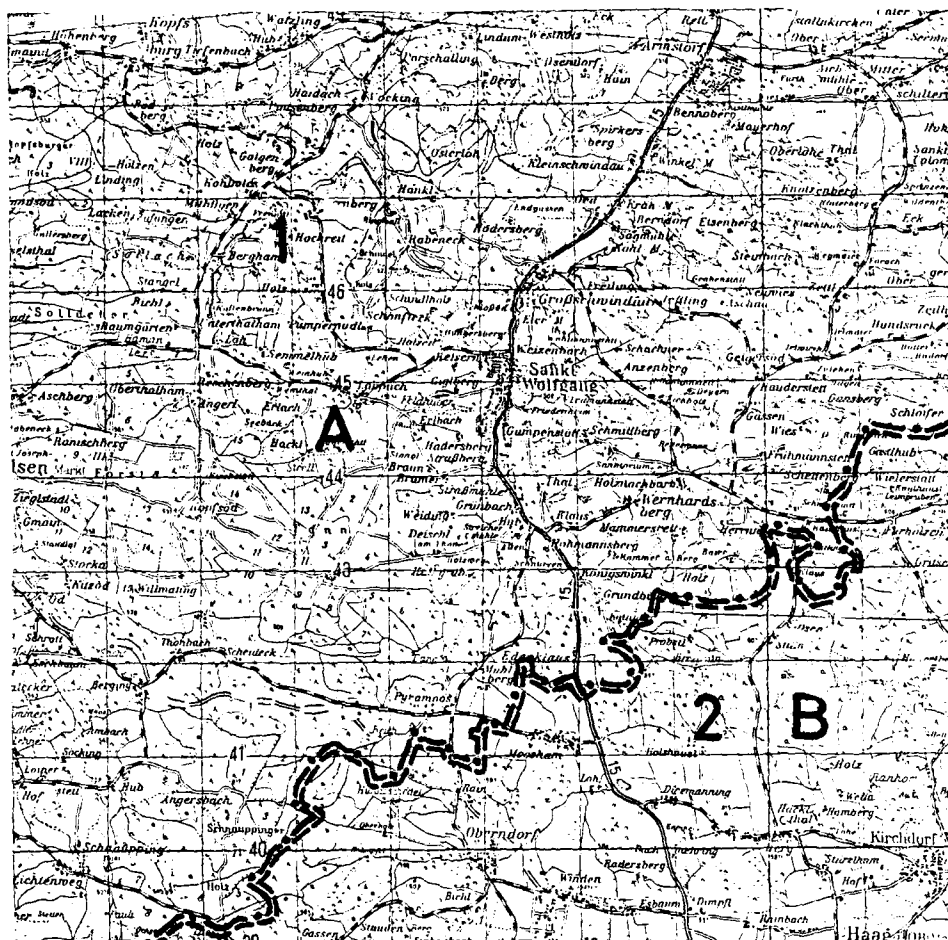


Fig. 23: Cell Areas Investigated,

Area No.: 22, Region No.: 48, Cell No.: 9

Quad Sheet No.: L 7738, L 7938

Forest Office: 1 Landshut, 2 Mühldorf

District Name: A Erding, B Mühldorf a. Inn

Federal State: Bavaria

--- Forest Office Border

--- District Border

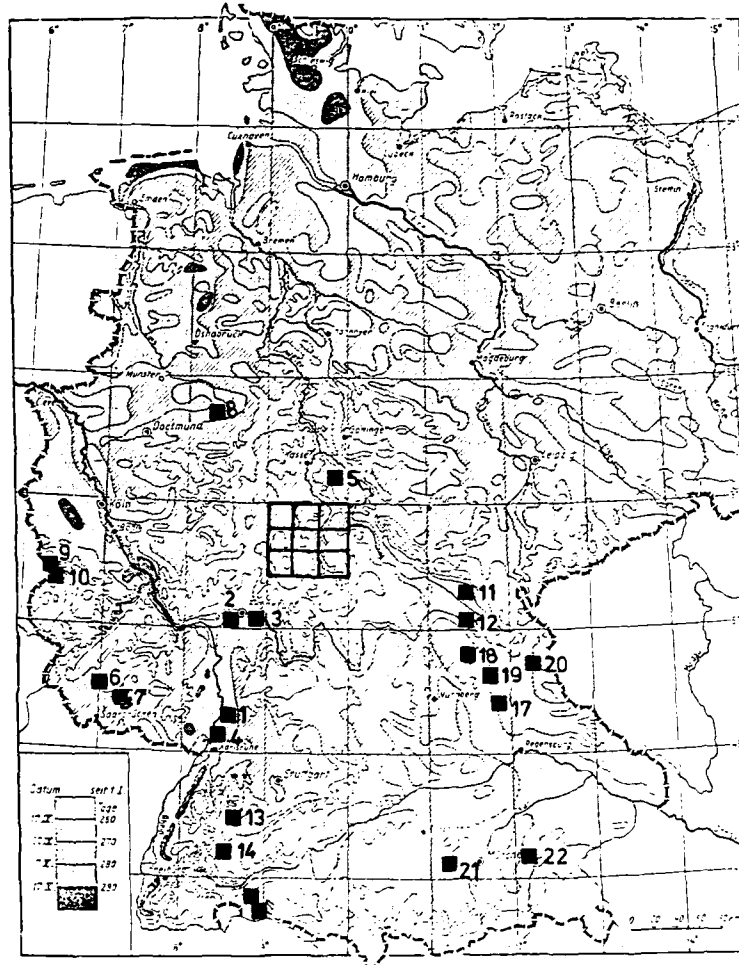


Fig. 24: Date of Planting for Oats (starting point)
in West and East Germany

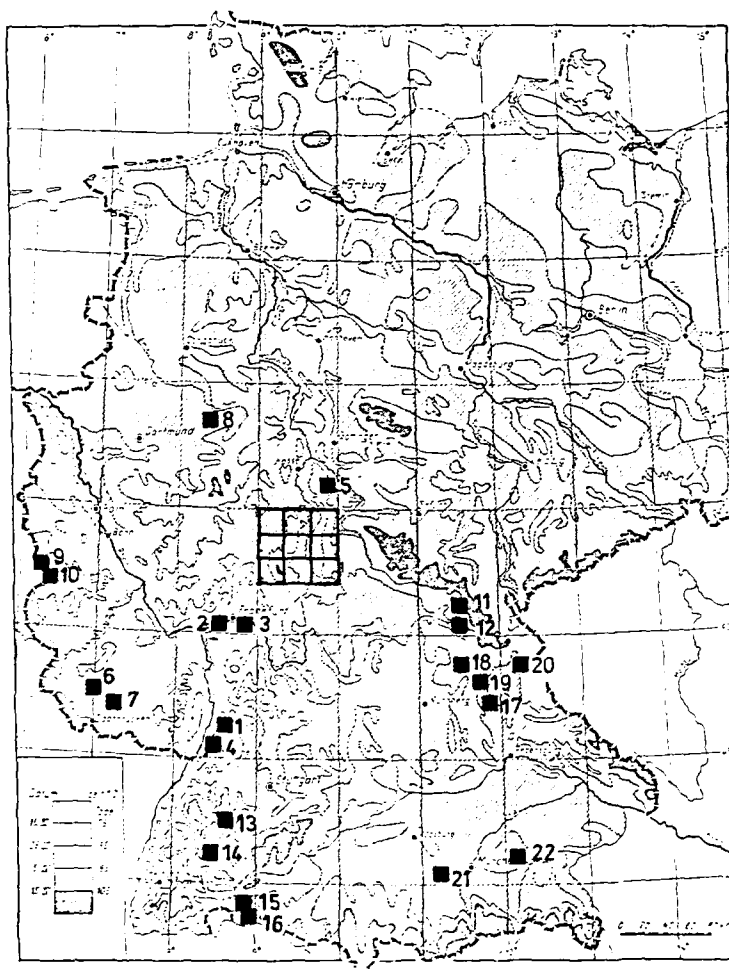


Fig. 25: Date of Planting for Winter Rye (starting point)
in West and East Germany

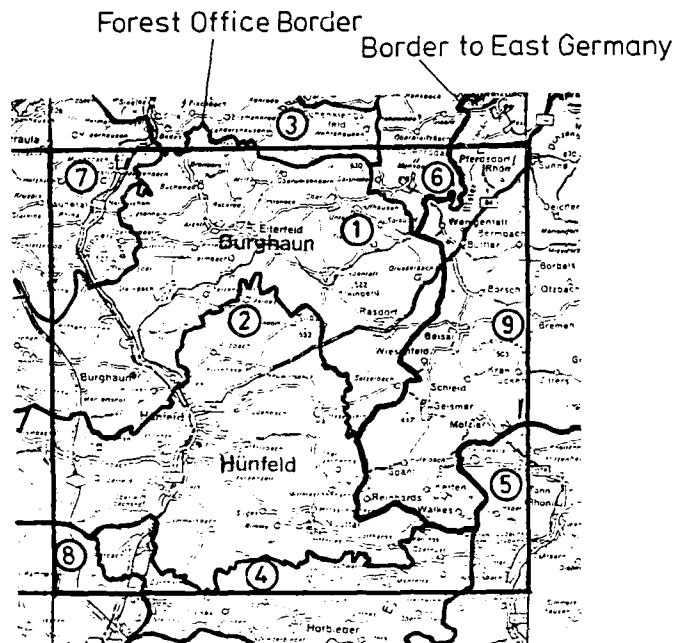
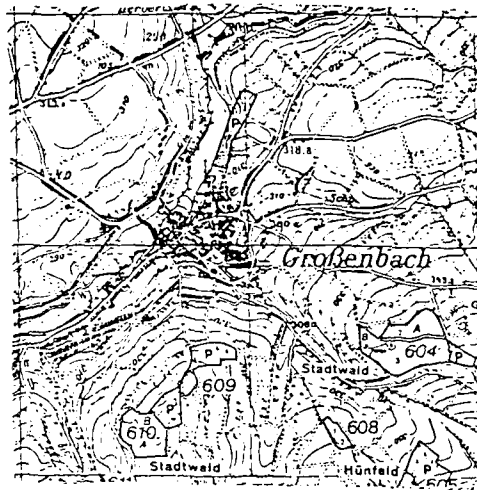


Fig. 26: Forest Office Map for the
Quad Sheet L 5324 Hünfeld

- 1 Burghaun
- 2 Hünfeld
- 3 Bad Hersfeld
- 4 Hofbieber
- 5 Hilders
- 6 Heringen
- 7 Niederaula
- 8 Fulda
- 9 East Germany



- 1 = Department and Under-Department No.
- 2 = Toatal Stock Area, ha
- 3 = Approx. Stock Percentage, %
- 4 = Species
- 5 = Age
- 6 = Average Height, m
- 7 = Locality Class
- 8 = Canopy Closure
- 9 = Stock Area, ha
- 10 = Excess Area, ha
- 11 = Location Code

1	2	3	4	5	6	7	8	9	10	11
U NR	BESTANDS	BESTOCKUNGS	HOLZ		MITTEL	BONI	BEST	TEIL	UEBERSCH	STANDORTS
ART F	FLAECHE	ANTEIL	ART	ALTER	HOEHE	TAET	GRAD	FLAECHE	TEILFL	SCHLUESSEL
HA								HA	HA	
604A301	1.2	030	HEU	045	12.0	25	07	0.7	0.0	384341
604A302	1.2	007	WEI	040	14.0	15	07	0.1	0.0	384341
604A303	1.2	005	AS	040	15.0	10	07	0.1	0.0	384341
604A304	1.2	010	BU	045	14.0	20	07	0.1	0.0	384341
604A305	1.2	010	EI	045	14.0	20	07	0.1	0.0	384341
604A306	1.2	009	FI	025	15.0	05	07	0.1	0.0	384341
604B001	0.8	060	AH	021	13.5	10	10	0.5	0.0	384331
604B002	0.8	030	ES	021	15.0	10	10	0.2	0.0	384331
604B003	0.8	010	EI	030	15.0	10	10	0.1	0.0	384331
605 001	1.0	065	KI	102	22.5	25	06	0.7	0.0	384311
605 002	1.0	015	FI	085	24.0	25	06	0.3	0.0	384311
606A001	1.0	035	KI	072	20.5	20	09	0.0	0.0	384311
606A002	1.0	015	FI	072	22.0	25	09	0.2	0.0	384311
606B001	2.5	030	KI	050	15.5	22	08	2.0	0.0	384341
606B002	2.5	020	ELA	050	16.0	30	08	0.5	0.0	384341
607 001	0.9	020	SKI	021	0.0	15	09	0.7	0.0	384341
607 002	0.9	020	KI	040	14.0	15	09	0.2	0.0	384341
607 004	0.1	100	KI	075	20.0	20	08	0.1	0.0	384331
608 101	0.4	100	ER	000	0.0	20	00	0.4	0.0	384332
608 201	0.3	100	ER	005	0.0	15	09	0.3	0.0	384332
609 001	0.6	055	KI	025	16.0	35	04	0.3	0.0	384341
609 002	0.6	025	FI	025	15.0	50	04	0.2	0.0	384341
609 003	0.6	015	EI	090	15.0	40	04	0.1	0.0	384341
609 004	0.6	005	KIR	050	14.0	25	04	0.0	0.0	384341
610A001	2.2	100	SK	000	0.0	15	00	2.2	0.0	384341
610B001	0.9	100	KI	060	18.5	20	06	0.9	0.0	384331
610B003	0.4	100	KI	035	12.0	20	04	0.4	0.0	384341
611A001	1.4	100	KI	060	18.0	20	06	1.4	0.0	384341

Fig. 27: Part of the Hünfeld Forest Office Map with Detailed Forest Areas (604, 608, 609, 610) Including the Forestry Data

(P = private forest. inventory Date: 7 Jan. 1987)

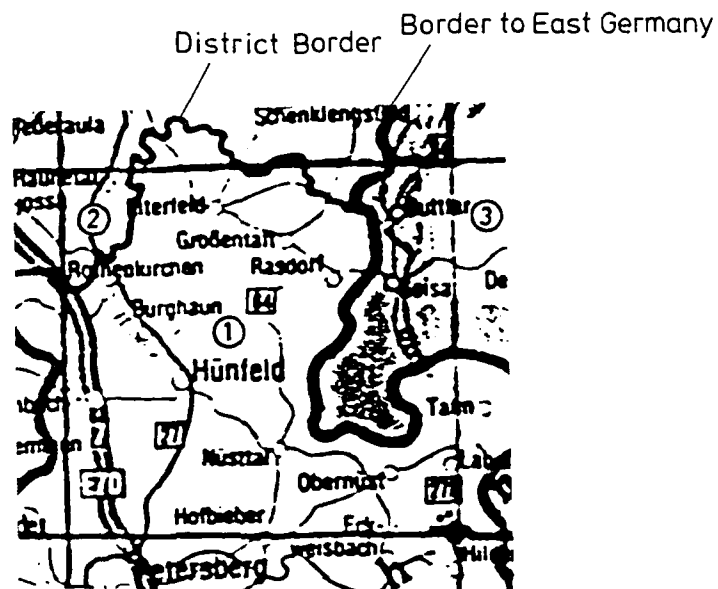


Fig. 28: District Map for the Quad Sheet L 5324

- 1 Fulda
- 2 Hersfeld Rotenburg
- 3 East Germany

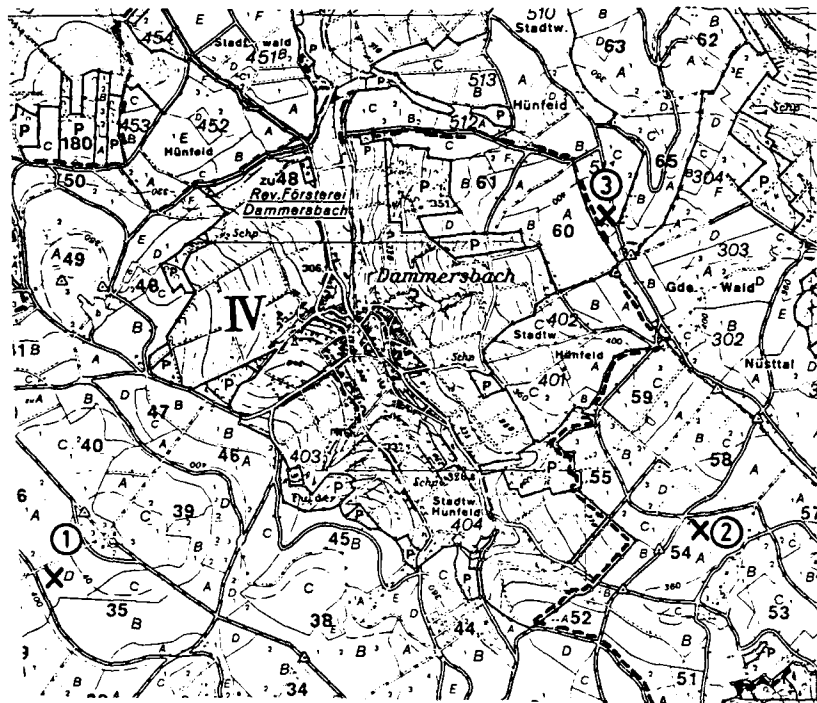


Fig. 29: Locations of Site Nos.: 1, 2 and 3

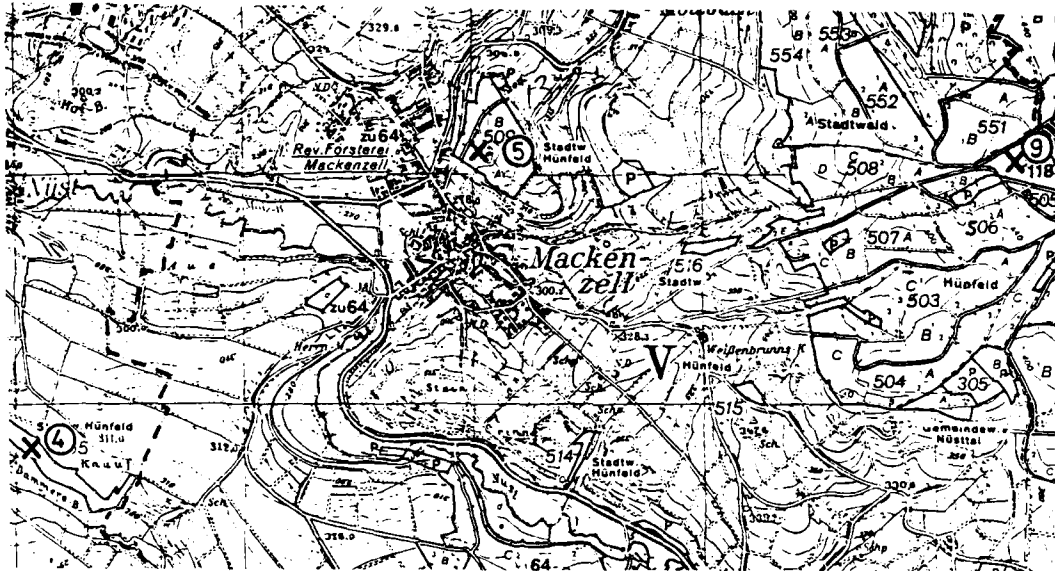


Fig. 30: Location of Site Nos.: 4, 5 and 9

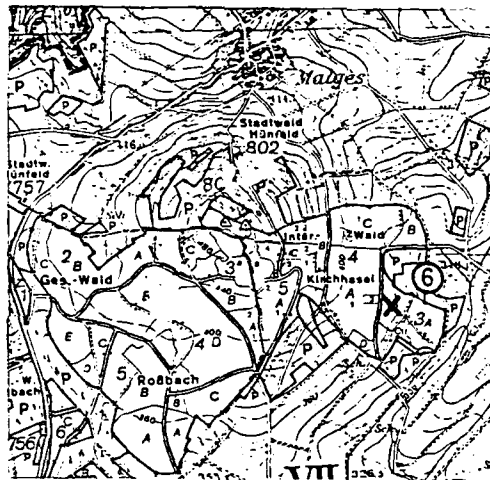


Fig. 31: Location of Site No. 6

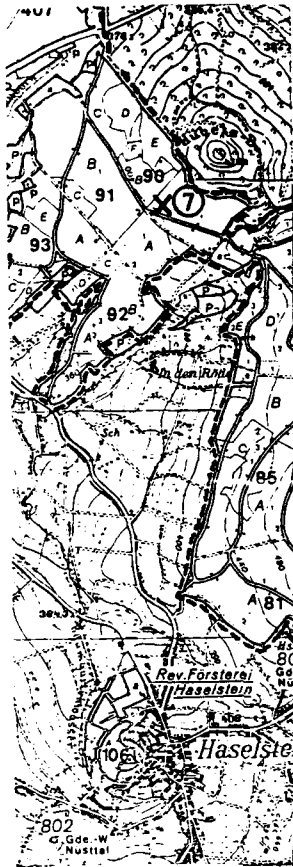


Fig. 32: Location of Site No. 7

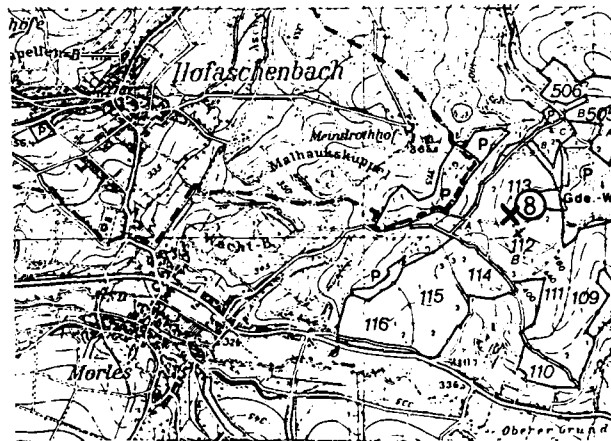


Fig. 33: Location of Site No. 8

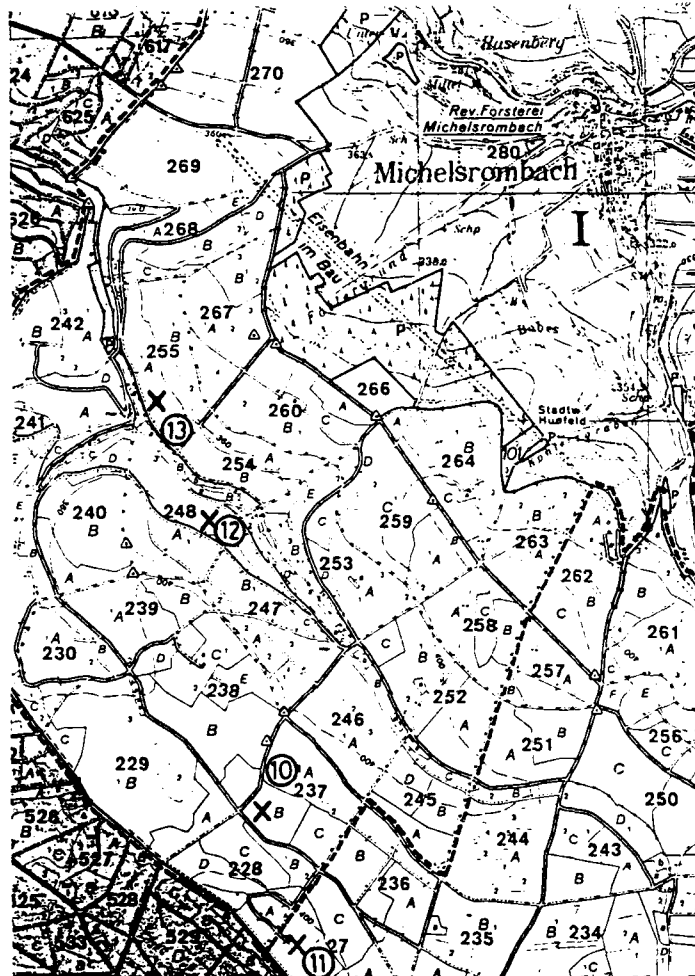


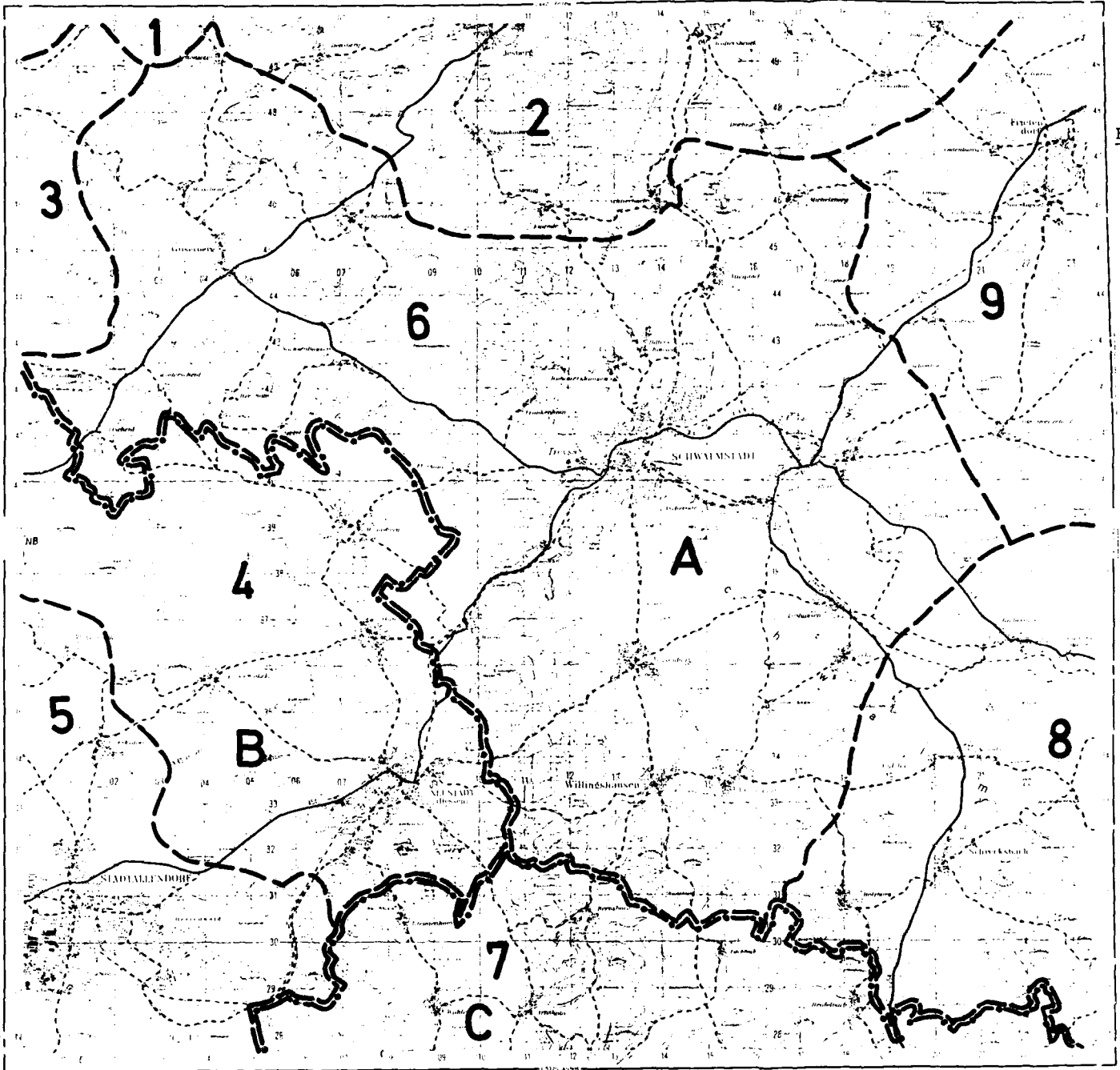
Fig. 34: Location of Site Nos. 10, 11, 12 and 13

Deutschland 1:50000
MB NB

Ziegenhain

Ausgabe 4 DMG Serie M 745

L 5120



Fig

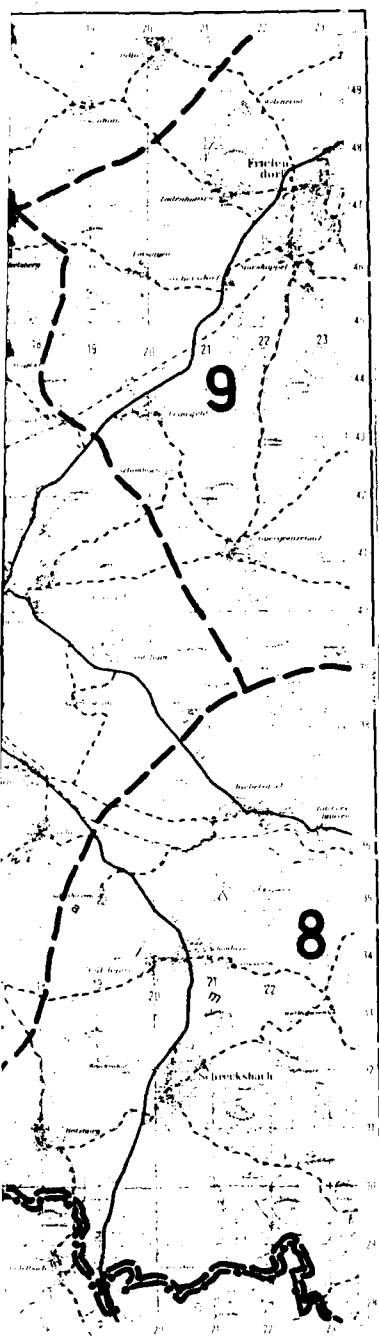


Fig. 35: Quad Sheet L 5120

Forest Office:

- 1 Bad Wildungen
- 2 Jesberg
- 3 Burgwald
- 4 Rauschenberg
- 5 Kirchhain
- 6 Schwalmstadt
- 7 Alsfeld
- 8 Neukirchen
- 9 Homberg/Efze

District Name:

- A Schwalm Eder
- B Marburg Biedenkopf
- C Vogelsberg

--- Forest Office Border

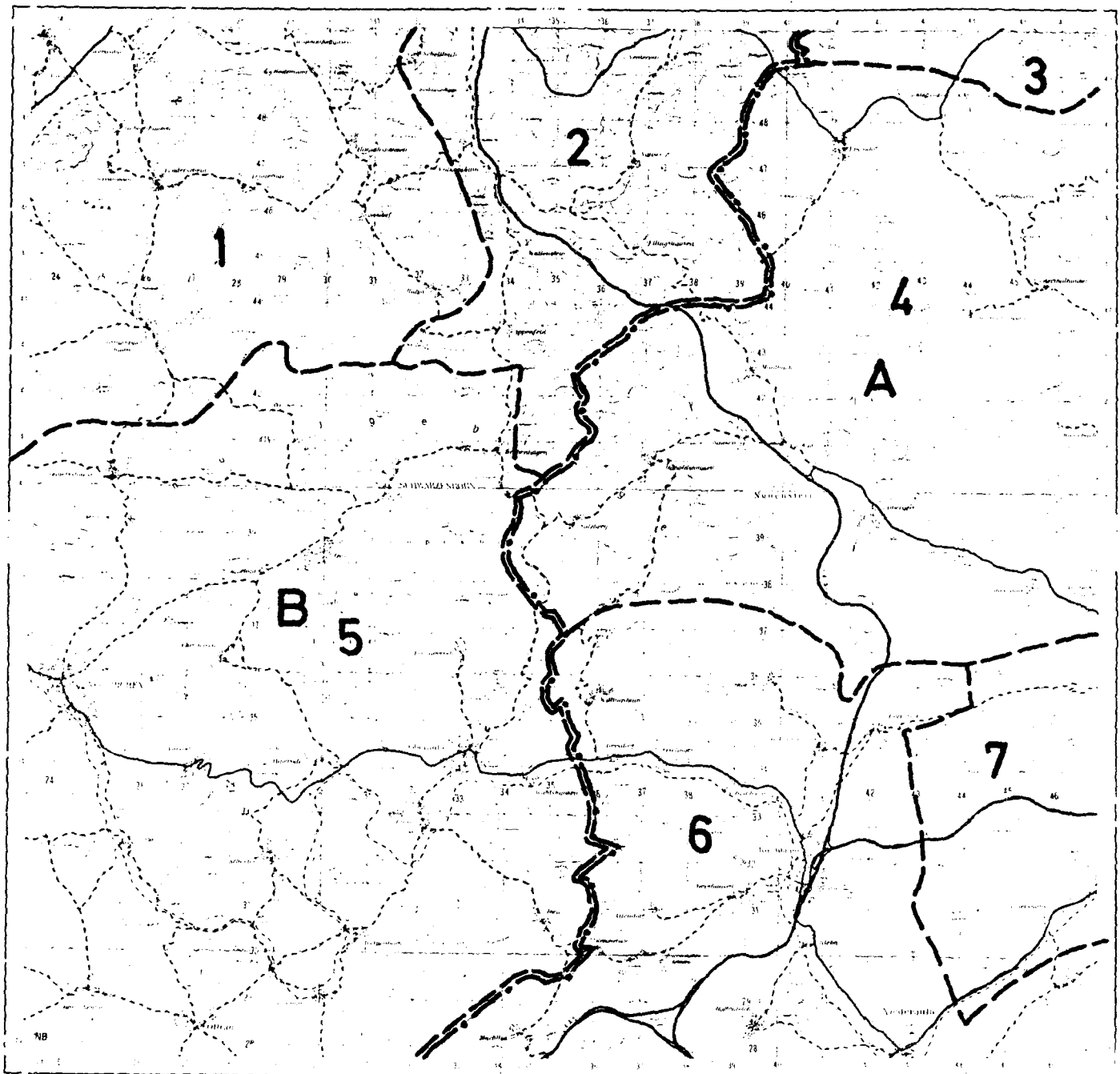
— District Border

Deutschland 1:50000

Neukirchen

Ausgabe 4 DMG Serie M 745

L 5122



L 5122



Fig. 36: Quadsheet L 5122

Forest Office:

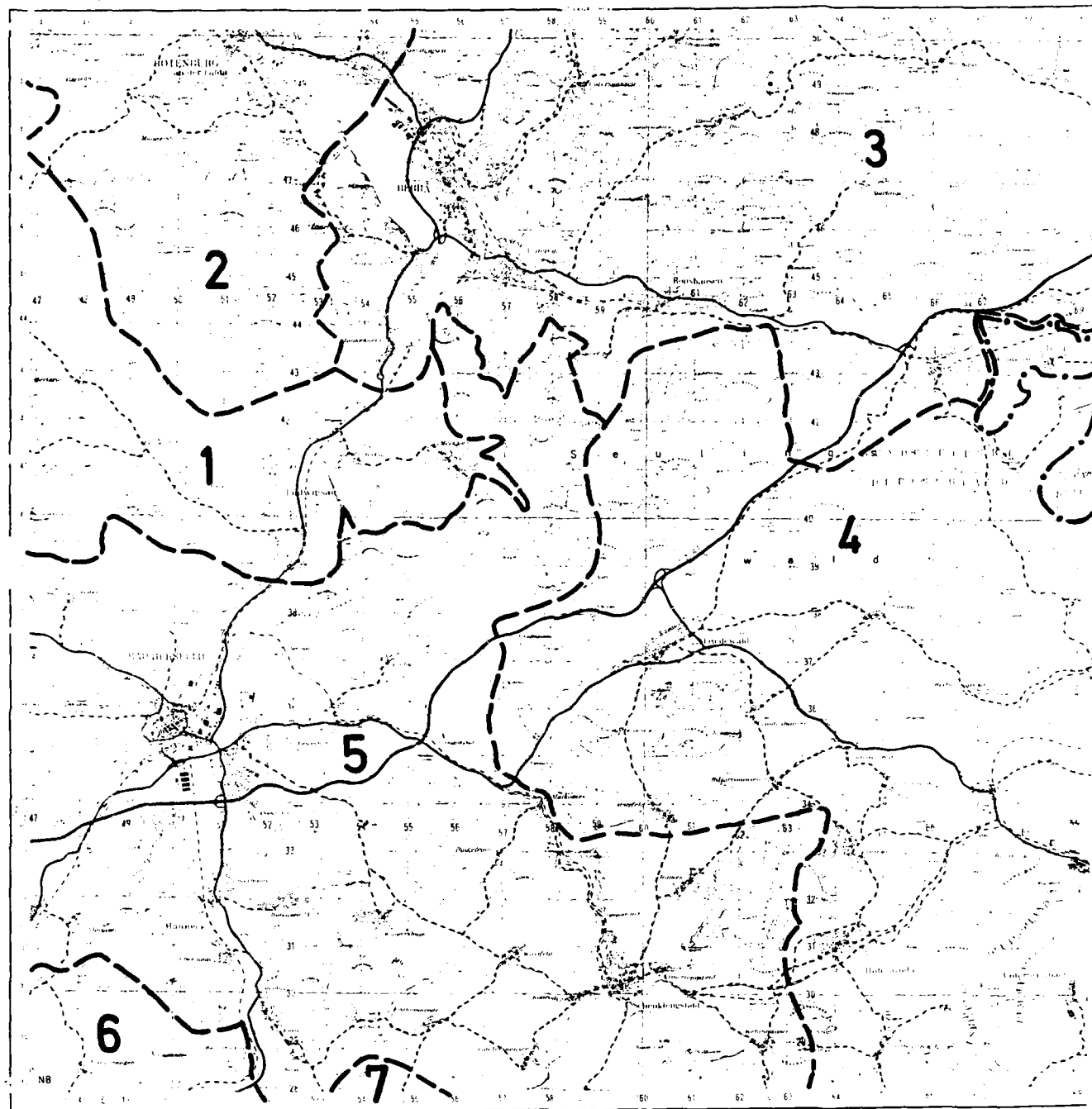
- 1 Homberg/Efze
- 2 Knüllwald
- 3 Rotenburg
- 4 Neuenstein
- 5 Neukirchen
- 6 Niederaula
- 7 Bad Hersfeld
- 8 Neukirchen

District Name:

- A Hersfeld Rotenburg
- B Schwalm-Eder

--- Forest Office Border

--- District Border



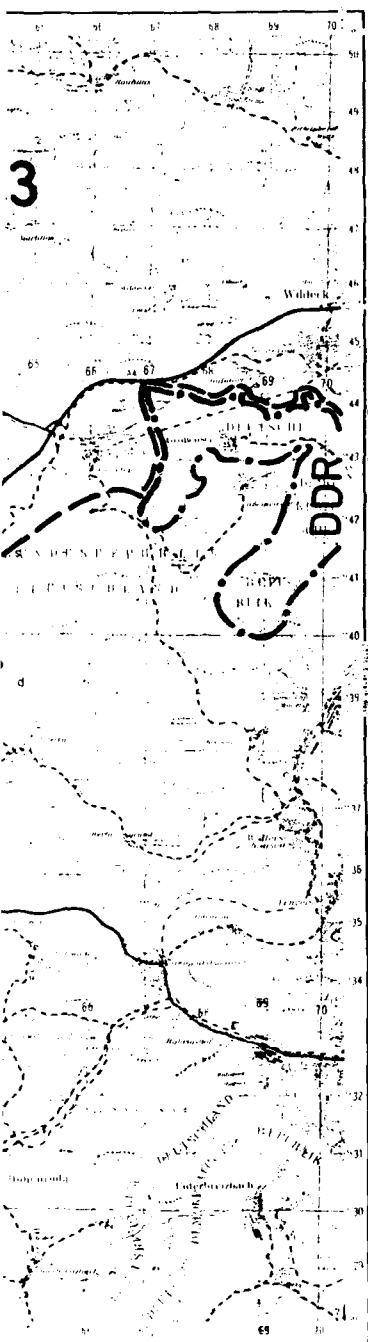


Fig. 37: Quad Sheet L 5124

Forest Office:

- 1 Neuenstein
- 2 Rotenburg
- 3 Nentershausen
- 4 Heringen
- 5 Bad Hersfeld
- 6 Niederaula
- 7 Burghaun

District Name:

Hersfeld-Rotenburg

--- Forest Office Border

Deutschland 1:50000
M 745

Alsfeld

Ausgabe 4 DMG Serie M 745

L 5320

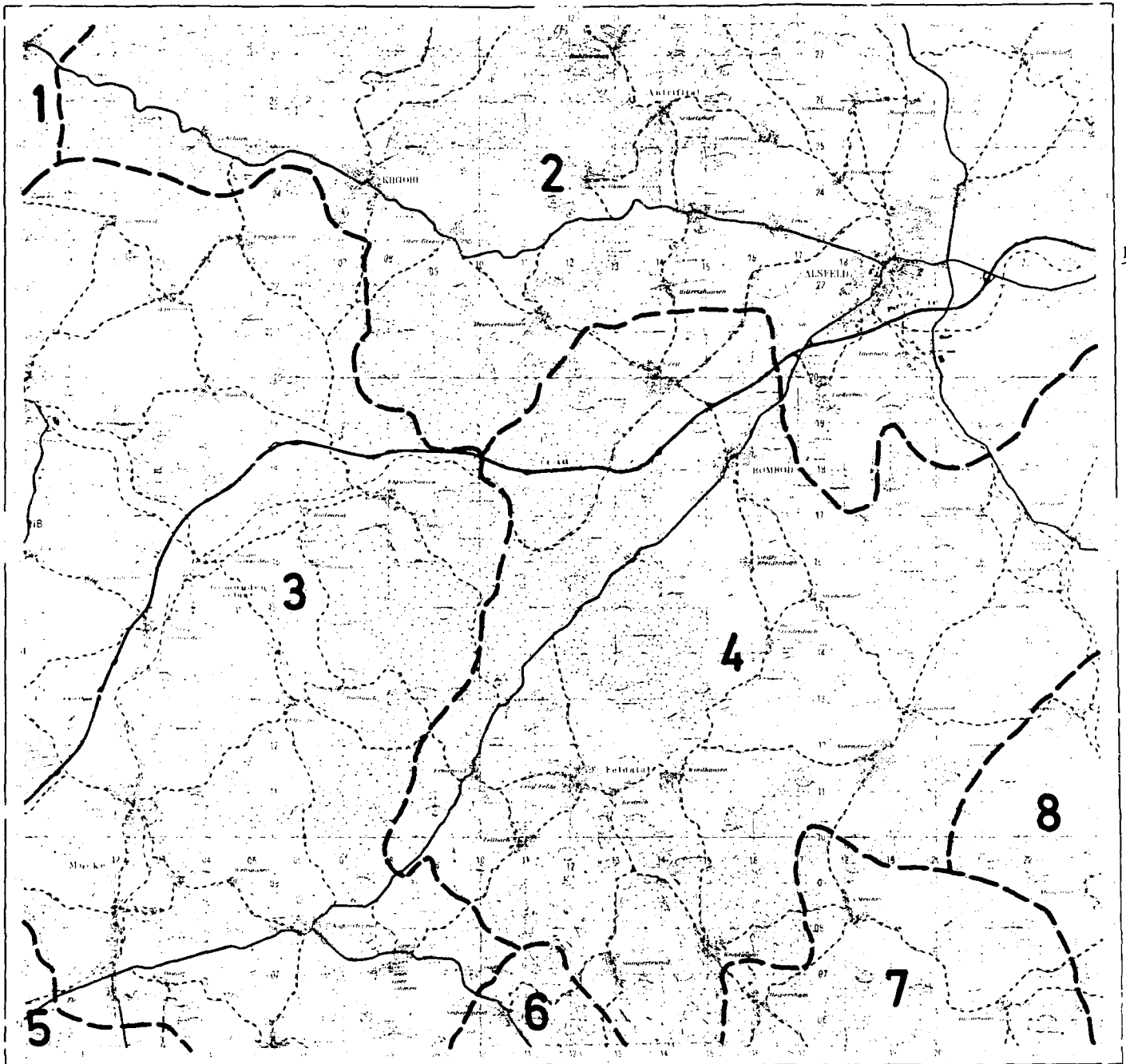


Fig.

Fig. 38: Quad Sheet L 5320

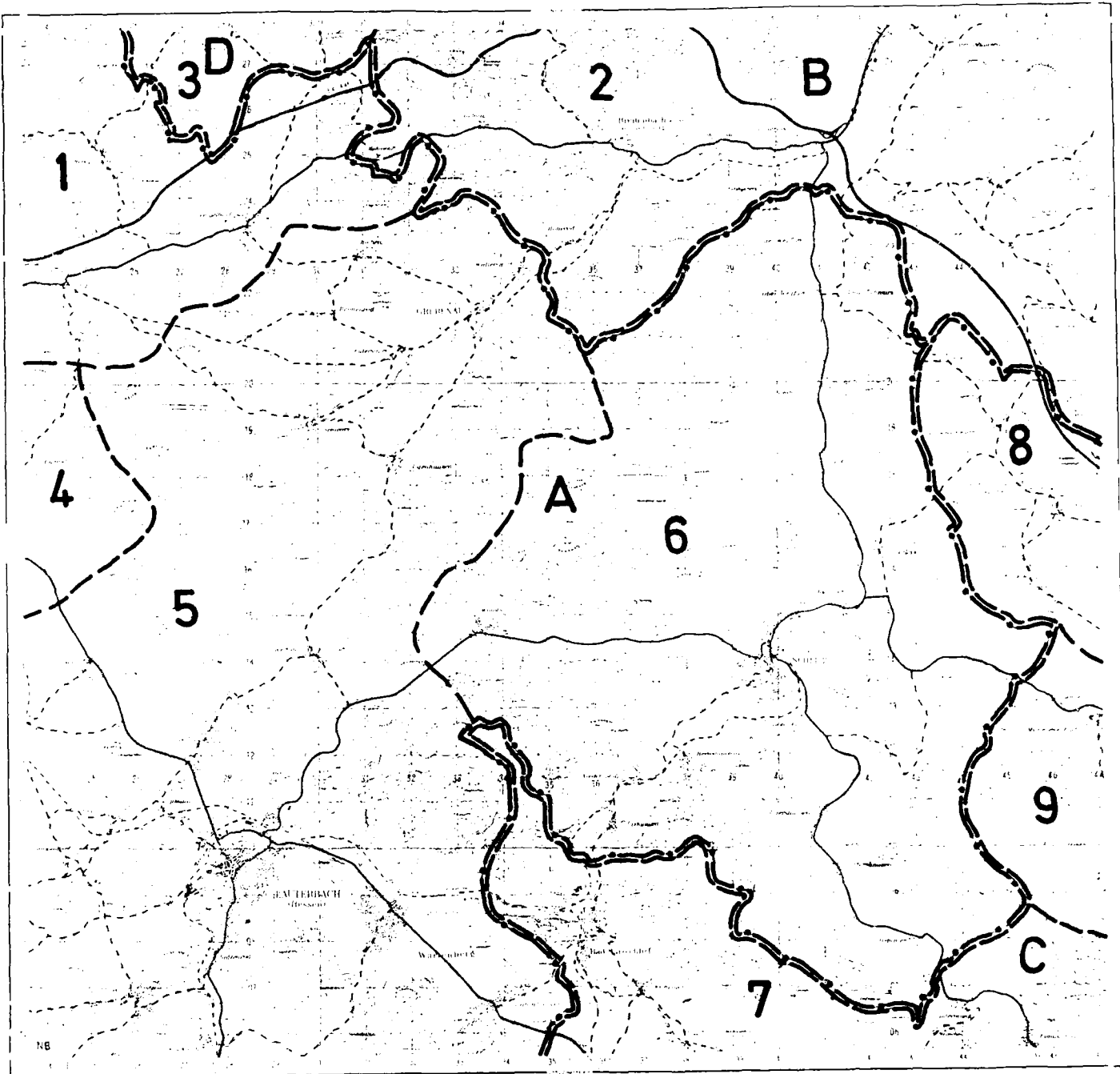
Forest Office:

- 1 Kirchhain
- 2 Alsfeld
- 3 Homberg/Ohm
- 4 Romrod
- 5 Grünberg
- 6 Schotten
- 7 Grebenhain
- 8 Grebenau

District Name:

Vogelsberg

--- Forest Office Border



L 5322

Fig. 39: Quad Sheet L 5322

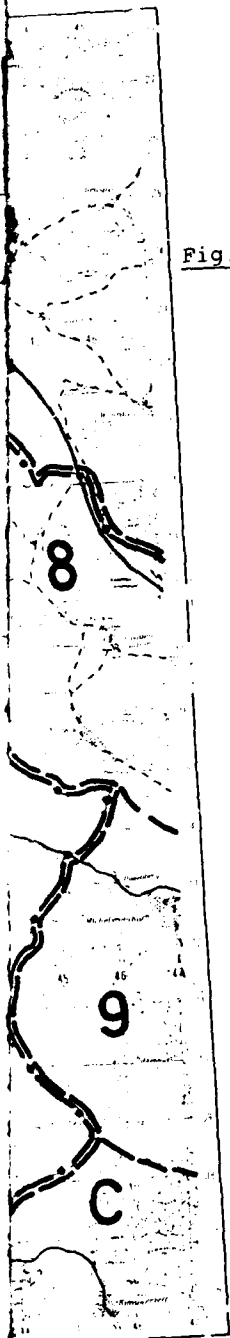
Forest Office:

- 1 Alsfeld
- 2 Niederaula
- 3 Neukirchen
- 4 Romrod
- 5 Grebenau
- 6 Schlitz
- 7 Fulda
- 8 Burghaun
- 9 Hünfeld

District Name:

- A Vogelsberg
- B Hersfeld-Rotenburg
- C Fulda
- D Schwalm-Eder

--- Forest Office Border
--- District Border

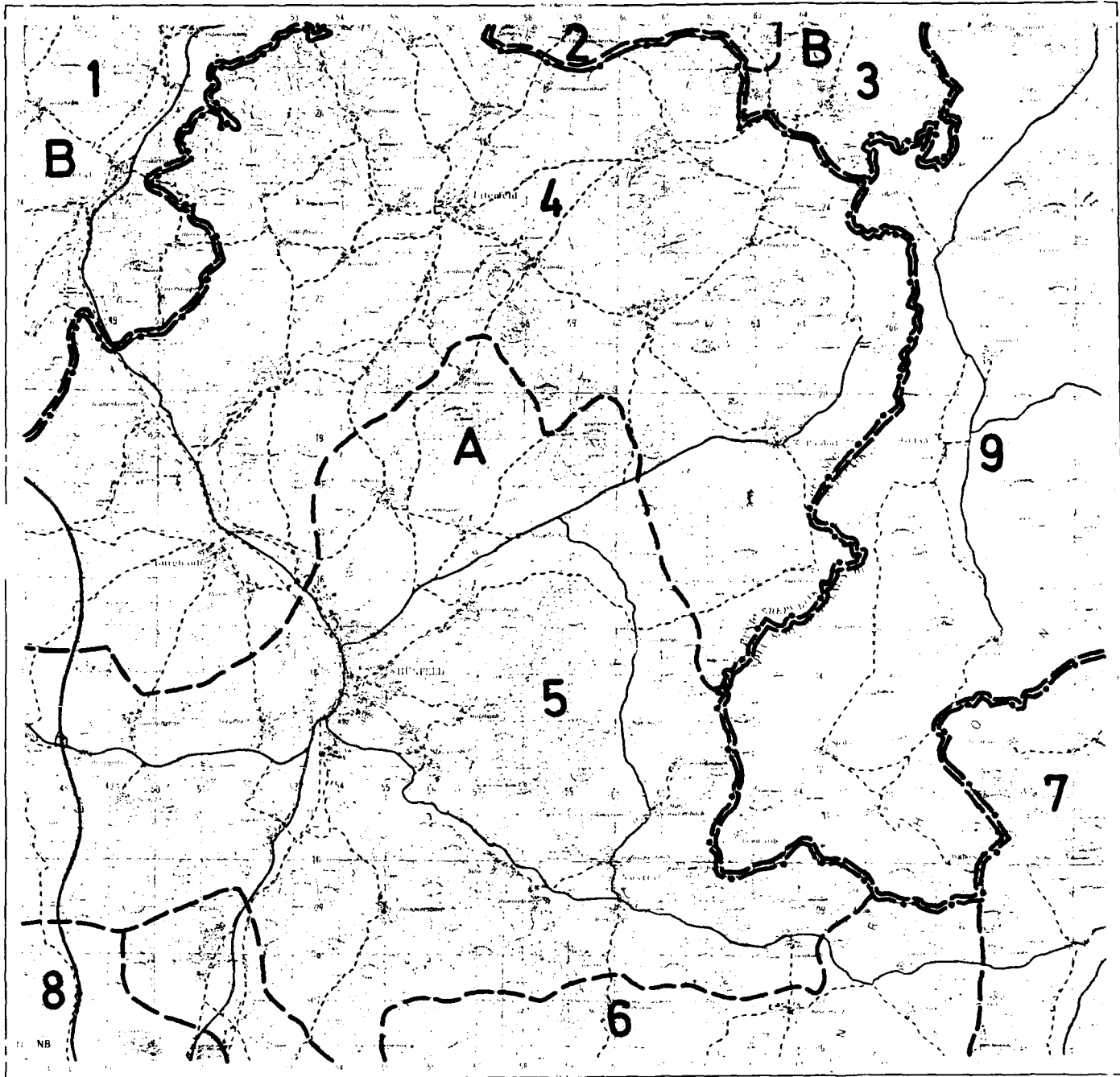


Deutschland 1:50 000

Hünfeld

Ausgabe 5 DMG Serie M 745

L 5324



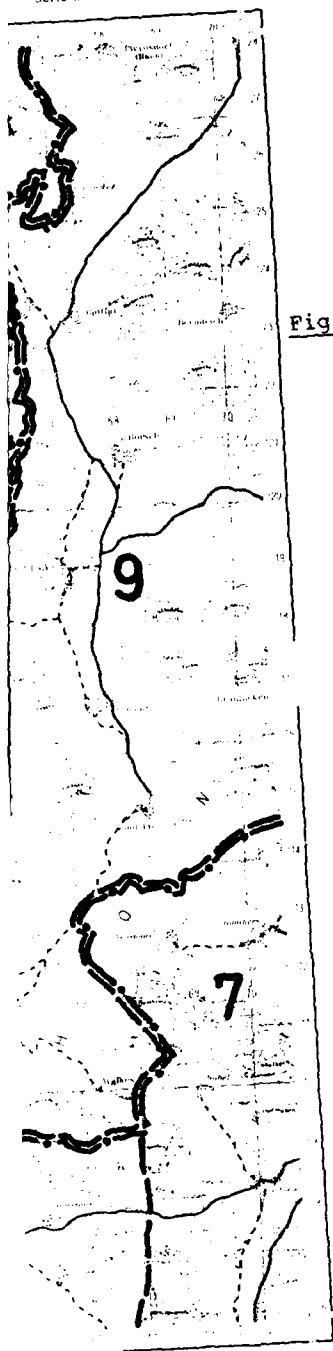


Fig. 40: Quad Sheet L 5324

Forest Office:

- 1 Niederaula
- 2 Bad Hersfeld
- 3 Heringen
- 4 Burghaun
- 5 Hünfeld
- 6 Hofbieber
- 7 Hilders
- 8 Fulda
- 9 East-Germany

District Name:

- A Fulda
- B Hersfeld-Rotenburg

--- Forest Office Border

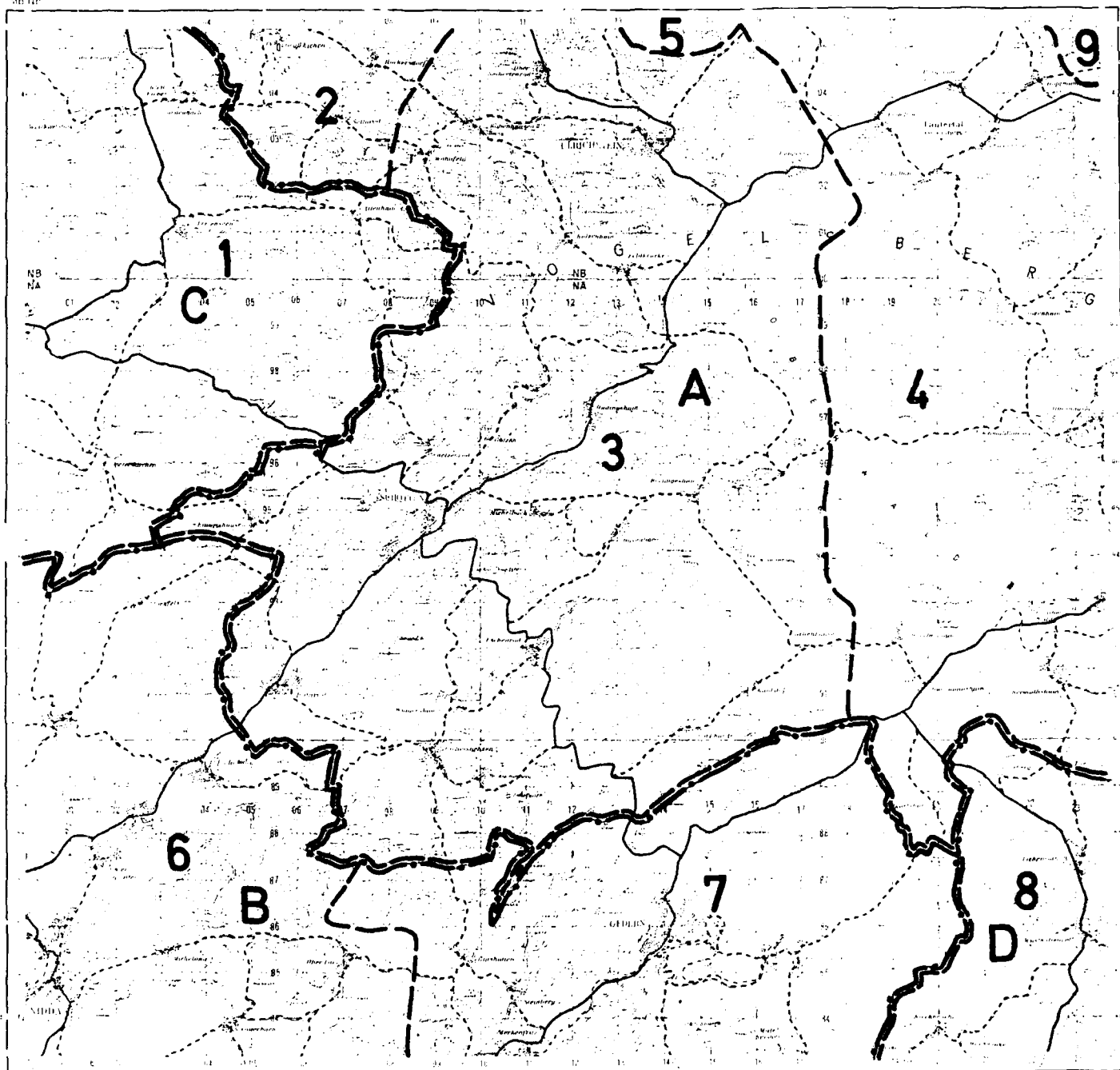
— District Border

Deutschland 1.50 000
908 147

Schotten

Aug 21st 4 PM, Sat. M 145

L 5520



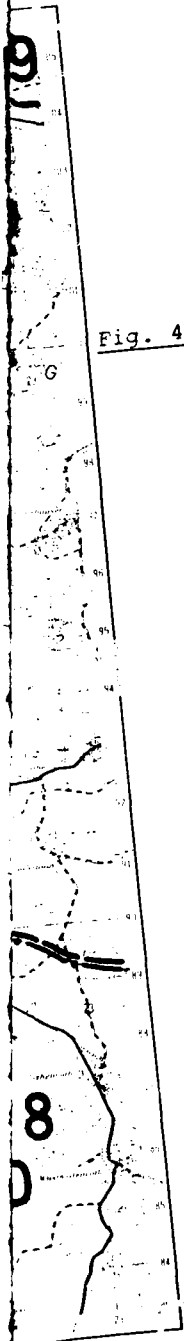


Fig. 41: Quad Sheet L 5520

Forest Office:

- 1 Grünberg
- 2 Homberg/Ohm
- 3 Schotten
- 4 Grebenhain
- 5 Romrod
- 6 Nidda
- 7 Budingen
- 8 Bad Soden-Salmünster
- 9 Grebenau

District Name:

- A Vogelsberg
- B Wetterau
- C Gießen
- D Main-Kinzig

--- Forest Office Border
--- District Border

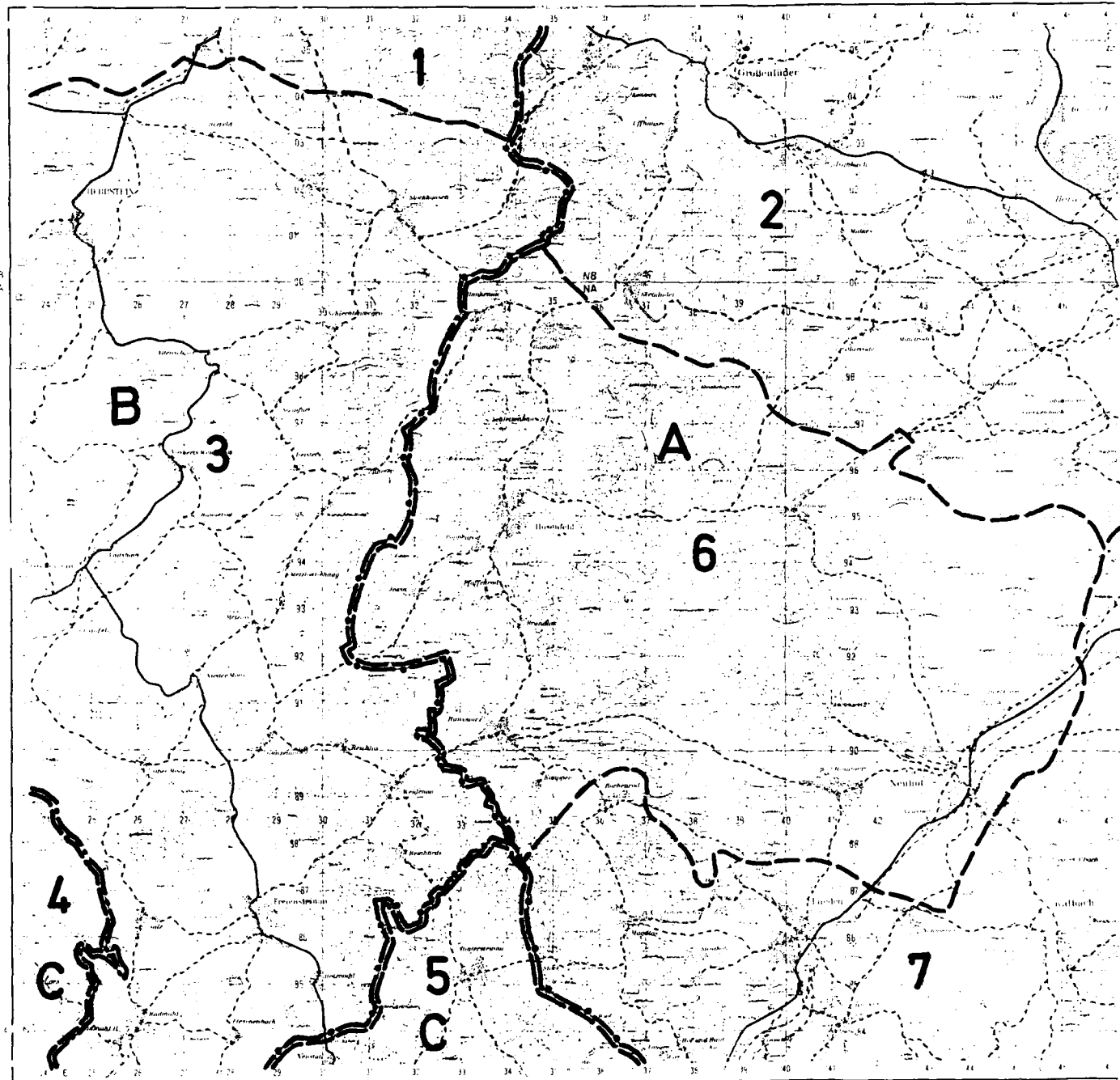
Deutschland 1:50000

Herbstein

Ausgabe 4-DMG

Serie M 745

L 5522



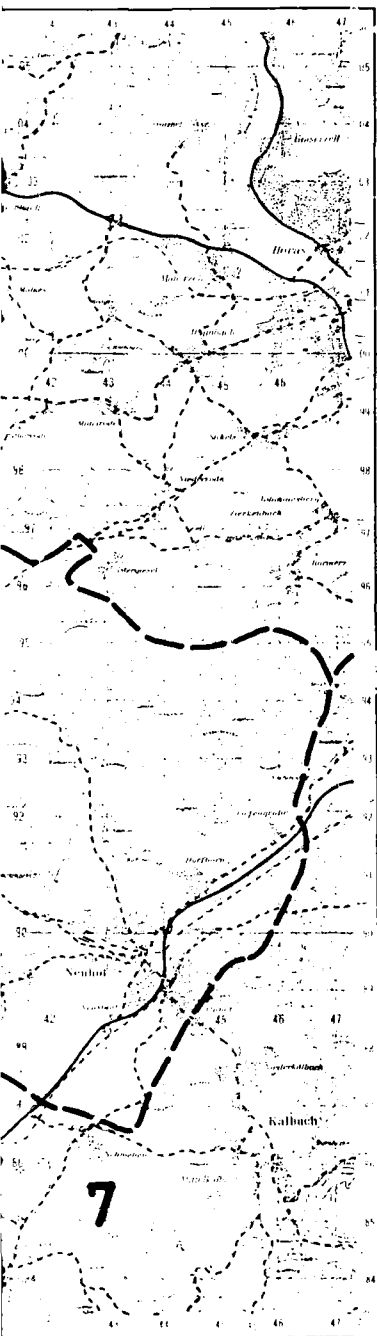


Fig. 42: Quad Sheet L 5522

Forest Office:

- 1 Grebenau
- 2 Fulda
- 3 Grebenhain
- 4 Bad Soden-Salmünster
- 5 Schlüchtern
- 6 Neuhof
- 7 Kalbach

District Name:

- A Fulda
- B Vogelsberg
- C Main Kinzig

--- Forest Office Border

--- District Border

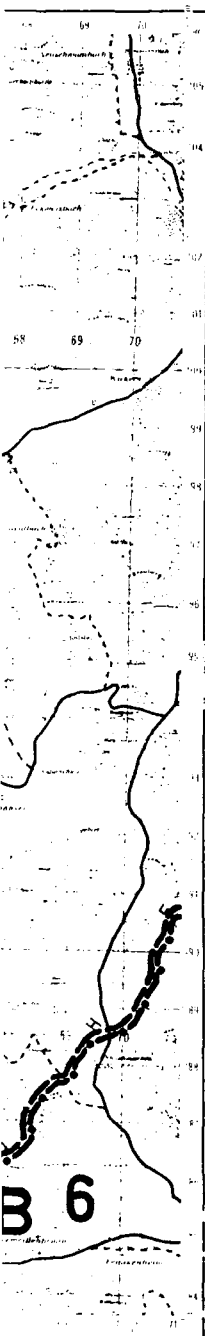


Fig. 43: Quad Sheet L 5524

Forest Office:

- 1 Fulda
- 2 Hofbieber
- 3 Hilders
- 4 Kalbach
- 5 Bad Brückenau
- 6 Bad Neustadt

District Name

- A Fulda
- B Rhön-Grabfeld
- C Bad-Kissingen

- Forest Office Border
 --- District Border

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Table 1: Geographical Description of the 22 Areas (Forestry Data)

Area No.	Region No.	Cell No.	Quad Sheet No.	Federal State	Forest Office
1	1A	1	L 6716; L 6718	Baden Württemberg	Schwetzingen, Wiesloch ¹⁾
2	1A	2	L 5916	Hesse	Hofheim, Mördelen-Walldorf
3	1A	3	L 5918	Hessen	Neu-Isenburg, Langen, Seligenstadt
4	1A	4	L 6916	Baden Württemberg	Karlsruhe, Karlsruhe-Hardt, Bruchsal
5	21	1	L 4724; L 4924	Hesse	Bad Soden-Allendorf, Wanfried, Hess.-Lichtenau
6	21	6	L 6506; L 6508	Saarland	Schmelz, Sotzweiler, Urexweiler, Lockweiler
7	21	7	L 4316; L 4516	Northrhine Westfalia	Meiste-Kneblingshausen, Anröchte, Steinhausen
8	21	9	L 6508; L 6510; L 6708; L 6710	Rhineland Palatine Saarland	Kusel, Waldmohr, Zweibrücken
9	26	1	L 5502;	Northrhine Westfalia	Karlsberg, Jagersburg
10	26	2	L 5502; L 5504; L 5702; L 5704	Northrhine Westfalia	Monschau, Wahlerscheid, Dedenborn
11	26	4	L 5734	Northrhine Westfalia	Udenbroth, Losheim, Hollerath, Prüm-Nord
12	26	8	L 5934	Rhineland Palatine	Nordthalben, Kronach
13	48A	1	L 7516; L 7518	Bavaria	Stadtsteinach
14	48A	2	L 7716	Baden Württemberg	Horb ¹⁾
15	48A	3	L 8118; L 8318	Baden Württemberg	Oberndorf, Schramberg
16	48A	4	L 8318	Baden Württemberg	Engen, Radolfzell
17	48	1	L 6536; L 6736	Bavaria	Radolfzell
18	48	2	L 6334;	Bavaria	Amberg ¹⁾
19	48	3	L 6334; L 6336; L 6534; L 6536	Bavaria	Pegnitz, Betzenstein, Sulzbach-Rosenberg
20	48	4	L 6338; L 6340	Bavaria	Sulzbach-Rosenberg
21	48	8	L 7930; L 7932	Bavaria	Vohenstrauß ¹⁾
22	48	9	L 7738; L 7938	Bavaria	Landsberg ¹⁾

1) Forestry data are not available

Tabelle 2: Distribution of Tree Species

Species	Dominant Species
Traubeneiche Stieleiche Übrige Eichen	oak
Buche Pappel Ulme Esche Bergahorn Spitzahorn Kirsche Linde Nuß Edelkastanie Übrige Edellaubhölzer Roteiche Birke Erle Hainbuche Aspe Weide Robinie Übrige Laubbäume	beech
Fichte Sitkafichte Omorica-fichte Übrige Fichten Tanne Abies procera Abies grandis Übrige Tannen Douglasie Thuja Tsuga Übrige Nadelbäume	spruce
Kiefer Schwarzkiefer Weymouthskiefer Übrige Kiefern Europäische Lärche Japanische Lärche andere Lärchen	pine

Table 3: Geographical Description of the 22 Areas (Agricultural Data)

Area No.	Region No.	Cell No.	Quad Sheet No.	Federal State	District Name
1	1A	1	L 6716; L 6718	Baden Württemberg	Rhein-Neckar, Stadt-Heidelberg
2	1A	2	L 5916	Hesse	Groß-Gerau, Main-Taunus, Stadt Frankfurt
3	1A	3	L 5918	Hesse	Stadt-Offenbach, Offenbach, Stadt Frankfurt
4	1A	4	L 6916	Baden Württemberg	Karlsruhe, Stadt Karlsruhe
5	21	1	L 4724; L 4924	Hesse	Werra Meißner
6	21	6	L 6506; L 6508	Saarland	Saarlouis, St. Wendel, Merzig-Wadern
7	21	7	L 4316; L 4516	Northrhine Westfalia	Soest, Paderborn
8	21	9	L 6508; L 6510; L 6708; L 6710	Rhineland Palatine, Saarland	Kusel, Kaiserslautern
9	26	1	L 5502;	Northrhine Westfalia	Aachen
10	26	2	L 5502; L 5504; L 5702; L 5704	Northrhine Westfalia; Rhineland Palatine	Enskirchen, Daun
11	26	4	L 5734	Bavaria	Kronach
12	26	8	L 5934	Bavaria	Kulmbach
13	48A	1	L 7516; L 7518	Baden Württemberg	Freudenstadt
14	48A	2	L 7716	Baden Württemberg	Rottweil
15	48A	3	L 8118; L 8318	Baden Württemberg	Konstanz
16	48A	4	L 8318	Baden Württemberg	Konstanz
17	48	1	L 6536; L 6736	Bavaria	Amberg-Sulzbach
18	48	2	L 6334;	Bavaria	Bayreuth (Kreis), Amberg-Sulzbach
19	48	3	L 6334; L 6336; L 6534; L 6536	Bavaria	Amberg-Sulzbach
20	48	4	L 6338; L 6340	Bavaria	Neustadt a.d. Wallnaab
21	48	8	L 7930; L 7932	Bavaria	Landsberg
22	48	9	L 7738; L 7938	Bavaria	Erding, Mühldorf

Table 4: Land Use for the 22 Areas

Area Description			General Land Use					Agricultural Area				Crop Type				
Area No.	Region No.	Cell No.	Total Area (km ² = 100%)	Urban Area (%)	Forest Area (%)	Agric. Area (%)	Wet Linear Feature (%)	Agric. Area (km ² = 100%)	Farm Land (%)	Meadows, Pastures (%)	Farm Land (km ² = 100%)	Grain (%)	Corn (%)	Green Fodder (%)	Sugar Beets, Turnips (%)	Potatoes (%)
1	1A	1	100	21.5	38	39.5	1	39.5	85	15	33.5	57	18	12	10	3
2	1A	2	100	33	24	39	4	39	90	10	35	66	8	6	17	3
3	1A	3	100	38	58.5	13	0.5	13	80	20	9.5	65	22	7	1	4
4	1A	4	100	16	33	49.5	1.5	49.5	84	16	41.5	63	14	15	6	2
5	21	1	100	5	46	48.8	0.2	48.8	67	33	32.7	77	5	7	8	2
6	21	6	100	7.5	22	70.2	0.3	70.2	57	43	40.2	83	7	8	1	1
7	21	7	100	4	14	81.9	0.1	81.9	72	28	58.9	78	10	9	2	1
8	21	9	100	12	28.5	59	0.5	59	61	39	36	80	8	6	3	3
9	26	1	61	8	14	77.5	0.5	47.2	47	53	22.2	64	2	3	30	1
10	26	2	49	3	46	50.9	0.1	25	48	52	12	79	1.5	6	12.5	1
11	26	4	100	5	74	20	1	20	55	45	11	68	9	16	1	6
12	26	8	100	7	19	73.5	0.5	73.5	66	34	48.5	69	9	13	2	5
13	48A	1	100	6	24	69.7	0.3	69.7	48	52	35.5	68	5	23	1	3
14	48A	2	100	5.5	25	69.4	0.1	69.4	51	49	35.4	70	5	21	1	3
15	48A	3	97.5	7	15.5	77.2	0.3	75.7	56	44	42.4	62	19	16	1	2
16	48A	4	90.5	8	21.3	54	7.2	49	56	44	27	62	19	16	1	2
17	48	1	100	3	59.9	37	0.1	37	69	31	25.5	69	14	10	2	5
18	48	2	100	4.5	37.5	57.4	0.1	57.4	62	38	35.6	66	12	12	4	6
19	48	3	100	2.5	32	65.3	0.2	65.3	69	31	45.1	69	14	10	2	5
20	48	4	100	4.5	42.5	52	1	52	59	41	31	68	13	9	1.5	8.5
21	48	8	100	6	20	63.4	10.6	63.4	47	53	29.8	60	19	16	4	1
22	48	9	100	2.5	25	72.4	0.1	72.4	64	36	46.4	50	39	8	1	2

Table 5: Planting Dates for Summer Crops

Summer Cereals / Root Crops	Date of Planting
Oat	16.03. - 15.04.
Summer barley	16.03. - 15.04.
Summer mixed cereal	16.03. - 15.04.
Potatoes	20.03. - 20.04.
Suger beet	01.04. - 01.05.
Turnips	01.04. - 01.05.
Peas / beans	20.03. - 20.04.
Corn/Maize	20.04. - 20.05.

Table 6: Planting Dates for Winter Cereal and Rape

Winter Cereal / Rape	Date of Planting
Barley	15.09. - 15.10.
Rye	17.09. - 17.10.
Wheat	01.10. - 15.11.
Rape	01.09. - 15.09.

Table 7: Harvest Dates and Growth Heights

Plant	Growth Heights (cm)		Date of Harvesting
	unsprayed	sprayed	
Winter barley	90 - 110	80 - 90	10.07. - 30.07.
Winter rye	100 - 150	70 - 90	01.08. - 20.08.
Winter wheat	90 - 110	80 - 90	15.08. - 15.09.
Oat	90 - 120		15.08. - 30.08.
Summer barley	80 - 100		15.08. - 30.08.
Grain corn	180 - 250		10.10. - 20.10.
Silc corn	280 - 220		15.09. - 30.09.
Rape	90 - 120		20.07. - 10.08.

Table 8: Overview of Possible Crop Rotation

A	A1	B	C	D
1. leaf crop 2. truck crop 3. " 4. truck crop (frequent double repeat)	1. leaf crop 2. truck crop 3. " (repeat 2-4 times)	1. leaf crop 2. truck crop 3. " 4. leaf cr. 5. truck "	1. leaf crop 2. truck crop 3. " (generally repeated several times)	1. leaf crop 2. truck crop 3. " 4. leaf cr. 5. " " 6. truck " 7. leaf " 8. truck "
leaf cr. 25 truck " 75 Four-field farming	Leaf Crop to truck Crop Ratio: 33% 40% 50% 67% 60% 50%			63% 37%
	Three-field farming	Rhineland crop rotation	Two-field farming (crop rotation)	(Over-crop rotation)

Table 9: Tillage Practices in Possible Crop Rotation

A	B	C	D
1. Sugar beet 2. Winter wheat 3. Oats 4. Winter rye 5. Fodder crop 6. Oats 7. Winter wheat 8. Winter rye	Sugar beet Winter wheat Winter rye Fodder crop Oats - - -	Sugar beet Winter wheat Potatoes Winter rye Fodder crop Oats - -	early Potatoes with Vegetables following Sugar beet Winter wheat Winter rye - - - -
truck crops 75 % leaf crops 25 %	60 % 40 %	50 % 50 %	50 % (40 %) 50 % (60 %)

Table 10: Description of Area No.1

Altitude Above Sea Level Range

100 - 140 m

General Land Use (Total Area = 100 km²)

Urban areas	21.5 %
Forest areas	38.0 %
Agricultural areas	39.5 %
Wet linear features	1.0 %

Agricultural Area (Total Area = 39.5 km²)

Farm land	85 %
Meadows, pastures	15 %

Crop Type (Total Area = 33.5 km²)

Grain, summer + winter	57 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain	42 %	25.08-25.10	25.10-23.04	start 23.04
- Summer grain	15 %	25.08-15.04	15.04-14.05	start 14.05
Corn	18 %	10.10-10.05	10.05-30.05	start 20.06
Green fodder	12 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips	10 %	12.11-25.04	25.04-27.05	start 20.06
Potatoes	3 %	01.10-18.05	18.05-10.06	start 19.06

Ploughing Depth Range

10 - 12 inch

Approx. date of planting for summer grain: Mid March

Approx. date of planting for winter grain: Mid October

Soil Types: SC, ML, OL, SM, SP

Table 11: Description of Area No. 2

Altitude Above Sea Level Range

90 - 240 m

General Land Use (Total Area = 100 km²)

Urban areas	33.0 %
Forest areas	24.0 %
Agricultural areas	39.0 %
Wet linear features	4.0 %

Agricultural Area (Total Area = 39 km²)

Farm land	90 %
Meadows, pastures	10 %

Crop Type (Total Area = 35 km²)

Grain, summer + winter 66 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 52 %	24.08-02.11	02.11-18.04	start 18.04
- Summer grain 14 %	25.08-19.04	19.04-17.05	start 17.05
Corn 8 %	02.10-18.05	18.05-06.06	start 21.06
Green fodder 6 %	21.08-01.09	01.09-01.11	start 01.11
Sugar beets, turnips 17 %	02.11-03.05	03.05-01.06	start 23.06
Potatoes 3 %	10.10-20.05	20.05-10.06	start 26.06

Ploughing Depth Range

10 - 12 inch

Approx. date of planting for summer grain: End of March

Approx. date of planting for winter grain: Mid October

Soil Types: SP, SM, ML, CL

Table 12: Description of Area No. 3

Altitude Above Sea Level Range

100 - 193 m

General Land Use (Total Area = 100 km²)

Urban areas	28.0 %
Forest areas	58.5 %
Agricultural areas	13.0 %
Wet linear features	0.5 %

Agricultural Area (Total Area = 13 km²)

Farm land	80 %
Meadows, pastures	20 %

Crop Type (Total Area = 9.5 km²)

Grain, summer + winter	65 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	51 %	24.08-02.11	02.11-18.04	start 18.04
- Summer grain	14 %	24.08-19.04	19.04-17.05	start 17.05
Corn	22 %	02.10-18.05	18.05-06.06	start 21.06
Green fodder	7 %	21.08-01.09	01.09-01.11	start 01.11
Sugar beets, turnips	1 %	02.11-03.05	03.05-01.06	start 23.06
Potatoes	4 %	10.10-20.05	20.05-10.06	start 26.06

Ploughing Depth Range

10 - 12 inch

Approx. date of planting for summer grain: End of March

Approx. date of planting for winter grain: Mid October

Soil Types: ML, SM,

Table 13: Description of Area No. 4

Altitude Above Sea Level Range

110 - 253 m

General Land Use (Total Area = 100 km²)

Urban areas	16.0 %
Forest areas	33.0 %
Agricultural areas	49.5 %
Wet linear features	1.5 %

Agricultural Area (Total Area = 49.5 km²)

Farm land	84 %
Meadows, pastures	16 %

Crop Type (Total Area = 41.5 km²)

Grain, summer + winter	63 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	43 %	01.09-10.10	10.10-28.04	start 28.04
- Summer grain	20 %	10.09-16.04	16.04-13.05	start 13.05
Corn	14 %	18.09-16.05	16.05-30.05	start 20.06
Green fodder	15 %	13.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips	6 %	30.10-07.05	07.05-30.05	start 30.05
Potatoes	2 %	06.10-15.05	15.05-10.06	start 26.06

Ploughing Depth Range

10 - 12 inch

Approx. date of planting for summer grain: Mid March

Approx. date of planting for winter grain: Begin of October

Soil Types: ML, CL, SP

Table 14: Description of Area No. 5

Altitude Above Sea Level Range

220 - 750 m

General Land Use (Total Area = 100 km²)

Urban areas	5.0 %
Forest areas	46.0 %
Agricultural areas	48.8 %
Wet linear features	0.2 %

Agricultural Area (Total Area = 48.8 km²)

Farm land	67 %
Meadows, pastures	33 %

Crop Type (Total Area = 32.7 km²)

Grain, summer + winter 77 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 57 %	09.09-17.11	17.11-10.05	start 10.05
- Summer grain 20 %	14.09-10.04	10.04-28.05	start 18.05
Corn 5 %	20.19-23.05	23.05-10.06	start 25.06
Green fodder 7 %	20.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips 8 %	16.10-10.05	10.05-10.06	start 21.07
Potatoes 2 %	05.10-10.05	10.05-30.05	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of September

Soil Types: ML, CL

Table 15: Description of Area No. 6

Altitude Above Sea Level Range

290 - 525 m

General Land Use (Total Area = 100 km²)

Urban areas	7.5 %
Forest areas	22.0 %
Agricultural areas	70.2 %
Wet linear features	0.3 %

Agricultural Area (Total Area = 70.2 km²)

Farm land	57 %
Meadows, pastures	43 %

Crop Type (Total Area = 40.2 km²)

Grain, summer + winter 83 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 43 %	21.09-24.10	24.10-04.05	start 04.05
- Summer grain 40 %	15.09-23.04	23.04-18.05	start 18.05
Corn 7 %	25.10-20.05	20.05-10.06	start 30.06
Green fodder 8 %	13.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 1 %	10.11-14.05	14.05-08.07	start 08.07
Potatoes 1 %	17.10-19.05	19.05-15.06	start 30.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of September

Soil Types: CL, CL/ML, SC, SM

Table 16: Description of Area No. 7

Altitude Above Sea Level Range

130 - 342 m

General Land Use (Total Area = 100 km²)

Urban areas	4.0 %
Forest areas	14.0 %
Agricultural areas	81.9 %
Wet linear features	0.1 %

Agricultural Area (Total Area = 81.9 km²)

Farm land	72 %
Meadows, pastures	28 %

Crop Type (Total Area = 58.9 km²)

Grain, summer + winter 78 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 63 %	28.08-30.10	30.10-27.04	start 27.04
- Summer grain 15 %	07.08-30.03	30.03-20.05	start 20.05
Corn 10 %	17.10-19.05	19.05-01.06	start 20.06
Green fodder 9 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 2 %	22.11-20.04	20.04-30.05	start 01.07
Potatoes 1 %	11.10-01.05	01.05-30.05	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: End of March

Approx. date of planting for winter grain: Begin of October

Soil Types: ML, ML/CL, CL

Table 17: Description of Area No. 8

Altitude Above Sea Level Range

230 - 424 m

General Land Use (Total Area = 100 km²)

Urban areas	12.0 %
Forest areas	28.5 %
Agricultural areas	59.0 %
Wet linear features	0.5 %

Agricultural Area (Total Area = 59 km²)

Farm land	61 %
Meadows, pastures	39 %

Crop Type (Total Area = 36 km²)

Grain, summer + winter 80 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 34 %	01.09-10.10	10.10-28.04	start 28.04
- Summer grain 46 %	10.09-16.04	16.04-13.05	start 13.05
Corn 8 %	18.09-16.05	16.05-30.05	start 20.06
Green fodder 6 %	13.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 3 %	30.10-07.05	07.05-30.05	start 30.05
Potatoes 3 %	06.10-15.05	15.05-10.06	start 27.06

Ploughing Depth Range

10 - 12 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: Begin of October

Soil Types: CH, CL, SC, SM

Table 18: Description of Area No. 9

Altitude Above Sea Level Range

480 - 656 m

General Land Use (Total Area = 61 km²)

Urban areas	8.0 %
Forest areas	14.0 %
Agricultural areas	77.5 %
Wet linear features	0.5 %

Agricultural Area (Total Area = 47.2 km²)

Farm land	47 %
Meadows, pastures	53 %

Crop Type (Total Area = 22.2 km²)

Grain, summer + winter 64 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 60 %	06.09-10.10	10.10-13.05	start 13.05
- Summer grain 4 %	17.09-15.04	15.04-20.05	start 20.05
Corn 2 %	28.10-15.05	15.05-01.06	start 20.06
Green fodder 3 %	20.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips 30 %	23.11-25.05	05.05-10.06	start 01.07
Potatoes 1 %	16.10-15.05	15.05-08.06	start 05.07

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: Begin of October

Soil Types: ML, ML/CL, CL, OH

Table 19: Description of Area No. 10

Altitude Above Sea Level Range

500 - 689 m

General Land Use (Total Area = 49 km²)

Urban areas	3.0 %
Forest areas	46.0 %
Agricultural areas	50.9 %
Wet linear features	0.1 %

Agricultural Area (Total Area = 25 km²)

Farm land	48 %
Meadows, pastures	52 %

Crop Type (Total Area = 12 km²)

Grain, summer + winter 79 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 42 %	05.09-29.11	29.11-16.04	start 16.04
- Summer grain 37 %	14.09-17.04	17.04-20.05	start 20.05
Corn 1.5 %	28.10-21.05	21.05-10.06	start 25.06
Green fodder 6.0 %	20.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips 12.5 %	06.11-30.04	30.04-05.06	start 01.07
Potatoes 1.0 %	10.10-17.05	17.05-06.06	start 01.07

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of October

Soil Types: ML, ML/CL, CL, SP

Table 20: Description of Area No. 11

Altitude Above Sea Level Range

330 - 602 m

General Land Use (Total Area = 100 km²)

Urban areas	5.0 %
Forest areas	74.0 %
Agricultural areas	20.0 %
Wet linear features	1.0 %

Agricultural Area (Total Area = 20 km²)

Farm land	55 %
Meadows, pastures	45 %

Crop Type (Total Area = 11 km²)

Grain, summer + winter 68 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 26 %	17.09-18.11	18.11-07.05	start 07.05
- Summer grain 42 %	17.09-06.05	06.05-30.05	start 30.05
Corn 9 %	17.10-18.05	18.05-06.06	start 26.06
Green fodder 16 %	25.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips 1 %	08.11-16.05	16.05-10.06	start 30.06
Potatoes 6 %	11.10-28.05	28.05-18.06	start 27.06

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: End of April

Approx. date of planting for winter grain: Mid October

Soil Types: ML, CL,

Table 21: Description of Area No. 12

Altitude Above Sea Level Range

310 - 582 m

General Land Use (Total Area = 100 km²)

Urban areas	7.0 %
Forest areas	19.0 %
Agricultural areas	73.5 %
Wet linear features	0.5 %

Agricultural Area (Total Area = 73.5 km²)

Farm land	66 %
Meadows, pastures	34 %

Crop Type (Total Area = 48.5 km²)

Grain, summer + winter 69 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 14 %	17.09-18.11	18.11-07.05	start 07.05
- Summer grain 55 %	17.09-06.05	06.05-30.05	start 30.05
Corn 9 %	17.10-18.05	18.05-06.06	start 26.06
Green fodder 13 %	25.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips 2 %	08.11-16.05	16.05-10.06	start 30.06
Potatoes 5 %	11.10-28.05	28.05-18.06	start 27.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Mid April

Approx. date of planting for winter grain: Begin of October

Soil Types: SP, SC, CL, CH, ML, SM

Table 22: Description of Area No. 13

Altitude Above Sea Level Range

390 - 714 m

General Land Use (Total Area = 100 km²)

Urban areas	6.0 %
Forest areas	24.0 %
Agricultural areas	69.7 %
Wet linear features	0.3 %

Agricultural Area (Total Area = 69.7 km²)

Farm land	48 %
Meadows, pastures	52 %

Crop Type (Total Area = 33.5 km²)

Grain, summer + winter	68 %		Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	44 %	a)	12.09-20.09	20.09-22.04	start 22.04
		b)	03.10-30.10	30.10-10.05	start 10.05
- Summer grain	24 %	a)	12.09-19.04	01.05-15.05	start 20.05
		b)	03.10-01.05	08.05-20.05	start 20.06
Corn	5 %	a)	14.10-08.05	08.05-30.05	start 20.06
		b)	01.11-12.05	12.05-05.06	start 30.06
Green fodder	23 %	a)	30.08-05.09	05.09-01.11	start 01.11
		b)	-	-	start -
Sugar beets, turnips	1 %	a)	31.10-21.04	21.04-30.05	start 30.06
		b)	20.11-10.05	10.05-10.06	start 10.07
Potatoes	3 %	a)	26.09-10.05	10.05-10.06	start 20.06
		b)	03.10-15.05	15.05-15.06	start 25.06

a) Altitude 500 m above sea level
b) Altitude 500 m above sea level

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Mid April

Approx. date of planting for winter grain: End of September

Soil Types: SC, CL, SM, ML

Table 23: Description of Area No. 14

Altitude Above Sea Level Range

645 - 726 m

General Land Use (Total Area = 100 km²)

Urban areas	5.5 %
Forest areas	25.0 %
Agricultural areas	69.4 %
Wet linear features	0.1 %

Agricultural Area (Total Area = 69.4 km²)

Farm land	51 %
Meadows, pastures	49 %

Crop Type (Total Area = 35.4 km²)

Grain, summer + winter 70 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 38 %	03.10-30.10	30.10-10.05	start 10.05
- Summer grain 32 %	03.10-01.05	01.05-20.05	start 20.05
Corn 5 %	01.11-12.05	12.05-05.06	start 30.06
Green fodder 21 %	30.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips 1 %	20.11-10.05	10.05-10.06	start 10.07
Potatoes 3 %	03.10-15.05	15.05-15.06	start 25.06

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: End of April

Approx. date of planting for winter grain: End of October

Soil Types: CL, ML, SC/SM

Table 24: Description of Area No. 15

Altitude Above Sea Level Range

429 - 846 m

General Land Use (Total Area = 97.5 km²)

Urban areas	7.0 %
Forest areas	15.5 %
Agricultural areas	77.2 %
Wet linear features	0.3 %

Agricultural Area (Total Area = 75.7 km²)

Farm land	56 %
Meadows, pastures	44 %

Crop Type (Total Area = 42.4 km²)

Grain, summer + winter 62 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 27 %	27.09-07.11	07.11-20.05	start 20.05
- Summer grain 35 %	27.09-13.04	13.04-22.05	start 22.05
Corn 19 %	31.10-17.05	17.05-15.06	start 10.07
Green fodder 16 %	27.08-10.09	10.09-01.11	start 01.11
Sugar beets, turnips 1 %	25.10-15.05	15.05-15.06	start 10.07
Potatoes 2 %	30.09-15.05	15.05-15.06	start 10.07

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: Begin of October

Soil Types: SC, CL, SM, PT

Table 25: Description of Area No. 16

Altitude Above Sea Level Range

395 - 703 m

General Land Use (Total Area = 90.5 km²)

Urban areas	8.0 %
Forest areas	21.3 %
Agricultural areas	54.0 %
Wet linear features	7.2 %

Agricultural Area (Total Area = 49.0 km²)

Farm land	56 %
Meadows, pastures	44 %

Crop Type (Total Area = 42.4 km²)

Grain, summer + winter 62 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 35 %	16.09-15.10	15.10-30.04	start 30.04
- Summer grain 27 %	09.08-13.04	13.04-14.05	start 14.05
Corn 19 %	26.10-05.05	05.05-05.06	start 01.07
Green fodder 16 %	27.08-10.09	10.09-01.11	start 01.11
Sugar beets, turnips 1 %	25.10-26.04	26.04-28.05	start 25.07
Potatoes 2 %	30.09-09.05	09.05-10.06	start 30.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: Begin of October

Soil Types: SM, SL, SC/SP, PT

Table 26: Description of Area No. 17

Altitude Above Sea Level Range

390 - 542 m

General Land Use (Total Area = 100 km²)

Urban areas	3.0 %
Forest areas	59.9 %
Agricultural areas	37.0 %
Wet linear features	0.1 %

Agricultural Area (Total Area = 37 km²)

Farm land	69 %
Meadows, pastures	31 %

Crop Type (Total Area = 25.5 km²)

Grain, summer + winter 69 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 30 %	11.09-01.11	01.11-20.04	start 20.04
- Summer grain 39 %	15.09-23.04	23.04-10.05	start 10.05
Corn 14 %	21.10-11.05	11.05-30.05	start 15.06
Green fodder 10 %	15.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 2 %	18.11-04.05	04.05-30.05	start 30.06
Potatoes 5 %	17.10-12.05	12.05-10.06	start 25.06

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: Begin of October

Soil Types: SC, CL, SM

Table 27: Description of Area No. 18

Altitude Above Sea Level Range

400 - 608 m

General Land Use (Total Area = 100 km²)

Urban areas	4.5 %
Forest areas	37.5 %
Agricultural areas	57.4 %
Wet linear features	0.1 %

Agricultural Area (Total Area = 57.4 km²)

Farm land	62 %
Meadows, pastures	38 %

Crop Type (Total Area = 35.6 km²)

Grain, summer + winter 66 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 29 %	04.09-05.11	05.11-20.04	start 20.04
- Summer grain 37 %	09.09-05.05	05.05-18.05	start 18.05
Corn 12 %	13.10-11.05	11.05-30.05	start 15.06
Green fodder 12 %	13.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 4 %	06.11-05.05	05.05-30.05	start 26.06
Potatoes 6 %	28.09-16.05	16.05-10.06	start 21.06

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Mid April

Approx. date of planting for winter grain: End of September

Soil Types: CL, CL/ML, SM, SC

Table 28: Description of Area No. 19

Altitude Above Sea Level Range

430 - 647 m

General Land Use (Total Area = 100 km²)

Urban areas	2.5 %
Forest areas	32.0 %
Agricultural areas	65.3 %
Wet linear features	0.2 %

Agricultural Area (Total Area = 65.3 km²)

Farm land	69 %
Meadows, pastures	31 %

Crop Type (Total Area = 45.1 km²)

Grain, summer + winter 69 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 30 %	20.09-11.11	15.11-12.05	start 12.05
- Summer grain 39 %	20.09-02.05	02.05-28.05	start 28.05
Corn 14 %	26.10-25.05	25.05-15.06	start 01.07
Green fodder 10 %	30.08-15.09	15.09-01.11	start 01.11
Sugar beets, turnips 2 %	30.10-16.05	16.05-05.06	start 05.06
Potatoes 5 %	10.10-18.05	18.05-15.06	start 30.06

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: Begin of October

Soil Types: SM, SC, ML, CL

Table 29: Description of Area No. 20

Altitude Above Sea Level Range

510 - 801 m

General Land Use (Total Area = 100 km²)

Urban areas	4.5 %
Forest areas	42.5 %
Agricultural areas	52.0 %
Wet linear features	1.2 %

Agricultural Area (Total Area = 52 km²)

Farm land	59 %
Meadows, pastures	41 %

Crop Type (Total Area = 31 km²)

Grain, summer + winter 68 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 23 %	18.09-08.11	08.11-20.05	start 20.05
- Summer grain 45 %	28.09-02.05	02.05-28.05	start 28.05
Corn 13 %	06.11-04.06	04.06-18.06	start 04.07
Green fodder 9 %	30.08-15.09	15.09-01.11	start 01.11
Sugar beets, turnips 1.5 %	06.11-08.05	08.05-05.06	start 10.07
Potatoes 8.5 %	11.10-18.05	18.05-15.06	start 08.07

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Mid April

Approx. date of planting for winter grain: End of September

Soil Types: SM

Table 30: Description of Area No. 21

Altitude Above Sea Level Range

545 - 670 m

General Land Use (Total Area = 100 km²)

Urban areas	6.0 %
Forest areas	20.0 %
Agricultural areas	63.4 %
Wet linear features	10.6 %

Agricultural Area (Total Area = 63.4 km²)

Farm land	47 %
Meadows, pastures	53 %

Crop Type (Total Area = 29.8 km²)

Grain, summer + winter 60 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 38 %	03.09-08.10	08.10-28.04	start 28.04
- Summer grain 22 %	07.09-20.04	22.04-20.05	start 20.05
Corn 19 %	26.10-05.05	05.05-02.06	start 20.06
Green fodder 16 %	30.08-10.09	10.09-01.11	start 01.11
Sugar beets, turnips 4 %	04.11-27.04	27.04-27.05	start 01.07
Potatoes 1 %	13.10-12.05	12.05-12.06	start 03.07

Ploughing Depth Range

6 - 8 inch

Approx. date of planting for summer grain: Mid April

Approx. date of planting for winter grain: Begin of October

Soil Types: CL, PT

Table 31: Description of Area No. 22

Altitude Above Sea Level Range

460 - 640 m

General Land Use (Total Area = 100 km²)

Urban areas	2.5 %
Forest areas	25.0 %
Agricultural areas	72.4 %
Wet linear features	0.1 %

Agricultural Area (Total Area = 72.4 km²)

Farm land	64 %
Meadows, pastures	36 %

Crop Type (Total Area = 46.4 km²)

Grain, summer + winter 50 %	Soil idle	Spot coverage growth height < 6 inch	Completely covered
- Winter grain 30 %	06.09-06.10	06.10-05.05	start 05.05
- Summer grain 20 %	31.08-15.04	15.04-19.05	start 19.05
Corn 39 %	31.10-12.05	12.05-15.06	start 30.06
Green fodder 8 %	30.08-10.09	10.09-01.11	start 01.11
Sugar beets, turnips 1 %	04.10-10.05	10.05-10.06	start 10.07
Potatoes 2 %	12.10-15.05	15.05-15.06	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: End of April

Approx. date of planting for winter grain: End of October

Soil Types: SC, CL, ML

Table 33: Geographical Description of the 13 Test Sites

Site No.	Quad Sheet	Forest Department No.	Wetness Condition	UTM Coordinates	Figure No.
1	L 5324	35D	3 moderately fresh	5365 0790	29
2	L 5324	54A1	1 fresh	5640 0825	
3	L 5324	511A	3 moderately fresh	5620 0950	
4	L 5324	455	4 moderately dry	5415 1120	30
5	L 5324	509B	3 moderately fresh	5610 1250	
9	L 5324	118B1	4 moderately dry	5820 1245	
6	L 5324	3B	6 alternating wet	5710 1950	31
7	L 5324	90A	1 fresh	6045 1725	32
8	L 5324	113A1	4 moderately dry	6155 0950	33
10	L 5322	237B	6 alternating wet	4530 0970	34
11	L 5322	227B	1 fresh	4560 0905	
12	L 5322	248A2/1?	2 extremely fresh	4520 1045	
13	L 5322	255A2	3 moderately fresh	4490 1120	

Table 34: Results of Soil Investigations for the 13 Test Sites

Site No.	Sampling Depth in	Specific Gravity g/cm ³	Density		Moisture Content %	Organic Ingredient %	Soil Type USCS	Cone 0-6" psi	Index 6-12" psi
			Bulk t/m ³	Dry t/m ³					
1	1-6	2.61	1.61	1.24	29.4	5.6	SM/SC	123	293
2	1-6	2.59	1.48	1.18	25.4	8.5	ML/SM	65	169
3	1-6	2.58	1.08	0.86	25.7	7.5	GM/GC	141	277
4	1-6	2.50	1.24	1.04	19.2	14.9	ML	133	271
5	1-6	2.56	1.20	1.00	19.5	8.5	ML/SM	189	294
6	1-6	2.53	1.27	0.92	37.9	6.3	ML/SM	98	125
7	1-6	2.53	1.31	1.02	29.0	6.9	ML/SM	189	300
8	1-6	2.60	1.68	1.40	20.4	3.7	ML/SM	247	300
9	1-6	2.41	1.47	1.06	38.0	12.5	ML/SM	240	300
10	1-6	2.38	1.16	0.76	52.8	24.2	SM/SP	92	240
11	1-6	2.55	1.56	1.14	36.8	6.1	SM/SP	113	217
12	1-6	2.47	1.92	1.54	24.3	11.2	SM/SP	81	131
13	1-6	2.49	1.41	1.20	18.1	13.0	SM/SP	104	242

Table 35: Predicted and Real Soil Values for the 13 Test Sites

Site No.	Moisture Content			Soil Type		Cone real 0-6" psi	Index average 0-6" psi
	predicted by forest office, humidity class	real value %	average value %	predicted by forest office	real USCS		
4 8 9	4 moderately dry	19.2 20.4 38.0	25.8	2 SM 1 ML 1 ML	ML ML/SM ML/SM	133 247 240	207
13 5 3 1	3 moderately fresh	18.1 19.5 25.7 29.4	23.3	2 SM 2 SM 2 SM 2 SM	SM/SP ML/SM GM/GC SM/SC	104 189 141 123	139
2 7 11	1 fresh	25.4 29.0 36.8	30.4	2 SM 1 ML 1 ML	ML/SM ML/SM SM/SP	65 189 113	122
12	2 extremely fresh	24.3		2 SM	SM/SP	81	
6 10	6 alternating wet	37.9 52.8	45.3	1 ML 2 SM	ML/SM ML/SM	98 92	95

Table 36: Topo Quad Sheet Description of the HIMO-area (Forestry Data)

Area No.	Quad Sheet No.	Forest Office	Federal State
1	L 5120 Ziegenhain	Bad Wildungen, Jesberg, Burgwald, Rauschenberg, Kirchhain, Schwälmstadt, Alsfeld, Neukirchen, Homberg/Efze	Hesse
2	L 5122 Neukirchen	Homberg/Efze Knullwald, Rotenburg, Neuenstein, Neukirchen, Niederaula, Bad Hersfeld	Hesse
3	L 5124 Bad-Hersfeld	Neuenstein, Rotenburg, Nentershausen, Heringen, Bad Hersfeld, Niederaula, Burghaun	Hesse
4	L 5320 Alsfeld	Kirchhain, Alsfeld, Homberg/Ohm, Romrod, Grünberg, Schotten, Grebenhain, Grebenau	Hesse
5	L 5322 Lauterbach	Alsfeld, Niederaula, Romrod, Grebenau, Schlitz, Fulda Burghaun, Hünfeld Neukirchen	Hesse
6	L 5324 Hünfeld	Niederaula, Bad-Hersfeld, Heringen, Burghaun, Hün- feld, Hofbieber, Hilders, Fulda	Hesse
7	L 5520 Schotten	Grünberg, Homberg/Ohm, Schotten, Grebenhain, Nidda, Büdingen, Bad Soden-Salmünster, Grebenau, Romrod	Hesse
8	L 5522 Herbstein	Grebenau, Fulda, Grebenhain, Bad Soden- Salmünster, Schlüchtern, Neuhof, Kalbach	Hesse
9	L 5524	Fulda, Hofbieber, Hilders, Kalbach,	Hesse
	Fulda	Bad Brückenau, Bad Neustadt	Bavaria

Table 37: Topo Quad Sheet Description of the HIMO-area (Agricultural Data)

Area No.	Quad Sheet No.	District Name	Federal State
1	L 5120 Ziegenhain	Schwalm-Eder Marburg-Biedenkopf Vogelsberg	Hesse
2	L 5122 Neukirchen	Hersfeld-Rotenburg Schwalm-Eder	Hesse
3	L 5124 Bad-Hersfeld	Hersfeld-Rotenburg	Hesse
4	L 5320 Alsfeld	Vogelsberg	Hesse
5	L 5322 Lauterbach	Vogelsberg Hersfeld-Rotenburg Fulda Schwalm-Eder	Hesse
6	L 5324 Hünfeld	Fulda Hersfeld-Rotenburg	Hesse
7	L 5520 Schotten	Vogelsberg Wetterau Gießen Main-Kinzig	Hesse
8	L 5522 Herbstein	Fulda Vogelsberg Main-Kinzig	Hesse
9	L 5524 Fulda	Fulda Rhön-Grabfeld Bad-Kissingen	Hesse

Table 38: Land Use Data for the HIMO-area

Area Description	General Land Use					Agricultural Area			Crop Type					
Quad Sheet No.	Total Area in km ² (=100%)	Urban Area (%)	Forest Area (%)	Agric. Area (%)	Wet Linear Feature (%)	Total Agric. Area in km ² (=100%)	Farm Land (%)	Meadows, Pastures (%)	Total Farm Land in km ² (=100%)	Grain (%)	Corn (%)	Green Fodder (%)	Sugar Beets, Turnips (%)	Potatoes (%)
L 5120	522	4	36	59	1	308	69	31	214	80	5	6	8	1
L 5122	521	3	56	40	1	208	71	29	147	80	5	6	7	2
L 5124	503	8	62	27	3	136	65	35	89	81	8	5	3	3
L 5320	523	3	35	61	1	319	50	50	160	80	10	4	4	2
L 5322	523	3	52	44	1	230	54	46	124	80	9	4	5	2
L 5324	424	5	28	65	2	276	61	39	144	75	8	11	4	2
L 5520	526	5	45	48	2	252	60	40	152	78	9	4	7	2
L 5522	527	5	28	65	2	343	51	49	174	79	10	4	5	2
L 5524	529	7	25	66	2	349	48	52	182	79	10	5	4	2

Table 39: Description of Quad Sheet No. L 5120

Altitude Above Sea Level Range

200 - 585 m

General Land Use (Total Area = 522 km²)

Urban areas	4 %
Forest areas	36 %
Agricultural areas	59 %
Wet linear features	1 %

Agricultural Area (Total Area = 308 km²)

Farm land	69 %
Meadows, pastures	31 %

Crop Type (Total Area = 214 km²)

Grain, summer + winter 80 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 70 %	24.08-28.09	28.09-27.04	start 27.04
- Summer grain 10 %	29.08-06.04	06.04-20.05	start 20.05
Corn 5 %	07.10-20.05	20.05-05.06	start 20.06
Green fodder 6 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 8 %	16.10-30.04	30.04-05.06	start 01.07
Potatoes 1 %	11.10-01.05	01.05-30.05	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: End of March

Approx. date of planting for winter grain: End of September

Soil Types: ML, SM, SC, ML/SM

Table 40: Description of Quad Sheet No. L 5122

Altitude Above Sea Level Range

204 - 636 m

General Land Use (Total Area = 521 km²)

Urban areas	3 %
Forest areas	56 %
Agricultural areas	40 %
Wet linear features	1 %

Agricultural Area (Total Area = 208 km²)

Farm land	71 %
Meadows, pastures	29 %

Crop Type (Total Area = 147 km²)

Grain, summer + winter	80 %		Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	71 %	a)	24.08-28.09	28.09-27.04	start 27.04
		b)	18.09-30.10	30.10-10.05	start 10.05
- Summer grain	9 %	a)	29.08-06.04	06.04-20.05	start 20.05
		b)	22.09-10.04	10.04-30.05	start 30.05
Corn	5 %	a)	07.10-20.05	20.05-05.06	start 20.06
		b)	27.10-25.05	25.05-10.06	start 25.06
Green fodder	6 %	a)	20.08-30.08	30.08-01.11	start 01.11
		b)	25.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips	7 %	a)	16.10-30.04	30.04-05.06	start 01.07
		b)	06.11-10.05	10.05-10.06	start 01.07
Potatoes	2 %	a)	11.10-01.05	01.05-30.05	start 28.06
		b)	16.10-18.05	18.05-05.06	start 30.06

a) Altitude < 500 m above sea level

b) Altitude > 500 m above sea level

Ploughing Depth Range

6 - 10 inch

Approx. date of planting for summer grain: End of March

Approx. date of planting for winter grain: End of September

Soil Types: ML, CL, SM, SP, SC

Table 41: Description of Quad Sheet No. L 5124

Altitude Above Sea Level Range

190 - 511 m

General Land Use (Total Area = 503 km²)

Urban areas	8 %
Forest areas	62 %
Agricultural areas	27 %
Wet linear features	3 %

Agricultural Area (Total Area = 136 km²)

Farm land	65 %
Meadows, pastures	35 %

Crop Type (Total Area = 89 km²)

Grain, summer + winter 81 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 72 %	24.08-28.09	28.09-27.04	start 27.04
- Summer grain 9 %	29.08-10.04	10.04-20.05	start 20.05
Corn 8 %	07.10-20.05	20.05-05.06	start 20.06
Green fodder 5 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 3 %	16.10-30.04	30.04-05.06	start 01.07
Potatoes 3 %	11.10-01.05	01.05-30.05	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of September

Soil Types: ML, SM, CL

Table 42: Description of Quad Sheet No. L 5320

Altitude Above Sea Level Range

209 - 534 m

General Land Use (Total Area = 523 km²)

Urban areas	3 %
Forest areas	35 %
Agricultural areas	61 %
Wet linear features	1 %

Agricultural Area (Total Area = 319 km²)

Farm land	50 %
Meadows, pastures	50 %

Crop Type (Total Area = 160 km²)

Grain, summer + winter 80 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 70 %	24.08-28.09	28.09-27.04	start 27.04
- Summer grain 10 %	29.08-06.04	06.04-20.05	start 20.05
Corn 10 %	07.10-20.05	20.05-05.06	start 20.06
Green fodder 4 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 4 %	16.10-30.04	30.04-05.06	start 01.07
Potatoes 2 %	11.10-01.05	01.05-30.05	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: End of April

Approx. date of planting for winter grain: End of September

Soil Types: ML, CL, SM, ML/CL

Table 43: Description of Quad Sheet No. L 5322

Altitude Above Sea Level Range

209 - 592 m

General Land Use (Total Area = 523 km²)

Urban areas	3 %
Forest areas	52 %
Agricultural areas	44 %
Wet linear features	1 %

Agricultural Area (Total Area = 230 km²)

Farm land	54 %
Meadows, pastures	46 %

Crop Type (Total Area = 124 km²)

Grain, summer + winter 80 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 71 %	24.08-05.10	05.10-27.04	start 27.04
- Summer grain 9 %	29.08-10.04	10.04-20.05	start 20.05
Corn 9 %	07.10-20.05	20.05-05.06	start 20.06
Green fodder 4 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 5 %	16.10-30.04	30.04-05.06	start 01.07
Potatoes 2 %	11.10-01.05	01.05-30.05	start 28.06

Ploughing Depth Range

6 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of September

Soil Types: SM, ML, ML/SM

Table 44: Description of Quad Sheet No. L 5324

Altitude Above Sea Level Range

240 - 718 m

General Land Use (Total Area = 424 km²)

Urban areas	5 %
Forest areas	28 %
Agricultural areas	65 %
Wet linear features	2 %

Agricultural Area (Total Area = 276 km²)

Farm land	61 %
Meadows, pastures	39 %

Crop Type (Total Area = 144 km²)

Grain, summer + winter	75 %		Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	66 %	a) b)	24.08-28.09 18.09-30.10	28.09-27.04 30.10-10.05	start 27.04 start 10.05
- Summer grain	9 %	a) b)	29.08-06.04 22.09-10.04	06.04-20.05 10.04-30.05	start 20.05 start 30.05
Corn	8 %	a) b)	07.10-20.05 27.10-25.05	20.05-05.06 25.05-10.06	start 20.06 start 25.06
Green fodder	11 %	a) b)	20.08-30.08 25.08-05.09	30.08-01.11 05.09-01.11	start 01.11 start 01.11
Sugar beets, turnips	4 %	a) b)	16.10-30.04 06.11-10.05	30.04-05.06 10.05-10.06	start 01.07 start 01.07
Potatoes	2 %	a) b)	11.10-01.05 16.10-18.05	01.05-30.05 18.05-05.06	start 28.06 start 30.06

a) Altitude < 500 m above sea level

b) Altitude > 500 m above sea level

Ploughing Depth Range

6 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of September

Soil Types: SM, ML, CL, ML/CL

Table 45: Description of Quad Sheet No. L 5520

Altitude Above Sea Level Range

128 - 773 m

General Land Use (Total Area = 526 km²)

Urban areas	5 %
Forest areas	45 %
Agricultural areas	48 %
Wet linear features	2 %

Agricultural Area (Total Area = 252 km²)

Farm land	60 %
Meadows, pastures	40 %

Crop Type (Total Area = 152 km²)

Grain, summer + winter	78 %		Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	69 %	a)	24.08-28.09	28.09-27.04	start 27.04
		b)	18.09-30.10	30.10-10.05	start 10.05
- Summer grain	9 %	a)	29.08-06.04	06.04-20.05	start 20.05
		b)	22.09-10.04	10.04-30.05	start 30.05
Corn	9 %	a)	07.10-20.05	20.05-05.06	start 20.06
		b)	27.10-25.05	25.05-10.06	start 25.06
Green fodder	4 %	a)	20.08-30.08	30.08-01.11	start 01.11
		b)	25.08-05.09	05.09-01.11	start 01.11
Sugar beets, turnips	7 %	a)	16.10-30.04	30.04-05.06	start 01.07
		b)	06.11-10.05	10.05-10.06	start 01.07
Potatoes	2 %	a)	11.10-01.05	01.05-30.05	start 28.06
		b)	16.10-18.05	18.05-05.06	start 30.06

a) Altitude < 500 m above sea level

b) Altitude > 500 m above sea level

Ploughing Depth Range

6 - 10 inch

Approx. date of planting for summer grain: Begin of April

Approx. date of planting for winter grain: End of September

Soil Types: ML, CL, SC

Table 46: Description of Quad Sheet No. L 5522

Altitude Above Sea Level Range

237 - 488 m

General Land Use (Total Area = 527 km²)

Urban areas	5 %
Forest areas	28 %
Agricultural areas	65 %
Wet linear features	2 %

Agricultural Area (Total Area = 343 km²)

Farm land	51 %
Meadows, pastures	49 %

Crop Type (Total Area = 174 km²)

Grain, summer + winter 79 %	Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain 70 %	24.08-28.09	28.09-27.04	start 27.04
- Summer grain 9 %	29.08-06.04	06.04-20.05	start 20.05
Corn 10 %	07.10-20.05	20.05-05.06	start 20.06
Green fodder 4 %	20.08-30.08	30.08-01.11	start 01.11
Sugar beets, turnips 5 %	16.10-30.04	30.04-05.06	start 01.07
Potatoes 2 %	11.10-01.05	01.05-30.05	start 28.06

Ploughing Depth Range

8 - 10 inch

Approx. date of planting for summer grain: End of March

Approx. date of planting for winter grain: End of September

Soil Types: ML, CL, SM, SC, ML/SM

Table 47: Description of Quad Sheet No. L 5524

Altitude Above Sea Level Range

245 - 950 m

General Land Use (Total Area = 529 km²)

Urban areas	7 %
Forest areas	25 %
Agricultural areas	66 %
Wet linear features	2 %

Agricultural Area (Total Area = 349 km²)

Farm land	48 %
Meadows, pastures	52 %

Crop Type (Total Area = 182 km²)

Grain, summer + winter	79 %		Soil idle	Spot coverage growth height 6 inch	Completely covered
- Winter grain	70 %	a) b)	24.08-28.09 18.09-30.10	28.09-27.04 30.10-10.05	start 27.04 start 10.05
- Summer grain	9 %	a) b)	24.08-06.04 22.09-10.04	06.04-20.05 10.04-30.05	start 20.05 start 30.05
Corn	10 %	a) b)	07.10-20.05 27.10-25.05	20.05-15.06 25.05-10.06	start 20.06 start 25.06
Green fodder	5 %	a) b)	20.08-30.08 25.08-05.09	30.08-01.11 05.09-01.11	start 01.11 start 01.11
Sugar beets, turnips	4 %	a) b)	16.10-30.04 06.11-10.05	30.04-05.06 10.05-10.06	start 01.07 start 01.07
Potatoes	2 %	a) b)	11.10-01.05 16.10-18.05	01.05-30.05 18.05-05.06	start 28.06 start 30.06

a) Altitude < 500 m above sea level

b) Altitude > 500 m above sea level

Ploughing Depth Range

6 - 10 inch

Approx. date of planting for summer grain: Begin of April
Approx. date of planting for winter grain: End of September

Soil Types: SM, CL, ML, SC, CH

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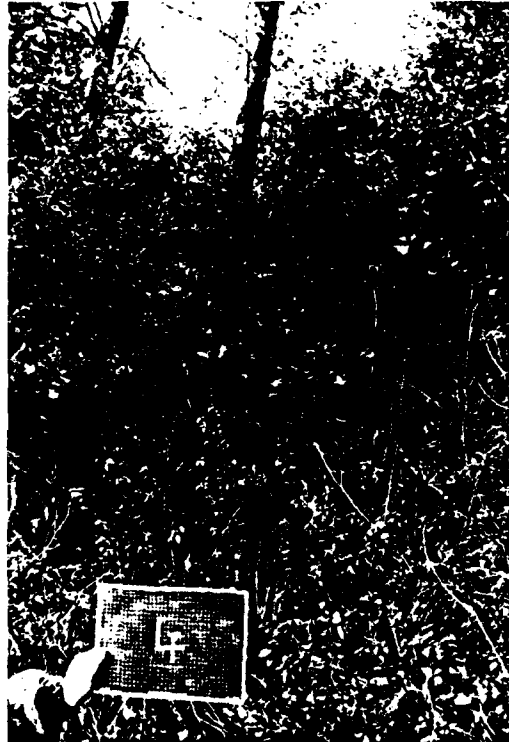
Site No. 1



Site No. 2



Site No. 3



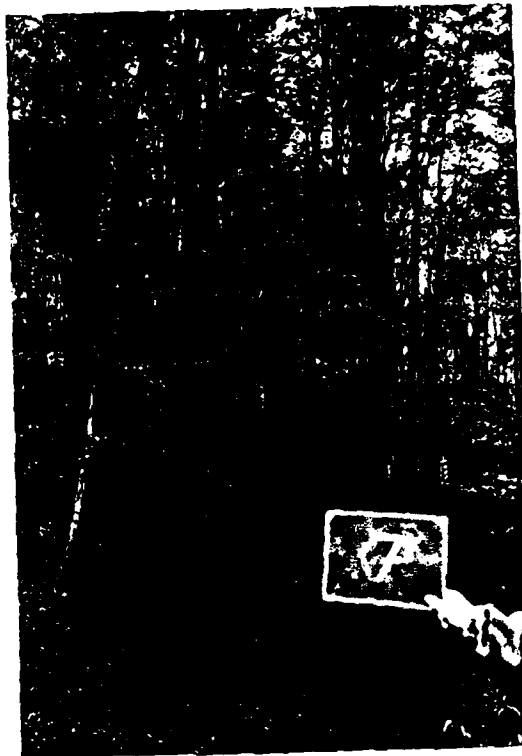
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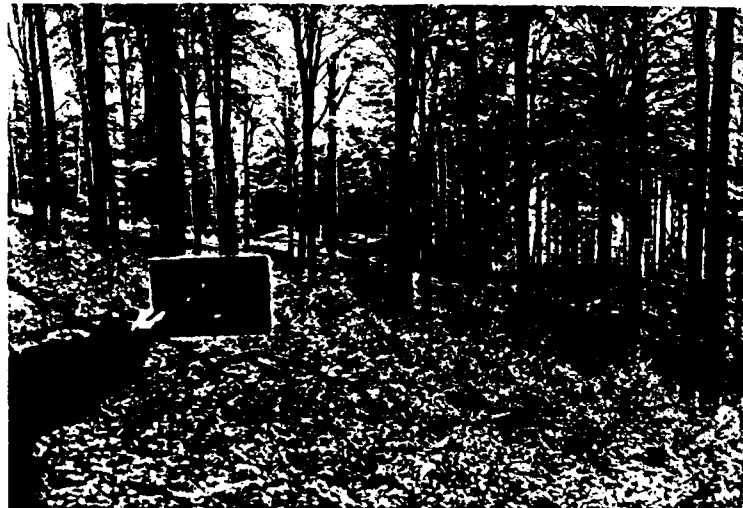
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