SOIL-SITE QUALITY RELATIONSHIPS ON THE UNIVERSITY OF IDAHO EXPERIMENTAL FOREST

A Thesis

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UNIVERSITY OF IDAHO GRADUATE SCHOOL

by

CHAD LYMAN McGRATH

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AUTHORIZATION TO PROCEED WITH FINAL DRAFT:

This thesis of Chad Lyman McGrath for the Master of Science degree with major in Forest Management and titled "Soil-Site Quality Relationships on the University of Idaho Experimental Forest," was reviewed in rough draft form by each Committee member as indicated by the signatures and dates given below and permission was granted to prepare the final copy incorporating suggestions of the Committee; permission was also given to schedule the final examination upon submission of two final copies to the Graduate School Office:

Major Professor Howard Zolnerowich Date Aug 12, 1975

Committee Members Maynard H. Hosberg Date Aug 12, 1975

Frank Pitkin Date Aug 12, 1975

REVIEW OF FINAL DRAFT:

College Dean A. A. Moslemi W.S. Date Aug 14, 1975

FINAL EXAMINATION: By majority vote of the candidate's Committee at the final examination held on date of Aug 14, 1975 Committee approval and acceptance was granted.

Major Professor Howard Zolnerowich Date Aug 14, 1975

GRADUATE COUNCIL FINAL APPROVAL AND ACCEPTANCE:

Graduate School Dean E. W. Tinkham Date 9-4-75

ABSTRACT

This study was designed to correlate certain soil and topographic properties with site index of Douglas-fir (*Pseudotsuga menziesii* Franco), grand fir (*Abies grandis* (Dougl.) Lindl.), and western larch (*Larix occidentalis* Nutt.) by multiple regression analysis. Site index information was obtained for twenty-one plots on the University of Idaho Experimental Forest.

The major portion of soil development was in volcanic ash and loess strata. All horizons in each profile were sampled and analyzed. These results along with certain topographic properties were used in the statistical analysis.

From these variables the following equations were selected for the prediction of site index of Douglas-fir, western larch, and grand fir:

Douglas-fir

1. Site index = 89.4507 + 1.4730(Eff. rooting depth) -0.0994(P in surface horizon) - 0.4643(Avail. H_2O in surface horiz.) -72.3721(Na in third horiz.) + 0.0360(C:N of third horiz.) - 4.8469 (Tex. of third horiz.)

R^2 = 0.8339

Standard error of estimate = 4.850

2. Site index = 6.6033 + 1.9463(Elev.) + 0.1774(Eff. rooting depth) + 0.6026(Wet consis. of second horiz.) - 4.1907(Tex. of third horiz.)

R^2 = 0.7542

Standard error of estimate = 5.375

Western larch

1. Site index = 252.4245 + 40.6077(02 depth) - 44.1904(pH of fourth horiz.) + 0.2557 (P of fourth horiz.)

R^2 = 0.9907

Standard error of estimate = 2.479

2. Site index = 291.3960 + 39.8304(02 depth) - 50.3588(pH of fourth horiz.)

R^2 = 0.8878

Standard error of estimate = 7.462

Grand fir

Site index = -75834.5657 + 12.9801(O.M. of surface horiz.) - 329.8935(N of surface horiz.) + 0.0757(Dry color of surface horiz.) + 7.2520(Mg of second horiz.)

R^2 = 0.9849

Standard error of estimate = 1.706

The prediction equations for Douglas-fir were probably the most valid as the equations for grand fir and western larch had higher R^2 values than would normally be expected when measuring a biological population. The reason for the high R^2 values for western larch was probably because of a limited number of observations. In the case of grand fir the high R^2 was not clearly understood. Even after correcting R^2 for degrees of freedom the value was only reduced from 0.9849 to 0.9772.

These prediction equations provide a land manager a tool for estimating site index for areas that are poorly stocked, stocked with undesirable species, or unstocked. Although this study was restricted to the University of Idaho Experimental Forest, the techniques and results could be applied to any area with similar parent materials, climate, and topography.

INTRODUCTION

Few soil-site studies of forest land in Idaho exist despite a wealth of information for other areas of the U.S. and other countries. However, the forest industry is of great economic importance to the state and especially so in northern Idaho. With the ever increasing demand for lumber and paper products it is essential that forest lands produce to the optimum. To get this optimum production, effective management must be practiced.

Investments in forest management are usually costly and must be based on fairly accurate estimates of expected future yields. Current methods of estimating forest site quality are based on site index. This requires well stocked stands of desired species. Many areas in northern Idaho have been cut-over or burned or are either poorly stocked, stocked with undesirable species, or unstocked. In situations such as these, an indirect method of evaluation is needed so that the best land use can be obtained. Through the correlation of soil and topographic characteristics and site index, site quality may be estimated by measuring these characteristics.

This study is designed to find the relationships between certain soil and topographic characteristics and site quality (as measured by site index) within the University of Idaho Experimental Forest. Although this study is

limited to the experimental forest, the methods and techniques could be applied to any area and the results could be used for any site with similar parent materials, climate and topography.

AREA DESCRIPTION

Location, Size, Access

The study area is designated as the Flat Creek Unit of the University of Idaho Experimental Forest. It is located 4 miles south along state highway 9 from the junction of state highway 9 and U.S. highway 95A in Latah County, Idaho. It includes all of section 33 and portions of sections 28, 31, and 32, T41N, R3W and portions of sections 4, 5, 7, and 8, T40N, R3W. All legal descriptions are based on the Boise Meridian.

The area consists of 2,765 acres and is accessible from state highway 9, by a U.S. Forest Service road leading to Brown's Meadow and by an unnamed logging road.

Geology

The study area is underlain by a granitic outlier of the Idaho Batholith called the Thatuna Batholith of the Mesozoic Era. Granodiorite is the chief rock type. This material has little affect on the soils developed within the study area as the entire vicinity was covered with several blankets of loess in the middle to late Pleistocene (Ross and Savage, 1963). The depth of the loess ranges from 2 feet (.61 m) to greater than 10 feet (3.05 m). The variability in the depth is probably due to differential erosion and deposition (drifting affect).

Approximately 6,600 years ago the volcanic eruption of Mt. Mazama (Crater Lake, Oregon) resulted in an ash fall over the entire region (Fryxell, 1965). Most of the ash has been eroded away in the study area except on sites which are presently in western redcedar/pachistima (Thuja plicata Donn/Pachistima myrsinites Raf.) habitat type and grand fir/pachistima (Abies grandis (Dougl.) Lindl./Pachistima myrsinites Raf.) habitat type. Apparently the kind and amount of vegetation in these areas during the altithermal period was sufficient to prevent extensive erosion of the volcanic ash. Where the ash deposits are present they range in depth from 10 to 20 inches (25.4 to 50.8 cm).

The majority of the soil development within the study area has taken place in the loess and volcanic ash strata.

Vegetation

The Flat Creek Unit is predominantly coniferous forest with a few small open meadows. There are four habitat types (Daubenmire and Daubenmire, 1968) represented. The majority of the area is grand fir/pachistima (Abies grandis (Dougl.) Lindl./Pachistima myrsinites Raf.). The next most common habitat type is western redcedar/pachistima (Thuja plicata Donn/Pachistima myrsinites Raf.). Douglas-fir/ninebark (Pseudotsuga menziesii Franco/Physocarpus malvaceous Camb.) habitat type is found on the drier, warmer slopes and ridgetops. The most restricted habitat type is

the subalpine fir/pachistima (Abies lasiocarpa (Hook.) Nutt./ Pachistima myrsinites Raf.) which occurs only in stream bottoms which are "frost pockets."

The distribution of vegetative communities within this area seems to be governed more by air drainage patterns and aspect than by elevation.

Much of the vegetation within the Flat Creek Unit has been disturbed by either logging, fire, insect damage, or grazing and is in varying stages of succession.

Climate

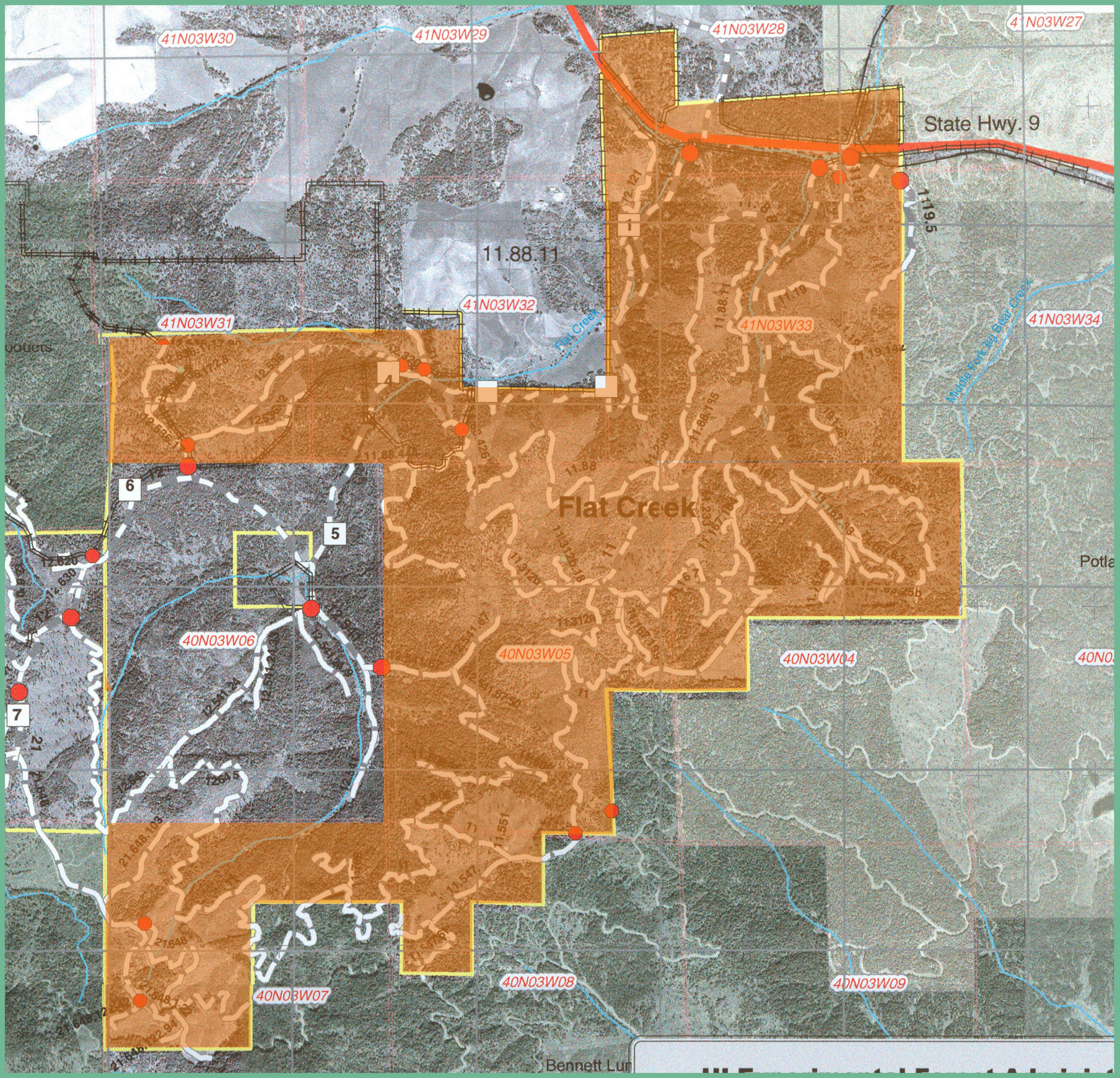
The climate within the study area is relatively mild. The mean annual temperature ranges from approximately 47°F (8.3°C) on the more open south and west facing slopes to several degress cooler on the north slopes and in the "frost pockets" and cold air drainage ways.

The mean annual precipitation ranges from approximately 25 to 30 inches (63.5 to 76.2 cm) with the majority coming during the winter.

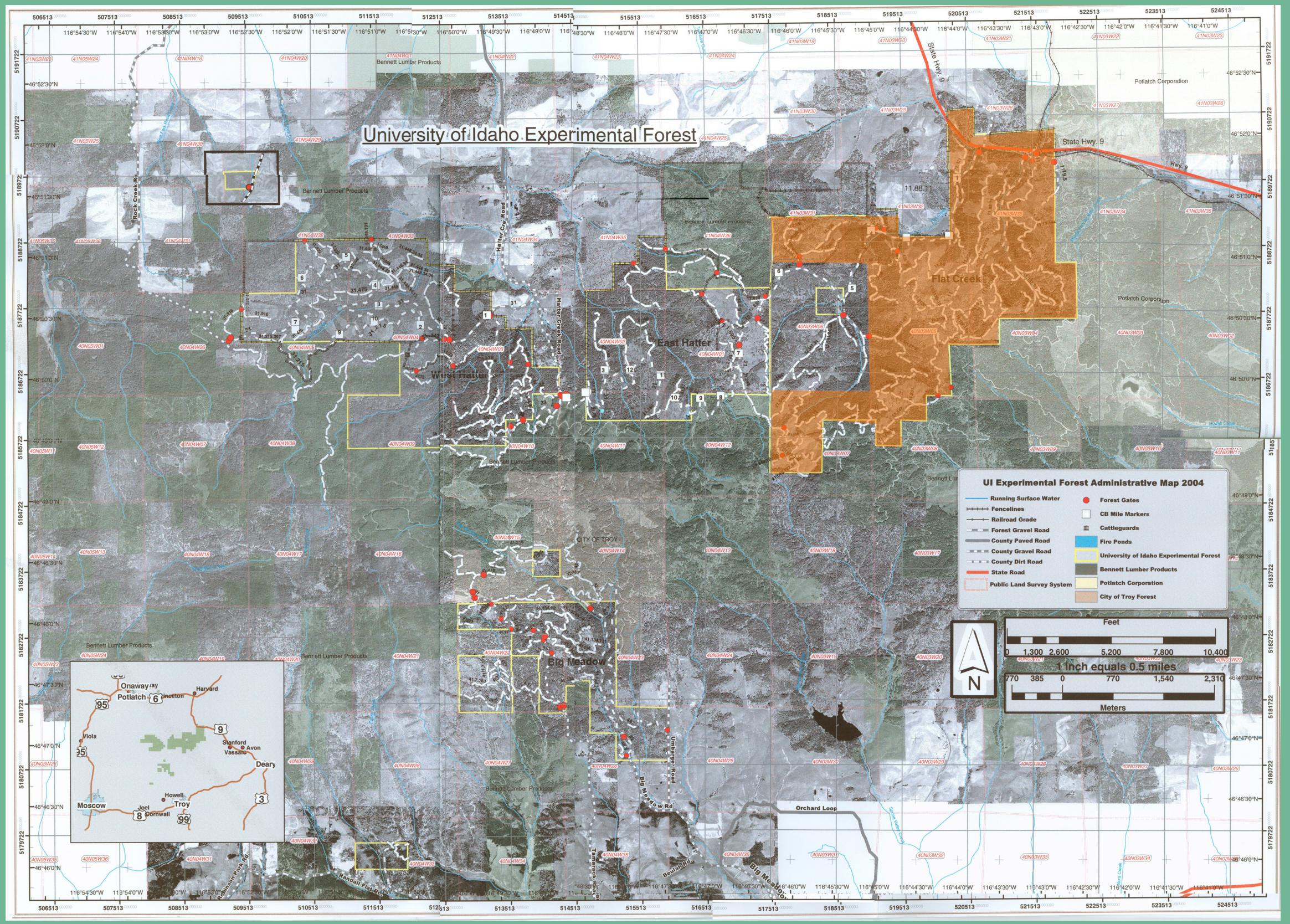
Topography

The study area is dominated by rounded secondary ridges generally running to the north and east of the Palouse Range. The gross aspect is northeast. The slopes average about 16% with a few ranging up to over 35% in the southwest corner near the crest of the range.

There is about 700 feet (213.4 m) of relief expressed in the study area with an average elevation of approximately 3,000 feet (914.6 m).



Flat Creek Unit-2004 map



University of Idaho Experimental Forest Map 2004

Location of Complete Research:

Author & Title: Chad Lyman McGrath:
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