Vegetation of the floodplains and first terraces of Rock Creek near Red Lodge, Montana
by Kenneth Eugene Tuinstra

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY in Botany
Montana State University

Abstract:
The floodplain vegetation of Rock Creek near Red Lodge, Montana was studied with a view to learning more about the relationship between riparian vegetation and trout habitat.

The major objectives of the study were to: (1) qualitatively and quantitatively describe the vegetation, (2) delineate the successional stages and relate the sequence to soil and other environmental factors, and (3) compare two adjacent sections of floodplain, one essentially undisturbed and the other heavily grazed. The vascular plants occurring on the flood-plain and nearby land forms were collected. The vegetation was sampled with permanent plots within and belt transects across the floodplain. Soils were sampled at two levels and analyzed for several physical and chemical properties.

The undisturbed vegetation of; the Rock Creek floodplain consists of several strata. • The tree stratum is composed nearly entirely of Populus trichocarpa. The tall shrub stratum has the following constituents: Cornus stolonifera, Salix sp., Prunus virginiana, Alnus incana, Betula occidentalis and Crataegus douglasii. Rosa acicularis, Symphoricarpos albus and Rubus idaeus are the most abundant taxa in the low shrub stratum. Characteristic herbaceous species occur under the woody vegetation, depending upon soil, water, light and the degree of disturbance.

Five successional stages, from Pioneer Stage to Mature Forest, have been designated and their floristic compositions compared. Soil samples were collected and analyzed from each . of these successional stages. Most soils are sandy, especially in early successional stages. There is an increase in the amount of organic matter, potassium and phosphorus with vege-tational development. Conductivity and 15-atmosphere moisture retention percentage are also greater in the advanced successional stages.

The essential elimination of the two shrub strata and the marked changes in the -floristic composition of the herbaceous vegetation indicate the effects of burning, clearing, grazing, flooding and stream course alteration within the floodplain.

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ABSTRACT

The floodplain vegetation of Rock Creek near Red Lodge, Montana was studied with a view to learning more about the relationship between riparian vegetation and trout habitat. The major objectives of the study were to: (1) qualitatively and quantitatively describe the vegetation, (2) delineate the successional stages and relate the sequence to soil and other environmental factors, and (3) compare two adjacent sections of floodplain, one essentially undisturbed and the other heavily grazed. The vascular plants occurring on the floodplain and nearby land forms were collected. The vegetation was sampled with permanent plots within and belt transects across the floodplain. Soils were sampled at two levels and analyzed for several physical and chemical properties.

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Five successional stages, from Pioneer Stage to Mature Forest, have been designated and their floristic compositions compared. Soil samples were collected and analyzed from each of these successional stages. Most soils are sandy, especially in early successional stages. There is an increase in the amount of organic matter, potassium and phosphorus with vegetational development. Conductivity and 15-atmosphere moisture retention percentage are also greater in the advanced successional stages.

The essential elimination of the two shrub strata and the marked changes in the floristic composition of the herbaceous vegetation indicate the effects of burning, clearing, grazing, flooding and stream course alteration within the floodplain.

INTRODUCTION

Statement of the Problem

The floodplain may be described as a strip of relatively smooth land bordering a stream and overflowed at time of high water (Leopold, Wolman and Miller, 1965). For millions of years flood plains have been centers of biological activity. The earliest agricultural settlements appear to have been those along tributaries of the lower Euphrates and Tigris rivers, and are now dated at around 7000 B.C. The kind of agriculture made possible by irrigation and the domestication of grasses--wheat, barley and rice--was permanent and demanded a large scale cooperation that led in turn to a closely knit social organization. The cultivation of irrigated lands that tied man to the river valleys led invariably to the development of cities with their granaries, market places, administrative centers and religious rites (Bardach, 1964). Today one finds that the centrality of rivers in human life has brought about profound conflicts of interest. Some of these interests include the preservation of an adequate water supply, the prevention of pollution, the control of floods, the continuation of high agricultural productivity and the maintenance of desirable recreational areas for a population with increasing leisure time.

The present problem, although not concerned with a large river, manifests many of the interesting aspects which are

being dealt with in connection with larger rivers. The study was supported by the Montana Fish and Game Department and the Montana Cooperative Fisheries Unit with a view to learning more about the relationship of riparian vegetation to trout habitat. The primary objective was to qualitatively and quantitatively describe the vegetation. In addition, the successional stages leading to the mature flood plain forest were delineated. To as great a degree as possible the successional stages were related to environmental factors. The factors influencing succession appear to be flooding, clearing, burning, grazing and mechanical stream course alterations. The study further involved the comparison of two sections along the stream which were nearly equivalent in area. One area is heavily grazed by cattle, while the other is essentially undisturbed by grazing, clearing, burning or alteration practices. The latter will hereafter be referred to as the natural area.

Description of the Study Area

Rock Creek originates at Glacier Lake on the Beartooth Plateau of Montana and Wyoming (Figure 1). The headwaters are near the Montana-Wyoming state boundary at an elevation of approximately 8600 feet above sea level. The stream flows northeasterly 59 miles until it joins the Clark's Fork River of the Yellowstone River Drainage. Most of Rock Creek would be classified as a straight stream (Leopold et al., 1965)

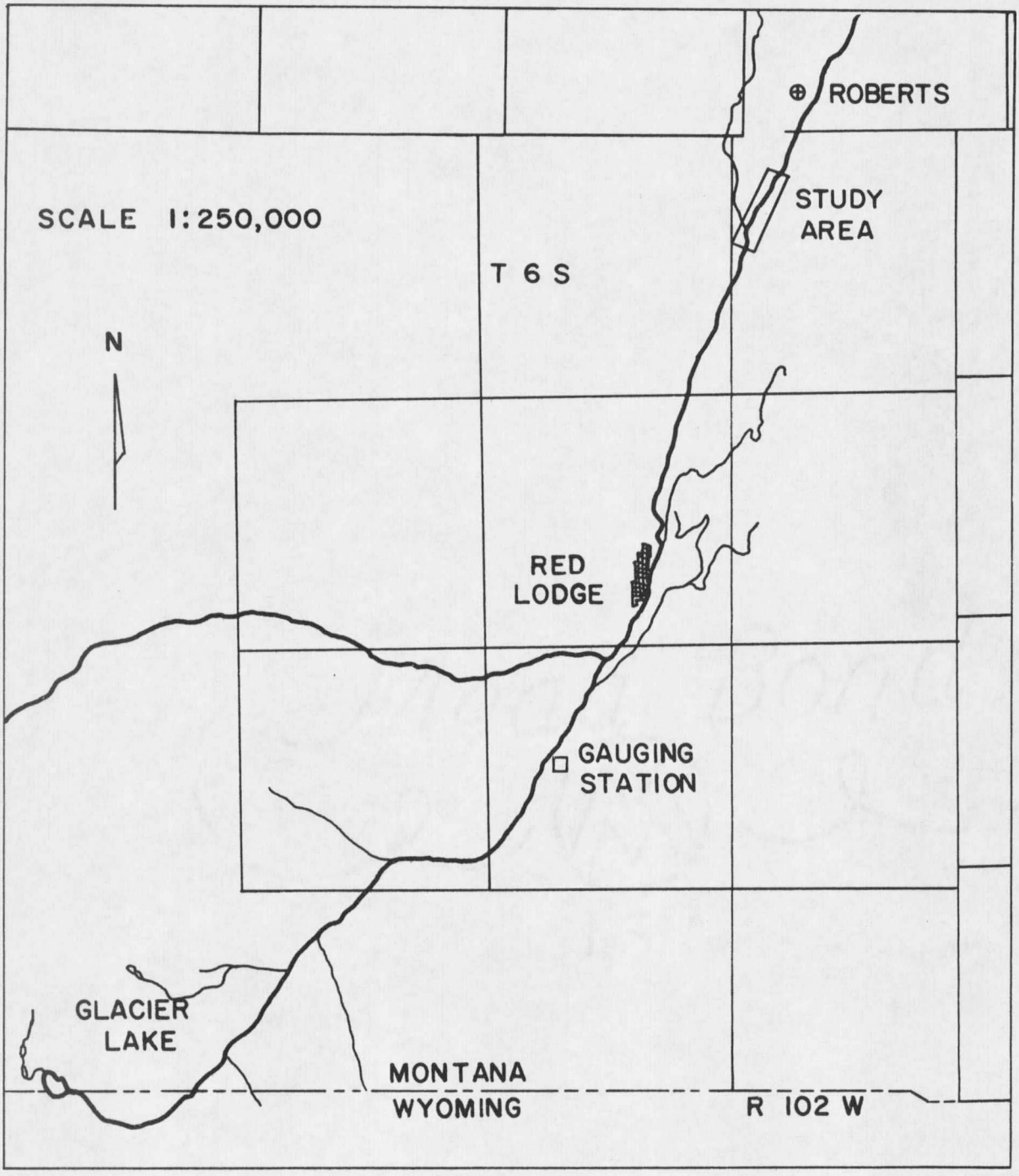

Figure 1. Map tracing the route of Rock Creek from origin at Glacier Lake to Roberts, Montana.

although in areas of heavy stream-side vegetation it may become a braided stream. The channel lacks most of the characteristics of a meandering stream (Matthes, 1941). At the United States Geological Survey recording station approximately four miles above Red Lodge, Montana, the stream has a drainage area of 124 square miles. It should be pointed out that this does not include the West Fork of Rock Creek and a few other small tributaries between the station and the study area. However, the station is also above the point at which water is diverted out of the stream for irrigation. This means that the recording station probably accurately reflects the natural discharge characteristics of Rock Creek. During late summer the volume of flow is generally less at the study area than in the upper reaches due to irrigation use. The 20 miles of stream above Red Lodge have an average gradient of 128 feet per stream mile, while the 23 miles between Red Lodge and the mouth of Red Lodge Creek have an average gradient of 66 feet.

Flood plain vegetation is probably most seriously affected by maximum discharge as opposed to either minimum discharge or average daily discharge. This is due to the fact that the maximum discharge usually occurs during flood or near flood conditions and does the most to physically alter the stream banks and flood plain. Table I presents the maximum discharge, minimum discharge and average daily discharge for the years 1951 to 1966

Table I. Maximum discharge, minimum discharge and average daily discharge (cfs) of Rock Creek near Red Lodge, for the years 1951 to 1966.

YEAR	MAXIMUM	MINIMUM	AVERAGE
1951	1460	28	199.8
1952	2590	30	182.2
1953	1300	24	148.9
1954	1570	18	149.6
1955	578	14	115.2
1956	1800	24	203.6
1957	3110	16	233.4
1958	1250	23	160.6
1959	1200	25	179.2
1960	680	27	118.7
1961	674	22	125.3
1962	912	23	174.2
1963	1120	15	180.6
1964	1330	24	156.3
1965	1450	24	214.0
1966	1230	22	154.1
Mean	1390.9	22.4	168.5

recorded at station 6-2095 of the United States Geological Survey (Rock Creek near Red Lodge, Montana) in cubic feet per second (U.S. Geological Survey, 1951-1960; 1961-1966). The maximum flow during these years has been recorded from May 15 to July 21 with the average date being June 14. The minimum discharge is more variable, occurring during the first four months of the calendar year with the average date being February 19. Figure 1 indicates the distribution of discharge over the year. The points plotted on the graph are the average daily flow for each month averaged for the years 1951 to 1966. It is easily observed that late spring and summer are the periods of highest average discharge. This is also the period when plants are most active physiologically. The results of this study will show which species and which plants have been most successful in perpetuating themselves in relation to various environmental stresses.

At its origin, the substrate of Rock Creek is Precambrian gneiss, schist, marble and associated rocks of the Cherry Creek series, pre-Cherry Creek formations and the Stillwater igneous complex. Near Mount Maurice, south of Red Lodge, the creek flows through Mississippian, Pennsylvania and Permian rocks of the Madison group and Amsden, Tensleep and Phosphoria formations. These Paleozoic formations are largely carbonates, sandstones and thin limestone. Near the point where Rock Creek emerges