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Supplement to the Soil Survey of Clark County Area, Idaho, Parts of Clark and Butte Counties

National Cooperative Soil Survey

This supplement is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey. The supplement was made cooperatively by the Natural Resources Conservation Service and the United States Department of the Interior, Bureau of Land Management; the University of Idaho, College of Agricultural and Life Sciences; and the Clark County Conservation District. It accompanies the most current official data for the soil survey of Clark County Area, Idaho, Parts of Clark and Butte Counties, available at http://websoilsurvey.nrcs.usda.gov.

Major fieldwork for the soil survey was completed in 2012. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 2018.

The General Soil Map in this supplement may be copied without permission. Enlargement of the map, however, could cause misunderstanding of the detail of mapping. If enlarged, the map does not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover Caption

Area southwest of Kilgore, Idaho. Idomonton, Longway, and Alex soils are on alluvial plains, and Parkalley and Latigo soils are on hills. The Centennial Mountains are in background.

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Additional information about the Nation's natural resources is available online from the Natural Resources Conservation Service at http://www.nrcs.usda.gov.

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Preface

This document is intended to provide supplemental information about the survey of the Clark County Area, Idaho, Parts of Clark and Butte Counties, that is not provided in the Web Soil Survey SSURGO data.

This supplement and the online soil survey data provide information that affects land use planning in this survey area. They are intended for many different users. Farmers, ranchers, foresters, and agronomists can use the information to evaluate the potential of the soil and the management needed for maximum food and fiber production. The information can be used by planners, community officials, engineers, developers, builders, and home buyers to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. It can also be used by conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control to help them understand, protect, and enhance the environment.

Supplement to the Soil Survey of Clark County Area, Idaho, Parts of Clark and Butte Counties

This document was developed to supplement the soil survey of Clark County Area, Idaho, Parts of Clark and Butte Counties. The data and maps for the survey were published previously for the Soil Survey Geographic Database (SSURGO) and are available through the Web Soil Survey online application (http://websoilsurvey.nrcs.usda.gov). This document provides information not available in Web Soil Survey. It contains information about the physiography, geology, relief, and formation of the soils in the survey area and about the rangeland, woodland, and wildlife habitat in the area.

With the completion of this soil survey, continuous soil mapping coverage of eastern Idaho is now available. This survey joins the soil surveys of Fremont County, Idaho, Western Part; Jefferson County, Idaho; Butte County Area, Idaho, Parts of Butte and Bingham Counties; Custer-Lemhi Area, Idaho, Parts of Blaine, Custer, and Lemhi Counties; and Targhee National Forest, Idaho and Wyoming.

Location of Clark County Area, Idaho, Parts of Clark and Butte Counties.

Additional Resources

More information about soils is available from the website of the Soil and Plant Science Division of the Natural Resources Conservation Service (https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/tools/). This site includes links to other sites where additional information specific to the soils in the survey area can be accessed, including the Web Soil Survey (http://websoilsurvey.nrcs.usda.gov). Spatial and tabular reports, including tables, interpretations, detailed map unit descriptions, and maps, can be accessed using the Web Soil Survey.

How This Survey Was Made

The survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in this survey area were mapped and correlated according to the concepts and limits of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map in this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soils That Formed on Lava Fields

Number of map units: 3
Percentage of survey area: 35 percent

1. Malm-Coffee-Grassyridge

Well drained and somewhat excessively drained, moderately deep to very deep soils that have slopes of 1 to 15 percent and formed in eolian deposits, in a frigid temperature regime and an aridic moisture regime

Percentage of survey area: 10 percent
Elevation: 4,800 to 5,400 feet
Frost-free period: 80 to 120 days
Mean annual precipitation: 7 to 14 inches

Major components
- Malm soils that formed in eolian deposits, on lava flows
- Coffee soils that formed in loess over basalt, on lava flows
- Grassyridge soils that formed in eolian deposits, on lava flows

Minor components
- Matheson soils that formed in eolian deposits over basalt, on lava flows and terraces

Major uses
Wildlife habitat, livestock grazing

2. Jacoby-Maremma-Blacknoll

Well drained, moderately deep to very deep soils that have slopes of 0 to 12 percent and formed in eolian deposits and alluvium derived dominantly from basalt, in a frigid temperature regime and in xeric and aridic moisture regimes

Percentage of survey area: 14 percent
Elevation: 4,800 to 6,000 feet
Frost-free period: 70 to 100 days
Mean annual precipitation: 8 to 20 inches

Major components
- Jacoby soils that formed in eolian deposits over basalt, on lava flows
- Maremma soils that formed in loess-influenced alluvium, on lava flows
- Blacknoll soils that formed in eolian deposits over basalt, on lava flows

Minor components
- Vickton soils that formed in loess-influenced alluvium over basalt, on lava flows
- Eaglecone soils that formed in eolian deposits over basalt, on lava flows

Major uses
Wildlife habitat, livestock grazing

3. Vadnais-Chickenridge

Well drained, deep soils that have slopes of 1 to 12 percent and formed in eolian deposits over bedrock, in a cryic temperature regime and a xeric moisture regime

Percentage of survey area: 11 percent
Elevation: 5,600 to 6,600 feet
Frost-free period: 30 to 70 days
Mean annual precipitation: 16 to 22 inches

Major components
- Vadnais soils that formed in eolian deposits over basalt, on lava flows
- Chickenridge soils that formed in eolian deposits over basalt, on lava flows

Minor components
- Spliten soils that formed in loess-influenced alluvium over basalt, on lava flows
- Crystalbutte soils that formed in loess-influenced alluvium derived from basalt, on lava flows
- Hopburn soils that formed in loess influenced by volcanic ash, on lava flows

Major uses
Wildlife habitat, livestock grazing

Soils That Formed on Alluvial Plains

Number of map units: 3
Percentage of survey area: 35 percent

4. Fallert-Patelzick-Deadhorse

Well drained soils that are shallow to cementation, have slopes of 0 to 12 percent, and formed in alluvium on fan remnants, in a frigid temperature regime and an aridic moisture regime

Percentage of survey area: 8 percent
Elevation: 5,000 to 8,000 feet
Frost-free period: 70 to 95 days
Mean annual precipitation: 8 to 16 inches

Major components
- Fallert soils that formed in alluvium derived from limestone, on fan remnants
- Patelzick soils that formed in loess-influenced alluvium over rhyolite, on pediments
- Deadhorse soils that formed in loess-influenced alluvium, on fan remnants

Minor components
- Nicholia soils that formed in alluvium derived from limestone, on fan remnants
- Fulwider soils that formed in loess-influenced alluvium derived from limestone, on fan remnants
- Paint soils that formed in alluvium derived from limestone, on fan remnants

Major uses
Wildlife habitat, livestock grazing

5. Simeroi-Packmo-Whiteknob

Well drained and excessively drained, very deep soils that have slopes of 0 to 30 percent and formed in alluvium, in a frigid temperature regime and in aridic and xeric moisture regimes

Percentage of survey area: 22 percent
Elevation: 4,800 to 7,500 feet
Frost-free period: 60 to 120 days
Mean annual precipitation: 7 to 16 inches

Major components
- Simeroi soils that formed in alluvium derived from limestone, on fan remnants
- Packmo soils that formed in alluvium, on fan remnants
- Whiteknob soils that formed in alluvium, on fan remnants

Minor components
- Deecree soils that formed in loess-influenced alluvium, on terraces
- Becreek soils that formed in alluvium, on stream terraces
- Medicine soils that formed in alluvium, on fan remnants
- St. Anthony soils that formed in alluvium, on terraces

Major uses
Production of irrigated small grain, potatoes, hay, and pasture; livestock grazing

6. Idmonton-Longway-Alex

Well drained to poorly drained, very deep soils that have slopes of 0 to 6 percent and formed in alluvium, in a cryic temperature regime and xeric moisture regime

Percentage of survey area: 5 percent
Elevation: 5,900 to 6,700 feet
Frost-free period: 30 to 60 days
Mean annual precipitation: 16 to 24 inches

Major components
- Idomonton soils that formed in loess-influenced alluvium, on fan remnants, flood plains, and stream terraces
- Longway soils that formed in alluvium derived from tuff, rhyolite, or quartzite, on fan remnants and stream terraces
- Alex soils that formed in alluvium derived from rhyolite, on stream terraces

Minor components
- Sudpeak soils that formed in alluvium derived from igneous rock, on fan remnants and stream terraces
- Seemore soils that formed in loess-influenced alluvium, on fan remnants, flood plains, and stream terraces

Major uses
Livestock grazing, pasture, wetland meadow pasture, wildlife habitat

Soils That Formed on Hills

Number of map units: 3
Percentage of survey area: 22 percent

7. Shagel-Mogg-Peaspear

Well drained, shallow to very deep soils that have slopes of 1 to 80 percent and formed in colluvium, in a frigid temperature regime and xeric moisture regime

Percentage of survey area: 9 percent
Elevation: 5,000 to 8,200 feet
Frost-free period: 50 to 100 days
Mean annual precipitation: 8 to 22 inches

Major components
- Shagel soils that formed in colluvium over rhyolite, on hillslopes
- Mogg soils that formed in colluvium over igneous rock, on hillslopes
- Peaspear soils that formed in loess-influenced alluvium or colluvium derived from calcareous sandstone, siltstone, or mudstone, on hillslopes and fan remnants

Minor components
- Argora soils that formed in colluvium derived from calcareous sandstone, shale, or siltstone, on canyon walls
- Ike soils that formed in colluvium derived from limestone, on hillslopes and ridges

Major uses
Livestock grazing, wildlife habitat

8. Parkalley-Latigo

Well drained, very deep soils that have slopes of 1 to 70 percent and formed in colluvium and alluvium derived from mixed sources, in a cryic temperature regime and xeric moisture regime

Percentage of survey area: 10 percent
Elevation: 5,500 to 8,500 feet
Frost-free period: 30 to 60 days
Mean annual precipitation: 16 to 22 inches

Major components
- Parkalley soils that formed in loess-influenced colluvium derived from rhyolite, on hillslopes
- Latigo soils that formed in loess-influenced alluvium derived from rhyolite, on fan remnants

Minor components
- Jackmill soils that formed in loess-influenced alluvium derived from igneous or metamorphic rock, on fan remnants
- Zeebar soils that formed in colluvium derived from quartzite, basalt, or tuff, on hillslopes and ridges
- Blackhorse soils that formed in loess-influenced colluvium derived from limestone, on hillslopes
- Rubble land

Major uses
Livestock grazing, wildlife habitat

9. Libeg-Owenspring-Philipsburg

Well drained, moderately deep to very deep soils that have slopes of 0 to 35 percent and formed in alluvium and colluvium derived from mixed sources, in a cryic temperature regime and an ustic moisture regime

Percentage of survey area: 3 percent
Elevation: 6,500 to 7,600 feet
Frost-free period: 50 to 70 days
Mean annual precipitation: 15 to 19 inches

Major components
- Libeg soils that formed in alluvium and colluvium derived from igneous rock, on fan remnants and stream terraces
- Owenspring soils that formed in alluvium over residuum derived from sedimentary rock, on hillslopes
- Philipsburg soils that formed in alluvium and colluvium, on fan remnants

Minor components
- Blaine soils that formed in alluvium derived from sandstone, on hillslopes
- Houlihan soils that formed in alluvium derived from igneous, metamorphic, or sedimentary rock, in swales
- Knep soils that formed in alluvium over residuum derived from sedimentary rock, on hillslopes

Major uses
Livestock grazing, wildlife habitat, wetland meadow pasture

Soils That Formed on Mountains

Number of map units: 2
Percentage of survey area: 8 percent

10. Zeebar-Fritz-Ediebench

Well drained, very deep soils that have slopes of 20 to 70 percent and formed in alluvium and colluvium derived from mixed sources, in a cryic temperature regime and xeric moisture regime

Percentage of survey area: 7 percent
Elevation: 5,500 to 9,000 feet
Frost-free period: 10 to 60 days
Mean annual precipitation: 16 to 28 inches

Major components
- Zeebar soils that formed in colluvium derived from quartzite, basalt, or tuff, on mountain slopes
- Fritz soils that formed in loess-influenced colluvium derived from limestone, on mountain slopes
- Eddiebench soils that formed in loess-influenced alluvium over colluvium derived from rhyolite or limestone, on mountain slopes

Minor components
- Windicreek soils that formed in alluvium and colluvium over residuum derived from calcareous sedimentary rock, on mountain slopes
- Medlo soils that formed in alluvium derived from limestone, on fan remnants and stream terraces
- Zeale soils that formed in alluvium and colluvium derived from limestone, on mountain slopes
- Raynoldson soils that formed in alluvium, on fan remnants

Major uses
Wildlife habitat, production of wood products, livestock grazing

11. Stringam-Sparky-Edgway

Well drained, very deep soils that have slopes of 5 to 35 percent and formed in alluvium and colluvium derived from mixed sources, in a cryic temperature regime and udic moisture regime

Percentage of survey area: 1 percent
Elevation: 6,500 to 8,000 feet
Frost-free period: 20 to 50 days
Mean annual precipitation: 21 to 30 inches

Major components
- Stringam soils that formed in alluvium derived from rhyolite, on mountain slopes
- Sparky soils that formed in loess-influenced colluvium derived from sandstone, on mountain slopes
- Edgway soils that formed in alluvium influenced by volcanic ash, on mountain slopes

Minor components
- Ezbin soils that formed in colluvium derived from igneous rock, on mountain slopes
- Sweethollow soils that formed in colluvium derived from sandstone, on mountain slopes

Major uses
Wildlife habitat, production of wood products, livestock grazing

Formation of the Soils

By William G. Hiett Jr., Natural Resources Conservation Service.

The five soil-forming factors—time, topography, climate, organisms, and parent material—have influenced soil formation in the survey area. Each of these factors acts on the earth in combination with the others to create soil.

Soil formation takes time; thus, within a human lifespan, it could be considered a finite resource. The use of soil by civilization is virtually unending. If landowners and resource managers are aware of how uniquely complicated it is to prevent soil degradation and learn to mitigate problems through properly applied conservation efforts, they can improve how soil resources are used and sustained. Learning about soil and its properties becomes imperative to make well-informed decisions on conservation practices.

Soil is composed of three different-sized particles—sand, silt, and clay, generally from largest to smallest. The particles range in size from 2 mm to as small as 0.0002 mm. They are weathered from minerals in the geologic parent material. The portioned amounts of clay, silt, and sand result in inherent soil properties such as texture, density, and available water-holding capacity. Soil texture is modified physically by features such as coarse fragments and organic material. Soils may be modified chemically by acid or basic material such as nitrogen fertilizer or weathering of limestone.

Soil scientists study and record observations of the chemical and physical characteristics of soil, identify repeating patterns of soil across the landscape, and identify similar and dissimilar soils on the landscape. They correlate spatial and tabular data to generate interpretations, descriptions of the soils, and maps that show the location of soils across the land.

Landforms shift as geomorphic shapes are constructed on the earth's surface. Relief in the survey area includes mountains, hills, lakes, terraces, streams, flood plains, and basins that are a result of volcanism and glaciation. Uplifts of the continent resulted in compression and extension of the crust. Layers of marine and freshwater deposits formed, eroded, and metamorphosed under intense pressure. Large areas of intrusive and extrusive igneous rock formed from volcanic activity as the North American plate drifted southwest over the hotspot presently under Yellowstone National Park. The soil survey is in an area of diverse parent material and complicated stratigraphy.

The survey area consists of lava fields, alluvial plains, hills, and mountains. It is in a transition zone among the Northern Rocky Mountains Province, the Basin and Range Province, and the Snake River Plain Section of the Columbia Plateau Province (Stevenson, 1993). Common landforms include fan remnants, hillslopes, outwash fans, stream terraces, flood plains, lava flows, fissure vents, dunes, and drainageways.

Lava Fields

About one-third of the survey area consists of loess and eolian material underlain by basalt. Formation of the parent material began about 16 million years ago, during the

Cenozoic Era, when lava flowed from hotspots beneath the earth's surface and formed low-relief lava plains.

During the Pleistocene Epoch, glaciers originated in the mountains surrounding the Snake River Plain. The Pinedale glaciation occurred 14 to 25 thousand years ago (Kya) and the Bull Lake glaciation 140 to 150 Kya. Meltwater from glaciers formed a series of ephemeral glacial lakes south of the survey area. The largest was Lake Terreton. The area was also inundated by a drainage of glacial Lake Bonneville.

When glaciers melt, they deposit material called glacial outwash. During dry periods, the outwash and lake sediment are uncovered and subject to windstorms. Prevailing winds scoured the exposed lake terraces, transported material to the northeast, and deposited it on the lava fields in the survey area. This fine sediment is the source of the loess and eolian material overlying the basalt flows. The coarser particles were deposited close to the source and the finer particles farther away. A noticeable difference in soil texture is evident in the survey area from the southwest to northeast.

The Wolverine and Snowshoe series formed in the coarsest textured material and in areas that receive the lowest amount of precipitation. These soils have minimal development in the profile because of the continual deposition of eolian material from windstorms. The mean annual precipitation is as low as 8 inches, and the rainfall rapidly infiltrates into the profile of sand. Only a small amount of organic material accumulates in the upper part of these soils. The Wolverine soils are classified as Entisols, and the Snowshoe soils are classified as Inceptisols.

To the northeast, the particle size decreases and precipitation increases at the higher elevations. The particle-size class is dominantly coarse-loamy. Coffee, Aecet, Grassyridge, Matheson, and Malm series are on the broad expanse of lava fields. The young landforms exhibit many features of past volcanic activity. Rock outcroppings cap lava pressure ridges, and exposed lava tubes and tumuli are in areas where columns of lava cooled in place. Depth to bedrock varies because of the undulating lava flows beneath the eolian deposits. Most of the map units are complexes of soils that are shallow to very deep. The surface texture typically is loamy fine sand, fine sandy loam, or loam. Slightly more soil development can be observed in the profile, which is indicated by secondary concentrations of calcium carbonate in Bk horizons. These soils are classified as Aridisols. They are in the frigid temperature regime and aridic bordering on xeric moisture regime. The Coffee soils have characteristics that are different from other geographically associated soils. Leaching has concentrated an abundance of sodium in a layer above the bedrock. These soils have a pH of 9 and a sodium absorption ratio of more than 13. They are classified as Sodic Xeric Haplocalcids and are mapped in complexes with soils that do not meet the criteria for a sodic horizon.

Near the town of Dubois, the surface texture is finer and precipitation is slightly higher. The soils in this area exhibit more weathering, are darker, and have more development in the profile. The dominant soils are those of the Eaglecone, Hotspot, Jacoby, Vickton, Pyrenees, Kuvasz, and Shar series. These soils are classified as Mollisols. They have a thick, dark-colored upper layer. The mean annual rainfall is 12 to 16 inches, and carbonates are leached to a depth of 7 inches or less. The soil temperature regime is frigid, and the soil moisture regime is xeric. The mean summer soil temperature is higher than 59 degrees F. Many of these soils are classified as Calcic Haploxerolls, but the soils that have calcium carbonates in the upper 7 inches are classified as Typic Calcixerolls. The soils are shallow to deep, and some have a considerable amount of coarse fragments, including gravel, cobbles, and stones, in the profile. The particle-size control section is 18 to 35 percent clay or more. Cryoturbation (frost churning) raises pieces of fractured basalt up into the finer material in the profile. Gravel from nearby rock outcroppings is in the upper part of the soils. The Shar series is on playas, which are closed drainage areas that have alluvial deposits of finer material. The particle-size control section in these soils is more than 35 percent clay.

East of Dubois, the elevation increases north of Camas Creek to the eastern boundary of Clark County. The moisture regime is xeric, and the mean annual precipitation is 16 to 21 inches. The higher precipitation and cooler soil temperatures influence the Akbash and Maremma series. These soils are classified as Calcic Pachic Haploxerolls. They have a thick mollic epipedon and calcium carbonate accumulation at a depth of 13 to 40 inches or more. Similar soils that have a thick mollic epipedon and are at higher elevations are those of the Chickenridge series, which are classified as Pachic Haplocryolls. Soils of the Katseanes and Vadnais series have more clay accumulation and are at an elevation of more than 6,500 feet. These soils are classified as Argicryolls.

South of Camas Creek, along the boundaries of Fremont and Jefferson Counties, are soils of the Jipper and Stipe series. The soils are sandy loam or loam in the upper part and have less than 18 percent clay in the particle-size control section. The calcium carbonate accumulation in these soils is much deeper than that in the soils of the western part of the lava fields. These soils are classified as Pachic Calcic Haploxerolls. They are in the frigid soil temperature regime and xeric soil moisture regime.

Dotted across the lava fields are volcanic features, including fissure vents, pressure ridges, tumuli, and craters. The Cinderbutte and Crystalbutte series are on the side slopes of these features. These soils formed in loess, eolian sand, and tephra. Cinders are mined from these soils by the county road department. The Hopburn series is on the edges of the volcanic features. These soils are classified as Vitrandic Haplocryalfs. Volcanic glass is dominant in the particle-size class.

The eastern part of the lava fields has a higher amount of rock outcroppings. This part has two distinct lava flows. The aa lava flows are crumbly and have a jagged surface. These flows act as a barrier to wind; thus, material is deposited on the leeward side. The pahoehoe lava flows are smooth and ropey. A micro-climate effect exists around the areas of exposed basalt, and the effective precipitation increases in these areas. Vegetation is more robust in low-lying areas around the rock outcroppings. The pahoehoe flows naturally are broader and have less relief. The soils in these areas have a more consistent shallow mantle of eolian sand and loess overlying the bedrock. The solum in areas of the aa lava flows commonly is thicker than that in areas of the pahoehoe lava flows.

Alluvial Plains

Alluvial plains, outwash plains, stream terraces, and flood plains stretch across the survey area in areas where the mountains meet the basin floor. Although these landforms are narrow in some places, they make up about one-fourth of the survey area. Sediment eroded from the mountains and hills fills the valleys. The age of the alluvium is apparent in the grade and size of the fragments and the content of clay. Modern deposits have more sand and silt, some clay and gravel, and in some areas, eolian deposits from ancient lakebeds. Older alluvium generally consists of well-sorted gravel, some sand, and less clay (Stevenson, 1993).

Birch Creek, Medicine Lodge Creek, Beaver Creek, and Camas Creek are the four largest drainageways in Clark County. The Birch Creek system drains into the Lost River Sinks, and the other creeks are tributaries of Mud Lake Basin. Most of the alluvial plains are affected by a rain shadow from orographic lifting of the mountains on the west side of the survey area.

Kilgore, Sudden, Sawtelpeak, Idmonton, and Seemore soils formed in alluvium derived from glacial outwash over residuum derived from rhyolite. The headwaters of Camas Creek are at the incised footslopes of the Centennial Mountains. The Kilgore soils formed on flood plains of streams such as Camas Creek, and they are poorly drained. The Kilgore soils have contrasting textures in the particle-size class, which is typical of soils that formed in alluvial deposits. The upper part is fine-loamy, and the lower part is sandy or sandy-skeletal. The Sudden and Sawtelpeak soils formed on flood plains of smaller streams. Water perches on a clay layer below the surface in these soils. The Idmonton and Seemore soils are somewhat poorly drained and have redoximorphic features typically associated with a seasonal high water table in the profile.

Stream terraces, outwash fans, and fan remnants are farther from the flood plains. The mean annual precipitation in these areas is 16 to 24 inches. The Fourme, Longway, and Alex soils are on these higher and drier landforms. These soils are well drained and have a water table at a depth of more than 60 inches. The soils are classified as Mollisols. They are in the cryic temperature regime and xeric moisture regime.

The Beaver Creek drainageway encompasses Thunder Gulch, Cottonwood Creek, Patelzick Creek, and several smaller creeks flowing south of Spencer, Idaho, and east toward Idmon, Idaho. The entire drainageway continues south to the boundary of Clark County, south of Dubois, Idaho. Soils of the St. Anthony taxadjunct and Becreek series are in this area. These soils formed in mixed alluvium derived from quartzite, sandstone, welded tuff, limestone, and chert. The upper part is eolian sand that has a texture of sand, loamy sand, or fine sandy loam, and the lower part is extremely gravelly and cobbly. These soils are classified as Mollisols. They are in the frigid temperature regime and xeric moisture regime. Typically, these soils are used to produce alfalfa and small grain. Center pivot irrigation is common.

The Medicine Lodge Creek and Birch Creek drainageways are west of Beaver Creek. Soils of the Lidy taxadjunct and the Simeroi, Medicine, Fallert, Whiteknob, Packmo, Zer, and Sparmo series formed in glacial outwash derived from limestone in this area. The landforms include flood plains, outwash plains, alluvial plains, stream terraces, and low fan remnants. The upper part of the soils is loam or silt loam, and the lower part is sandy and has a considerable amount of coarse fragments. The content of carbonate clay is 3 to 8 percent. The soils are classified as Haplocalcids. The soils have a high calcium carbonate equivalent at or near the surface. The Simeroi soils have carbonatic mineralogy and common coatings of calcium carbonate and silica on the faces of peds and surfaces of rocks. The temperature regime is frigid, and the moisture regime is aridic or aridic bordering on xeric. The mean annual rainfall is 7 to 12 inches. These soils are used for the production of irrigated alfalfa hay and grain and as rangeland. Common shrubs are low sagebrush, black sagebrush, and Wyoming sagebrush, and the dominant grass is bluebunch wheatgrass.

The northern reaches of Medicine Lodge Creek have narrow, cold, riparian corridors. The Medlo and Chips series formed in these areas in alluvium derived from limestone. These soils are on stream terraces and fan remnants. Poorly drained soils such as those of the Sudden and Sawtelpeak series also are common in these areas. The use and management of these soils is limited by the depth to the water table and the short growing season. Proper use and management of the soils helps to ensure stability of the stream bank. The Clark Conservation District has completed several successful restoration projects in severely eroded and damaged areas in the Medicine Lodge Creek drainageway.

At higher elevations in areas where the alluvial plains meet the mountain footslopes, the slope is 15 percent or more. Soils of the Raynoldson series are in these areas. These soils have a very coarse particle size because of the proximity to streams. The soils are classified as Mollisols. They are in the cryic temperature regime and xeric moisture regime.

Hills and Mountains

The Centennial Mountains frame the north side of the survey area and border Montana, along the Continental Divide. Only the edge of this forested area is in the survey area; most of it is in the Targhee National Forest. These mountainous areas formed in Tertiary and Quaternary colluvial and alluvial deposits and scattered volcanic material. The volcanic material and sedimentary rock formed in sediment deposited during the Upper Paleozoic and Mesozoic. The kinds of rock include dolomite, limestone, chert, sandstone, shale, and siltstone (Stevenson, 1993). The soils on the hills and mountains in the survey area formed dominantly in colluvium. The mean annual precipitation is 16 to 22 inches. The temperature regime is cryic, and the moisture regime is xeric.

The Peaspear and Blackhorse series are in the area between Webber Creek and Deep Creek, on the limestone hillslopes and ridges facing south toward the Lidy Hotsprings area. These soils formed in colluvium and alluvium derived from sedimentary rock. They have an argillic horizon and visible clay films lining the pores and on the faces of peds. The presence of an argillic horizon in the profile indicates an older, more stable landform, where soil-forming processes have acted longer on the parent material.

The Zeebar series covers many acres on the upper fan remnants and on the hills and mountains. These soils formed in colluvium derived from quartzite, basalt, and tuff. They have a well-defined argillic horizon even though the average content of clay in the particle-size control section is less than 40 percent. Syntectonic fractures in the quartz cobbles and stones is evidence of glaciation in these areas.

The Ediebench and Latigo series are on hills and mountains. They have a highly developed calcareous horizon below an argillic horizon. This is a result of the extensive age of the geomorphic surfaces and the accumulation of calcium carbonates from subsurface groundwater flow. These soils formed in colluvium derived from rhyolitic tuff. Tuff in the Latigo soils is part of the Kilgore Tuff unit that erupted from the Heise volcanic field approximately 4.5 million years ago. The reddish color of the tuff is a result of exposure to oxidation processes (Pedone, 2008). The Ediebench and Latigo soils provide high-quality wildlife habitat and native forage.

The Jackmill series is on hills and high-elevation fan remnants. The fan remnants consist of fanglomerate, which is likely re-worked material from the Beaverhead Group of the late Cretaceous or early Tertiary (Pedone, 2008). The Jackmill soils formed in colluvium derived from rhyolite, quartzite, sandstone, and some loess. These soils have faint clay films, but they do not have the increase in illuvial clay required to develop an argillic horizon. A lithologic discontinuity is in the lower part of the profile, where older deposits of alluvial material can be observed. This is characteristic of historic fan remnants.

The Shagel series is on broad, convex ridges of hills at the higher elevations. These soils formed in mixed colluvium derived from quartz and volcanic material, and they have mixed mineralogy. They are less than 20 inches deep to bedrock and have a very low available water-holding capacity. They support low sagebrush and bluebunch wheatgrass. The temperature regime is frigid, and the moisture regime is aridic bordering on xeric. Soils of the Mogg series are similar to the Shagel soils, but the Mogg soils do not classify as Mollisols because they have a thin, light-colored surface horizon. The Mogg and Shagel soils are mapped in complexes.

The soils on the hills and mountains in the survey area commonly have a duripan, or a root-restrictive subsurface layer cemented by illuvial silica and by calcium carbonate in some areas. The Westindian series is representative of several soils in the survey area that have a duripan. More than one duripan with varying degrees of cementation may be present in the profile. Heavy equipment is needed to excavate these layers. Many of the soils that have a duripan are classified as Haplodurids. The particle-size control section commonly averages more than 35 percent rock fragments. The soils of the Fulwider series are classified as Haplocalcids. They have less than 35 percent coarse fragments in the particle-size control section.

The hills and mountains in the area have Tertiary and Quaternary caps of rhyolite ashflow tuff. The tuff is high in content of ash and crystal and has some welded and glassy zones (Stevenson, 1993). Opal is in the rhyolite near Spencer, and obsidian is in the rhyolite in the Antelope Ridge area. Soils of the Anteloperidge series are north and east of Kilgore. These soils are very deep. They have an upper layer of coarse-loamy material and a lower layer of sandy or sandy-skeletal material. Sharp obsidian coarse fragments are in the profile. The soils are coarse grained as a result of the glassy material weathering in place. They are classified as Xeric Haplocryolls. The soils support mountain big sagebrush and Idaho fescue.

Soils of the Kitchell, Sheege, Adek, and Fritz series are at the higher elevations in the survey area. These soils formed in material that developed during mountain-building tectonic episodes that thrust-faulted older Paleozoic rock (Mississippian and Devonian limestone and dolomite) onto younger Mesozoic (Cretaceous) strata (Pedone, 2008). The soils typically have more than 35 percent rock fragments, 15 to 18 percent clay, and carbonatic mineralogy. The Sheege soils are on summits. They are shallow to fractured limestone and are extremely stony in the upper part. The Kitchell soils are on mountain slopes. They are very deep and formed in material derived from limestone, sandstone, and shale. The Adek soils are on convex mountain slopes, ridges, and summits. They are very deep and have rock fragments that are coated with calcium carbonates and silica. The Kitchell, Sheege, Adek, and Fritz soils support fringed sagewort, gray horsebrush, Sandburg bluegrass, bluebunch wheatgrass, and rabbitbrush. The frost-free period is 10 to 60 days.

At the highest elevations in the survey area, the mean annual rainfall is more than 22 inches. Typical soils are those of the Sweethollow, Sparky, Stringam, and Ezbin series. These soils are on mountain slopes, ridges, and interfluves of the Centennial Mountains. They support coniferous vegetation. They have a dark-colored, organic upper layer consisting of decomposed twigs, leaves, pine cones, and grass. The temperature regime is cryic, and the moisture regime is udic. The soils commonly are loamy-skeletal and have more than 35 percent rock fragments in the particle-size control section. They formed in colluvium derived from sandstone, quartzite, and extrusive igneous rock. These soils are used dominantly for the production of wood products, livestock grazing, and wildlife habitat.

Soils of the Parkalley series commonly are on drier aspects in close proximity to the forested soils. The plant community on these soils is shrubby and commonly consists of mountain big sagebrush, Idaho fescue, mountain brome, and forbs. The soils formed in loess-influenced colluvium and residuum derived from rhyolitic tuff. They have more than 35 percent flat and angular rock fragments in the control section and have an argillic horizon. Soils of the Hagenbarth soils are mapped in complex with the Parkalley soils. The Hagenbarth soils have less than 35 percent rock fragments in the particle-size control section.

Geology

By John P. Markov, State geologist for Oregon and Idaho, Natural Resources Conservation Service.

Physical Geology

The survey area transitions among three physiographic provinces—Northern Rocky Mountains, Basin and Range, and the Snake River Plain Section of Columbia Plateau. Each province has a unique geologic history that contributes to the complexity of the area. All of earth's major historical eras are represented in the rocks.

Precambrian rock, dated at more than 570 million years ago (Mya), consists of sedimentary and weakly metamorphosed sedimentary quartzite, siltite, and argillite of the Lemhi group. This rock is in the southern Lemhi Mountain Range, which bounds the western part of the survey area.

Paleozoic Era (540 to 251 Mya) rock consists of uplifted marine sedimentary units that range in age from Ordovician (505 to 438 Mya) to Permian (290 to 248 Mya). This rock is in the southern Lemhi Mountain Range, and it includes conglomerate, sandstone, shale, chert, carbonaceous mudstone, limestone, and dolomite that formed in shallow seas off the western edge of paleo-North America before being accreted with the continental craton. Rock of the Paleozoic encompasses a large span in the earth's history, and it represents a time of significant geological change, climatic shifts, and biological evolution.

Mesozoic Era (251 to 65 Mya) rock consists of Cretaceous Period (145 to 65 Mya) sedimentary conglomerate and sandstone of the Beaverhead Formation, in the southern Beaverhead Mountain Range. The Beaverhead Conglomerate was deposited as crustal movement shaped the Rocky Mountains, and it was folded while it was loose gravel (Alt and Hyndman, 1989). Cretaceous marine and deltaic sandstone and shale of the Cordilleran foreland basin is in the Centennial Mountain Range, along the northeastern part of the area. During the Mesozoic Era, the survey area was along the western bank of the Western Inland Seaway. This large inland sea connected the present-day Arctic Sea to the Gulf of Mexico. The global climate fluctuated throughout the Mesozoic Era, but it generally was warmer than it is today.

In the Cenozoic Era (65 Mya to present), much of the survey area is mantled by rock and unconsolidated sediment. During the Tertiary Period (65 to 2.6 Mya) and Quaternary Period (2.6 Mya to 11.7 thousand years ago [Kya]), wide intermontane valleys and most major drainageways in the survey area were filled with alluvium and colluvium. Late Tertiary rock (mid-Miocene Epoch and later) includes basin fill deposits, but it is dominantly volcanic deposits that range from rhyolite ignimbrite and tuff to lava flows of dacite and basalt. Silicic igneous volcanic rock is exposed in the Lemhi, Beaverhead, and Centennial Mountains. These deposits, known as the Heise volcanic field, erupted about 6.5 to 4.5 Mya, during the late Miocene Epoch (23 to 5.3 Mya) and early Pliocene Epoch (5.3 to 2.6 Mya). They consist of Blacktail Creek Tuff, Walcott Tuff, Conant Creek Tuff, and Kilgore Tuff (Morgan, 2005).

Basalt overlies rhyolite across the Snake River Plain. This rock erupted during the Pliocene Epoch (about 3 to 2.6 Mya) and Pleistocene Epoch (2.5 Mya to 11.7 Kya), and it commonly is covered with 1 to 3 meters of unconsolidated loess. These flowing eruptions were influenced by the migration of the intraplate hotspot, which currently underlies Yellowstone National Park. During this migration, crustal extension caused by the intrusion of magma allowed for bimodal volcanism. Basaltic and rhyolitic lava erupted along the margins of the Snake River Plain (Hughes, 1999). Glacial activity during the Pleistocene created cirque basins in the highest mountains adjacent to the survey area and deposited extensive glaciofluvial sediment, most notably along Webber Creek. During the Cenozoic Era, the continents moved into their current position and cycles of glaciation sculpted much of the Earth’s surface.

Much of the Paleozoic and Mesozoic strata in the survey area was subject to tectonic deformation 130 to 50 Mya. This occurred during the Sevier Orogeny, which was the result of compressional forces generated by a convergent plate boundary that thrust-faulted plates of older Paleozoic rock onto younger Mesozoic strata. This formed the block-faulted sections of the Lemhi and Beaverhead Mountain Ranges. These ranges are roughly parallel and trend north to northwest. Extensional deformation began after the Sevier Orogeny and during the mid-Eocene (56 to 34 Mya). This occurred concurrently with the Challis volcanic episode that produced much of the extrusive volcanic rock exposed in the area. The currently active tectonic regime of the Basin and Range Province began during the Miocene. Erosion, volcanism, and normal faulting continued during the Tertiary, creating the basin fill deposits and extensive volcanic rock units exposed in the area. Extensional deformation and associated faulting continue to develop the topographic relief across the area. Also during the Miocene, the eastern Snake River Plain began to form by tectonic movement of the North American plate over the shallow crustal hotspot under Yellowstone National Park.

Economic Geology

Clark and Butte Counties are rich in economic resources. Commodities including silver, phosphorous, lead, uranium, iron, copper, antimony, and gold have been mined in the survey area since the 1890s. Currently, about 700 claims are active.

Areas that have high potential as a source of geothermal energy span the eastern Snake River Plain and the adjacent Basin and Range Province north of the plain. This broad region was subject to extensional tectonism and voluminous hotspot-related volcanism during the Tertiary, and it has higher than normal heat flow that continues north into western Montana (Blackwell, 1989).

No significant coal-bearing strata are in the survey area (Lund and others, 2016). Three small coal-bearing zones underlain by Tertiary lignite are northeast of the area. The potential of these zones has not been assessed by the U.S. Geological Survey. The survey area is in the Idaho-Snake River Downwarp Oil and Gas province, but no oil or gas has been produced in the area. The only large-scale hydrocarbon production in Idaho is in Payette County, which is several hundred miles west of the survey area. Natural gas and liquid condensate is produced from Miocene lacustrine deposits in that county (Ratchford, 2015).

Phosphate-bearing rock is in the western part of Clark County, in Permian deposits of the Phosphoria Formation. Although surface exposures of this rock are in adjacent areas, it is not in production. Phosphate mining is common in southeast Idaho, dominantly in Caribou County.

Industrial minerals, such as sand, gravel, pumice, perlite, garnet, limestone, silica, gypsum, bentonite, diatomite, and zeolite, are abundant in Idaho. Three industrial mineral mines are in Clark County—Thermocal Mine in the southwest corner of the county, Fritz Creek Travertine Mine in the northwest corner, and Spencer Opal Mine in the northeast corner.

The Otis Gold Corporation mines gold near central Clark County. The Kilgore Gold Project consists of 232 federal mining claims and one Idaho State land permit. The project covers a total of 5,130 acres. It targets a gold deposit related to a zoned epithermal hot springs system in volcanic rock of the Miocene.

Surface and Groundwater Resources

Surface drainage in the survey area generally runs toward the east and south into the Snake River system and ultimately discharges into the Pacific Ocean. Medicine Lodge Creek, Beaver Creek, and Camas Creek are the primary drainageways. The survey area crosses eight watersheds—Red Rock, Idaho Falls, Upper Henrys, Lower Henrys, Beaver-Camas, Medicine Lodge, Birch, and Little Lost.

The prolific Eastern Snake Plain Aquifer (ESPA) underlies much of the survey area. The aquifer covers an area of about 10,800 square miles and is the largest fractured basalt aquifer in the state. According to the Idaho Department of Environmental Quality (IDEQ), the aquifer discharges nearly 2.6 trillion gallons of water annually into the Snake River. It is estimated to be more than 5,000 feet thick; however, the most productive zone is the upper 300 to 500 feet, where fracturing in the basalt is most significant. The groundwater migrates from the northeast to the southwest in this upper zone. The estimated total storage in this zone is 200 to 300 million acre-feet. In 1991, the Environmental Protection Agency (EPA) classified the ESPA as a sole source aquifer, which means that it supplies at least 50 percent of the drinking water consumed in the area. IDEQ listed it as a groundwater management area and published the ESPA Comprehensive Aquifer Management Plan in 2009.

Rangeland Management

By Tracie O'Neill, area rangeland management specialist, and Brendan Brazee, Idaho State rangeland management specialist, Natural Resources Conservation Service.

Introduction

About 769,840 acres of the survey area is native and seeded rangeland. A wide variety of soil and climatic factors influence the kinds and amounts of vegetation.

An ecological site is a distinctive kind of land that has specific physical characteristics, such as soil, climate, and topography. It differs from other kinds of land in its ability to produce a unique kind and amount of vegetation. The soils in the area were correlated to rangeland ecological sites during the survey; thus, the dominant rangeland ecological site for a map unit generally can be determined from the soil map. Soil properties that affect moisture supply and plant nutrients, such as soil depth, organic matter content, soil structure, clay content, and rock fragment content, have the greatest influence on the productivity of range plants. Soil chemical properties and the presence or absence of a seasonal high water table are important factors also. Each rangeland ecological site is identified by a name that includes soil or topographic characteristics, the precipitation zone, and the dominant species in the reference plant community. A list of plant symbols used for key species in the plant communities is in the USDA-NRCS PLANTS Database (http://plants.usda.gov/).

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that supports the reference plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruit of woody plants, but it does not include the increase in stem diameter of trees and shrubs. Total production is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. The relationship of green weight to air-dry weight varies according to factors such as aspect, amount of shade, recent precipitation, and unseasonably dry periods. Characteristic vegetation refers to the grasses, forbs, and shrubs that make up the majority of the reference plant community. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average generally because of low available soil moisture. Composition refers to the expected percentage of the total annual production for each species.

Description of Rangeland Ecological Sites by Landscape Position

Sites on Alluvial Plains and Lava Fields

The alluvial plains and lava fields are at the lowest elevations in the survey area. The mean annual precipitation is 6 to 14 inches, which is the lowest in the area. The associated rangeland ecological sites commonly are dry and gravelly. The plant community consists dominantly of black sagebrush (*Artemisia nova*), little sagebrush (*Artemisia arbuscula*), shadscale (*Atriplex confertifolia*), and bluebunch wheatgrass

(*Pseudoroegneria spicata* ssp. *spicata*). The total annual production is about 400 pounds per acre.

Some associated rangeland ecological sites on these landscapes are in areas of loamy soils. The plant community consists dominantly of Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) and bluebunch wheatgrass. The total annual production is 800 to 900 pounds per acre.

Sites on Hills

The hills in the survey area are at an elevation of 6,000 to 7,500 feet. The mean annual precipitation is 14 to 19 inches. The plant community consists dominantly of mountain big sagebrush (*Artemisia tridentata vaseyana*) and Idaho fescue (*Festuca idahoensis*). The total annual production is 800 to 2,000 pounds per acre. Bluebunch wheatgrass and Idaho fescue are co-dominant in many sites at the lower range in elevation. Mountain shrub communities, dominantly mountain snowberry (*Symphoricarpos oreophilus*) and antelope bitterbrush (*Purshia tridentata*), are co-dominant in sites at the upper end of the precipitation zone.

Sites on Mountains

The highest elevation landscapes in the survey area are the mountains bordering the northern boundary. The mountain slopes support a variety of rangeland ecological sites that have a mean annual precipitation of 19 inches or more. Woodland habitat types are dominant. The plant community consists dominantly of Douglas-fir (*Pseudotsuga menziesii*) or subalpine fir (*Abies lasiocarpa*) and an understory of grass or shrubs. Production of the understory vegetation is limited by shade from the conifer canopy.

Mountain slopes feature a more diverse topography; thus, they provide more niches to support more different rangeland ecological sites. Dry to wet meadow complexes are common at the upper elevations; willows and grasslike plants are dominant in these areas. The total annual production is 2,000 to 5,000 pounds per acre. Much of this landscape supports mountain big sagebrush-bluebunch wheatgrass/Idaho fescue ecological sites similar to those on the hills. The sites generally are on south- and west-facing slopes, where the effective precipitation is too low for trees to become dominant. The total annual production is 1,000 to 2,500 pounds per acre.

Management

Rangeland in the survey area traditionally has been used for livestock grazing. Farming, wildlife habitat, and recreation are other common uses. Management of rangeland requires knowledge of the soils, vegetation, and expected responses to a variety of disturbances. Proper management includes an evaluation of existing conditions and development of resource goals and objectives. Rangeland similarity and trend allow for comparison of the present conditions with the reference state of the ecological site. Similarity is determined by comparing the percent composition by weight of plant species at a site to that of the reference plant community. Apparent range trend evaluates a number of indicators at a site to determine the direction of change, either toward the reference plant community or away from it. Rangeland inventory, health, trend, and monitoring data help landowners make good management decisions that incorporate environmental and human variables. Adaptive management strategies allow for development of successful plans in areas where multiple landscapes and uses are in close proximity.

Prescribed grazing, fencing, water development, range seeding, and brush management can be used by landowners to manage vegetation to achieve specific goals and objectives. Properly managed rangeland provides wildlife habitat and recreational opportunities while also protecting the soil, water, and forage resources.

Woodland Management and Productivity

By Frank Gariglio, Idaho State forester, Natural Resources Conservation Service.

Only about 2 percent of the survey area is forested. The forested soils are those of the Edgway, Ezbin, Fitzwil, Fourme, Gany, Hagenbarth, Hapgood, Hopburn, Katpa, Ketchum, Kitchell, Koffgo, Povey, Rin, Sparky, Stringam, and Sweethollow series and Haplocryalfs.

These soils generally are on mountain slopes and foothills at an elevation of 6,400 to 8,400 feet. They are in transitional areas between the drier, lower elevation rangeland and the wetter, higher elevation forestland. The extensive forestland at the higher elevations is under the jurisdiction of the U.S. Forest Service and is not included in the survey area.

The presence of trees is dictated by the soils and climate in combination with stand history and site disturbances. Douglas-fir (*Pseudotsuga menziesii*) is the most common commercial species; however, the production of timber products from the private forestland in the area is limited. The forested areas also support quaking aspen (*Populus tremuloides*), subalpine fir (*Abies lasiocarpa*), limber pine (*Pinus flexilis*), and lodgepole pine (*Pinus contorta*). Use of timber harvest equipment is limited on the steeper slopes.

Each forested soil is correlated to a unique habitat type—limber pine/spike fescue (*Leucopoa kingii*), Douglas-fir/Rocky Mountain juniper (*Juniperus scopulorum*), Douglas-fir/mountain snowberry (*Symphoricarpos oreophilus*), Douglas-fir/pinegrass (*Calamagrostis rubescens*), Douglas-fir/Rocky Mountain maple (*Acer glabrum*), subalpine fir/blue huckleberry (*Vaccinium globulare*), subalpine fir/pinegrass, or subalpine/western meadow-rue (*Thalictrum occidentale*). Oregon boxleaf (*Paxistima myrsinites*) may be in the pinegrass and Rocky Mountain maple habitat types. The publication Forest Habitat Types of Eastern Idaho-Western Wyoming (Steele and others, 1983) provides information on the ecology, silviculture, and management of the forested resources in the survey area. The publication Fire Ecology of the Forest Habitat Types of Eastern Idaho and Western Wyoming (Bradley and others, 1992) provides information on the role of fire and the ecological responses of the soils following disturbance from wildfires.

The forests in the survey area, particularly those at the lower elevations, are characterized by sparse stand density, low basal area, and low or moderate productivity. The site index productivity values range from 25 to 53 (Brickell, 1968 50-year curve). Yield was not estimated because of limited data. Specific site index projections for the limber pine and Douglas-fir habitat types mapped in the survey area are in the following table.

Habitat type	Douglas-fir site index
Limber pine/spike fescue	25 ± ?
Douglas-fir/mountain snowberry	32 ± 6
Douglas-fir/pinegrass, Oregon boxleaf	51 ± 9
Douglas-fir/pinegrass	47 ± 5
Douglas-fir/Rocky Mountain maple, Oregon boxleaf	53 ± 5

Natural regeneration may occur in small openings. Competition from brush commonly is severe. It limits seedling establishment and survival rates as well as the total wood production of the stand. Understory shrub species include common juniper (*Juniperus communis*) and big sagebrush (*Artimesia tridentata* ssp. *tridentata*) in the driest areas and common snowberry (*Symphoricarpos albus*), Rocky Mountain maple, white spirea (*Spiraea betulifolia)*, and western chokecherry (*Prunus virginiana*) in areas that receive more moisture. The vegetation on most of the forested soils will revert to stands of seral brush if the overstory of mature Douglas-fir trees is removed without adequate plantings of Douglas-fir seedlings. To re-establish the forest in these areas immediately, adequate site preparation and hand planting are needed.

The forested soils are valuable for use as wildlife habitat and for the protection and function of the watershed as well as for aesthetic enjoyment and recreation. Some of the forest stands provide a source of firewood.

Wildlife

By Trisha Cracroft, Idaho State biologist, Natural Resources Conservation Service, and Josh Rydalch, regional wildlife biologist, Idaho Department of Fish and Game.

Much of the survey area is in one of the least populated counties in Idaho. The area has a diverse ecology from the foot of the continental divide to the cool, arid northeastern Snake River Plain. The survey area is comprised of several eco-regions that play a vital role in sustaining the regional wildlife populations. Much of the wildlife in the area use the higher elevations in summer and the lower valleys in winter. These areas provide high-quality habitat for fish and wildlife, and they are used for hunting, fishing, and other outdoor activities. The wildlife habitat can be created or improved by planting vegetation appropriate for the ecological site, maintaining the existing plant composition and community, or promoting the natural establishment of desirable plants. The plant communities and restoration efforts are affected by soil texture, temperature, and moisture; available water-holding capacity; wetness; slope; surface stoniness; and flooding.

Although relatively pristine climax sagebrush-steppe communities are in this area, most sites have been modified to some degree by historic livestock grazing. The survey area supports viable populations of greater sage-grouse (*Centrocercus urophasianus*) and pronghorn (*Antilocapra Americana*), which are dependent on contiguous sagebrush steppe communities large enough to provide all seasonal habitat requirements. In the 1990s, the sage-grouse population in this area was at an historic low. Recovery peaked in 2005 through 2007, and the population was stable in 2012 through 2016. The estimated population of pronghorn in 2011 was more than 1,200 individuals in winter and more than 1,300 in summer. Clark County is considered critical to sustaining future regional populations of sage-grouse and pronghorn. The sagebrush communities also provide important habitat for sagebrush-obligate and steppe-associated species such as pygmy rabbit (*Brachylagus idahoensis*), sage thrasher (*Oreoscoptes montanus*), Brewer's sparrow (*Spizella breweri*), long-billed curlew (*Numenius americanus*), short-eared owl (*Asio flammeus*), green-tailed towhee (*Pipilo chlorurus*), and ferruginous hawk (*Buteo regalis*).

Forested areas in the survey area are limited. They are in a relatively narrow zone along the northern margin of the area. Quaking aspen (*Populus tremuloides*) is relatively rare in the forests, but healthy communities provide high biodiversity and are critical for mule deer (*Odocoileus hemionus*), moose (*Alces americanus*), elk (*Cervus canadensis*), dusky grouse (*Dendragapus obscurus*), ruffed grouse (*Bonasa umbellus*), and spruce grouse (*Falcipennis canadensis*) as well as various songbirds, bats, amphibians, and pollinator insects. Other migratory bird species of particular conservation concern associated with alpine areas, coniferous forests, mountain meadows, and riparian areas include black rosy finch (*Leucosticte atrata*), fox sparrow (*Passerella iliaca*), olive-sided flycatcher (*Contopus cooperi*), Cassin's finch (*Haemorhous cassinii*), calliope hummingbird (*Selasphorus calliope*), Lewis's woodpecker (*Melanerpes lewis*), Williamson's sapsucker (*Sphyrapicus thyroideus*), and rufous hummingbird (*Selasphorus rufus*).

Mountain mahogany scrub and woodland communities are in small to large, scattered patches in steep canyons, in areas of rock outcroppings, and on steep slopes in the forested areas. This cover type includes both woodland and shrubland that consists dominantly of curl-leaf mountain mahogany (*Cercocarpus ledifolius*). Mountain mahogany provides important winter cover for mountain goat (*Oreamnos americanus*) and bighorn sheep (*Ovis canadensis*) and is highly palatable to moose, elk, and mule deer. Plants in areas that have high densities of wild ungulates commonly are browsed heavily. The golden eagle (*Aquila chrysaetos*) nests in this habitat, but it uses a variety of habitats for foraging, including shrubland, grassland, coniferous forest, farmland, and areas along rivers and streams.

Agricultural land commonly plays an important role for wildlife throughout the seasons. Irrigated pasture and hayfields provide nesting and foraging habitat for a wide variety of species, hedgerows and windbreaks provide shelter, and crop residue provides food. Long-billed curlew, Swainson's hawk (*Buteo swainsoni*), loggerhead shrike (*Lanius ludovicianus*), and other birds use irrigated agricultural land for nesting or foraging in summer. Mule deer, elk, and pronghorn commonly forage in hayfields or loaf in nearby pastures in winter.

Although elk were rare in the area in the early to mid-1900s, they currently are the most abundant ungulate. The estimated population is more than 3,800. The estimated population of mule deer is more than 3,000, and the estimated population of moose is more than 200. As many as 153 mountain goats were counted in the area in 1994, but the current population is unknown. The population of bighorn sheep in this area historically has been strong, but it has decreased dramatically in the last two decades. In recent years, at least two gray wolf (*Canis lupus*) packs have been documented in Clark County. A small number of grizzly bear (*Ursus arctos*) and white-tailed deer (*Odocoileus virginianus*) are in the survey area.

Thirteen of the thirty-seven species of amphibians and reptiles in Idaho are in the survey area. Amphibians have a two-phase lifestyle—an aquatic larva that metamorphoses into a terrestrial adult. Amphibian eggs require emersion in water or a very moist substrate. Reptile eggs have an impermeable membrane and are completely terrestrial. The body temperature of amphibians and reptiles is determined by the environment. Amphibians in the survey area include tiger salamander (*Ambystoma tigrinum*), western toad (*Anaxyrus boreas*), western chorus frog (*Pseudacris triseriata*), Columbia spotted frog (*Rana luteiventris*), Great Basin spadefoot (*Spea intermontane*), and northern leopard frog (*Lithobates pipiens*). Reptiles in the area include short-horned lizard (*Phrynosoma douglasii*) and western skink (*Eumeces skiltonianus*). Snakes include common garter snake (*Thamnophis sirtalis*), western terrestrial garter snake (*Thamnophis elegans*), rubber boa (*Charina bottae*), gopher snake (*Pituophis catenifer*), and western rattlesnake (*Crotalus viridis*). Soils associated with water features such as wetland, wet meadows, and irrigated cropland provide habitat for amphibians, and those on the drier uplands provide habitat for reptiles.

Aquatic habitats are not described or characterized in detail in the soil survey, but they should be considered in conservation planning. Land use practices on the surrounding landscapes have a profound effect on water quality because of the runoff. Sound conservation management on the uplands adjoining streams and wetland are as important as conservation practices applied in the stream channels. More than 1,000 lakes, rivers, and other fishing areas are in the survey area. Electrofishing surveys conducted by Idaho Fish and Game (IDFG) found that brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), and hybrid trout (Yellowstone cutthroat trout [*Oncorhynchus clarkii bouvieri*] crossed with rainbow trout) are common in the survey area. Other species introduced in the area are brown trout (*Salmo trutta*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), carp (*Cyprinids*), and various catfish and bullheads (*Ictalurids*).

The vegetation surrounding the bodies of water commonly provides important cover and nesting habitat for a variety of species of particular conservation concern. American bittern (*Botaurus lentiginosus*), eared grebe (*Podiceps nigricollis*) and western grebe (*Aechmophorus occidentalis*) are associated with freshwater wetland, marshes, shallow lakes, and ponds. The bald eagle (*Haliaeetus leucocephalus*) breeds and winters in areas adjacent to water bodies, and the willow flycatcher (*Empidonax traillii*) breeds in moist, shrubby areas that commonly have standing or running water.

As of spring 2017, the yellow-billed cuckoo (*Coccyzus americanus*), Canada lynx (*Lynx canadensis*), and grizzly bear were listed by the U.S. Fish and Wildlife Service (FWS) as threatened in the survey area. Whitebark pine (*Pinus albicaulis*) was listed as a candidate, and the North American wolverine (*Gulo gulo luscus*) was proposed as threatened. Yellow-billed cuckoos rely on dense wooded habitat. They nest in willows along streams and rivers and forage in nearby cottonwoods. No proposed critical habitat for the yellow-billed cuckoo is in the survey area. Canada lynx inhabit boreal forests that have cold, snowy winters and a high number of snowshoe hare (*Lepus americanus*). No critical habitat for Canada lynx is in the survey area. North American wolverine habitat is associated with high elevations that have a deep, persistent snow cover until late in spring. Critical habitat for wolverine has not been designated. The grizzly bear has been proposed for delisting. Adequate habitat for grizzly bear includes expansive forests intermixed with meadows and grassland. This habitat is associated with the Greater Yellowstone Recovery Zone. Whitebark pine is at high elevations, and the seeds are an important source of food for wildlife. Fire suppression, mountain pine beetle (*Dendroctonus ponderosae*), and white pine blister rust (*Cronartium ribicola*) have caused a decline in the abundance of whitebark pine. No critical habitat has been designated for this species.

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