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Supplement to the Soil Survey of the Caribou National Forest, Idaho and Wyoming

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 (USDA) and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal portion of the National Cooperative Soil Survey. The supplement was made cooperatively by the NRCS and the U.S. Forest Service (USFS). It accompanies the most current official data for the soil survey of the Caribou National Forest, Idaho and Wyoming, available at http://websoilsurvey.nrcs.usda.gov.

Major fieldwork for the soil survey was completed in 2008–2017.

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Cover Caption

Tincup Creek east of Wayan, Idaho, in the Caribou Range on the Soda Springs Ranger District of the Caribou-Targhee National Forest. Photograph by K. Green.

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July 2020

Preface

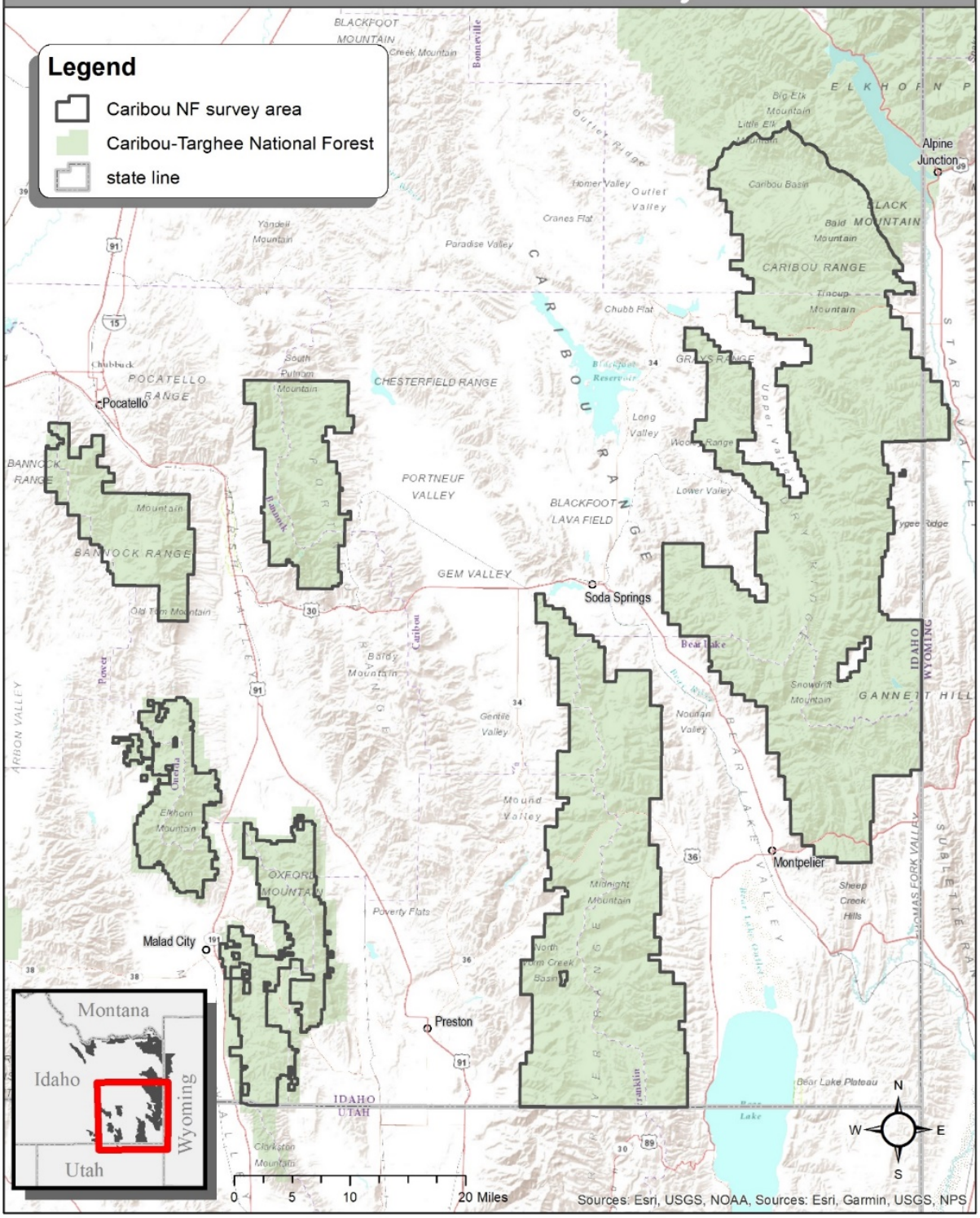
This document is intended to provide supplemental information about the soil survey of the Caribou National Forest that is not provided in the Soil Survey Geographic Database (SSURGO), which is available online through the Web Soil Survey https://websoilsurvey.sc.egov.usda.gov.

This supplement provides information on how the survey was completed, a general overview of the survey data, and key references.

Soil Survey of Caribou National Forest, Idaho and Wyoming

The online soil survey for the Caribou National Forest provides information on soil properties, forested habitat types, rangeland ecological sites, and more. This information can be used to manage the natural resources of the Caribou National Forest. Spatial and tabular data, including maps, detailed map unit descriptions, and interpretations can be accessed through the Web Soil Survey.

Caribou National Forest Survey Area



How This Survey Was Made

Overview

This survey was a cooperative effort between the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Soil and Plant Science Division, and the USDA, Forest Service, to complete an integrated resource inventory of the Caribou National Forest in Idaho and Wyoming. The survey meets the standards of the National Cooperative Soil Survey and provides the soil data needed for the management of the natural resources in the Caribou National Forest part of the Caribou-Targhee National Forest. The soil data provides basic land capability information for:

- defining desired natural resource conditions,
- watershed and landscape analyses,
- forest management planning and monitoring, and
- project planning and monitoring.

The survey area was mapped according to the *Soil Survey Manual* (Soil Science Division Staff, 2017). Soil information was correlated to the map unit concepts of several major land resource areas (MLRAs). MLRAs are geographically associated land resource units that have common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). The survey area intersects several MLRAs, including MLRA 47–Wasatch and Uinta Mountains, MLRA 43B–Central Rocky Mountains, MLRA 13–Eastern Idaho Plateaus, and MLRA 28A–Great Salt Lake Area (USDA, 2006). (See Appendix—Map of Major Land Resource Areas in Caribou National Forest.) The survey area is mountainous terrain that supports a mosaic of forests and rangeland.

Interagency field crews consisted of NRCS and Forest Service soil scientists, rangeland specialists, ecologists, and botanists. The field crews used published climate data, geology maps, vegetation classifications, and geospatial datasets, including high-resolution aerial imagery and 10-meter Digital Elevation Models (DEMs) and derivatives (i.e., elevation, slope percent, aspect, hillshade) to stratify the landscape. Using this information, the soil scientists selected locations for field observations. Data collection proceeded in an iterative manner with a goal to understand and document complex relationships among landforms, parent material, moisture and temperature regimes, soil properties, and native vegetation. The field crews collected data for nearly 2,000 integrated soil description/vegetation cover plots within the 1.1 million acres of the survey area. The field observations and the remote sensing imagery and DEMs and derivatives were used to document the map units in the survey area. Additional detail on the methodology is provided in the following paragraphs.

Interagency NRCS and USFS field review near Stewart Canyon in August 2014.

Soil

Field crews excavated and described undisturbed soil profiles, which are the vertical sequences of natural layers, or horizons, in a soil. The profile extends from the ground surface to bedrock or unaltered parent material, typically 2 meters (about 80 inches) or less. Most of the soil pits dug by hand were described to a depth of 1 meter (about 40 inches). Crews also recorded landform, slope, and slope shape following guidance in the *Field Book for Describing and Sampling Soils* (Schoeneberger et al, 2012). They classified the physical and chemical properties of each soil profile according to *Soil Taxonomy* (Soil Survey Staff, 2014). Miscellaneous areas of nonsoil or disturbed soil, such as rock outcroppings and mine pits, were also identified during the survey.

The five soil-forming factors—time, topography, climate, organisms, and parent material—have influenced soil formation in the survey area. As these factors change across the landscape, so do the soils. Soil scientists used the available spatial data (geologic maps, moisture/temperature models, slope and slope shape from DEMs, and high-resolution aerial imagery) to plan locations for data collection. An iterative process of prediction and observation across the survey area was used to document map units. This mapping process is described in the *Soil Survey Manual* (Soil Science Division Staff, 2017).

Seventeen soil profiles were collected for detailed laboratory analyses by the Kellogg Soil Survey Laboratory (National Cooperative Soil Survey, 2020). This data provided insight into important soil physical and chemical properties.

Soil Scientist K. Palmer excavating a soil profile near the top of Caribou Mountain. Photograph by C. Rebernak.

Soil profile of a forested site near Moonlight Meadow.

Data on soil and site properties were incorporated into models to predict how soils will perform under different resource management treatments. These interpretations were developed, tested, and refined through observation. The *Soil Survey Handbook* provides additional background information on interpretations (USDA-NRCS, 2020). Soil interpretations for construction and maintenance of native surface roads, susceptibility to compaction, hazard of erosion, and more are available through the Web Soil Survey. To build on the standard soil interpretations, employees of the Caribou-Targhee National Forest annually collect monitoring data and document observations of how different ecological

sites, forested habitat types, and soils respond to land management treatments, including prescribed fire, livestock grazing, and ground-based harvesting of timber, and to natural disturbances such as wildfire. These observations inform decisions about the management of local natural resources.

Soil Parent Material and Geology

The geology of the Caribou National Forest consists of deformed sediment and volcanic rock. Major lithologies include limestone, quartzite, volcanic rock, mudstone, dolomite, sandstone, and siltstone. Due to the mountainous landscape, many soils developed in colluvium (earth moved by gravity) or colluvium over residuum (earth moved by gravity over rock weathered in place). Many of the soils also have an influence of loess (windblown silt). Because of the complex geology and close relationship between lithology and soil parent material, a digital spatial layer of the formations and major lithologies was developed for the Caribou National Forest.

Source maps for the spatial layer include the following:

- *Geologic map of the Soda Springs quadrangle, southeastern Idaho* (Armstrong, 1969);
- *Geologic map compilation of the Malad City 30 x 60 minute quadrangle, Idaho* (Long and Link, 2007);
- *Geologic map compilation of the Pocatello 30 x 60 minute quadrangle, Idaho* (Link and Stanford, 1999);
- *Geologic map of the Preston 1 degree x 2 degrees quadrangle, southeastern Idaho and western Wyoming* (Oriel and Platt, 1980);
- *Geologic map of the Driggs quadrangle, Idaho* (Mitchell and Bennett, 1979); and
- *Geologic map and cross sections of the Caribou Mountain area, southeastern Idaho* (Huntsman and Platt, 1985).

The map layer of the geology compilation is stored in the official spatial files of the Caribou-Targhee National Forest.

Limestone outcrop in foreground; Caribou Mountain in background. Photograph by C. Rebernak.

Climate

Precipitation data from DAYMET spatial data sets were used to describe the average annual precipitation (Thornton et al., 2014). The average annual precipitation of the survey area ranges from 20 to 50 inches. Elevation data was from a 10-meter DEM. Elevation ranges from 5,000 to 9,900 feet. In the climate of the Intermountain West, aspect and slope can affect plant-available precipitation. Field mappers used Relative Effective Annual Precipitation (REAP) to help explain why the north-facing side of a mountain is forested and the south-facing side (similar elevation and average annual precipitation) supports a drier plant community of native sagebrush.

Using the elevation and average annual precipitation raster spatial data sets, NRCS personnel developed a model of moisture regime, temperature regime, and REAP. Observations of local soil moisture and temperature and hundreds of observations of plant species indicators across the survey area were used to refine the output of the model. This model aided in consistently predicting soil moisture/temperature regimes across the mountain terrain.

Vegetation

Vegetation cover data were collected at the same locations as the soil profile data. Data collection followed the protocol available in the *Terrestrial Ecological Unit Inventory Technical Guide* (Winthers et al., 2005). In 0.1-acre plots, field crews recorded ocular estimates of the percent canopy cover by species of trees, shrubs, grasses, and forbs. Crews calibrated the data annually by quantitative methods to improve the accuracy of the ocular estimates. A limited list of species was used for most of the plots. Species recorded for each plot were those that made up more than 5 percent of the cover and common species or indicator species of habitat types that made up less than 5 percent of the cover.

Soil description and vegetation plot data collected at a forested site in Skinner Canyon. Photograph by B. Spokas.

Forested Vegetation

The vegetation plot data allowed the crews to key and assign a forested habitat type to forested sites in the field. *Forest Habitat Types of Eastern Idaho-Western Wyoming* (Steele et al., 1983) contains a key, descriptions of forested habitat types, forest productivity, and observed species composition. Forested habitat types are mature, late-seral forest plant communities, or the natural composition of species that occurs after long periods without disturbance. The most common habitat types in the survey area are the subalpine fir (*Abies lasiocarpa*) and Douglas-fir (*Pseudotsuga menziesii*) series. Generally, a single forested habitat type is associated with a forested map unit component.

Forest productivity by habitat type was based on published values in *Forest Habitat Types of Eastern Idaho-Western Wyoming* (Steele et al., 1983). General production data of crop trees was considered adequate because the Caribou National Forest is managed for multiple uses rather than maximum crop yields.

In the Bear River Range (in MLRA 47), two publications of forested habitat types were applicable—*Coniferous Forest Habitat Types of Northern Utah* (Mauk and Henderson, 1984) and *Forest Habitat Types of Eastern Idaho-Western Wyoming* (Steele et al., 1983). For consistency in the survey area, a habitat type from the Utah guide was assigned only when a reasonable choice was not available in the Eastern Idaho-Western Wyoming guide.

In areas where aspen (*Populus tremuloides*) is dominant in the tree canopy but the site is clearly in a conifer forest series, an aspen community type was assigned in addition to the forested habitat type. *Aspen Community Types of the Intermountain Region* (Mueggler, 1988) was used to key this community type. This reference includes appendices that display similarity indexes of aspen community types (Mueggler, 1988) and forested habitat types (Steele et al., 1983; Mauk and Henderson, 1984). The connection between the mid-seral and late-seral composition of the forest provides additional information about the ecological dynamics of these forested sites.

Rangeland Vegetation

Map unit components that support rangeland and woodland vegetation types were correlated to an ecological site. Ecological site descriptions (ESDs) provide detailed information about ecological sites, which supports the assessment, planning, and monitoring of land and resources. An ESD includes:

- descriptions of reference plant/soil relationships,
- disturbance processes, and
- associated ecosystem dynamics (Caudle et al., 2013).

Ecological sites were keyed using properties of a site such as climate and REAP and physical and chemical properties of soils rather than the existing composition of the plant species.

The composition and percent cover of shrub and grass species were used to key sagebrush habitat types, which are described in *Sagebrush-Grass Habitat Types of Southern Idaho* (Hironaka, Fosberg and Winward,1983). This reference contains a description of the habitat types and a brief discussion of management implications. Map unit components that support sagebrush were correlated to a sagebrush habitat type. Map unit components that support shrubland or woodland vegetation were assigned all applicable vegetation classifications.

Area of sagebrush habitat type on Malad Range. Photograph taken August 2011.

Phosphate Mining

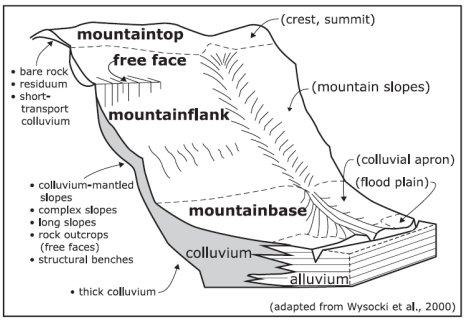
Phosphate is mined in the Caribou National Forest. Areas disturbed by open pit mines were mapped as miscellaneous areas, or Mined lands. Modifiers were used to differentiate features in the areas of Mined lands. The modifiers include open pits, slag and/or tailings, reclaimed and/or overburden, and reclaimed with impermeable cap. Reclaimed areas have a cover of salvaged soil 30 to 60 centimeters (1 to 2 feet) thick. Some of the reclaimed areas have an engineered impermeable layer under the cover of soil. These map units were assigned consistently across the phosphate mining region in southeastern Idaho.

Soil scientist and mine employee dig a pit in an area of reclaimed Mined lands. Photograph taken July 2011.

New growth in an area of recently planted, reclaimed Mined lands. An area that has an impermeable cap and a cover of soil is in foreground. Photograph taken June 2016.

Major Processes of Soil Formation in Caribou National Forest

Common soil parent material in the survey area is colluvium derived from bedrock and an influence of varying amounts of loess (windblown silt). Soil forms as accumulations, removals, and translocations alter the parent material over long periods of time. Topography is an important driver of soil formation in the mountains. Soil developing on a mountain flank in a convex (water-shedding) position loses material through natural erosion to downslope or concave (water-accumulating) positions. Water moving through the soil dissolves particles and compounds, depositing them deeper in the soil. Cold temperatures in winter and dry conditions in summer limit biological activity.



Geomorphic components of a mountain slope. Figure from page 3-43 of the *Field Book for Describing and Sampling Soils* (Schoeneberger et al., 2012).

Soil Classification

The soils in the survey area dominantly are classified as Mollisols. Mollisols have a mineral surface horizon that is soft, rich in organic matter, and about 23 centimeters (9 inches) thick or more. The organic matter accumulates in the soil from microbial activity breaking down perennial plant roots under the soil surface and leaf litter, wood, and other plant parts on the surface (Soil Survey Staff, 1999). Mollisols also have relatively high base saturation, or availability of magnesium, potassium, and calcium, from parent material derived from limestone or dolomite or an accumulation of loess (windblown silt) from valleys or the Snake River Plain.

Some of the soils in the survey area are classified as Alfisols. Alfisols have a translocated accumulation of clay in the subsoil as a result of clay particles being moved downward by water, and they have a thinner accumulation of organic matter in the mineral surface horizon (15 to 23 centimeters [6 to 9 inches]) as compared to Mollisols. The translocated clay indicates the age of the soils because it is thought to take thousands of years to develop. Alfisols in the survey area generally receive a higher amount of precipitation and have a lower soil pH. Alfisols also have relatively high base saturation (Soil Survey Staff, 1999).

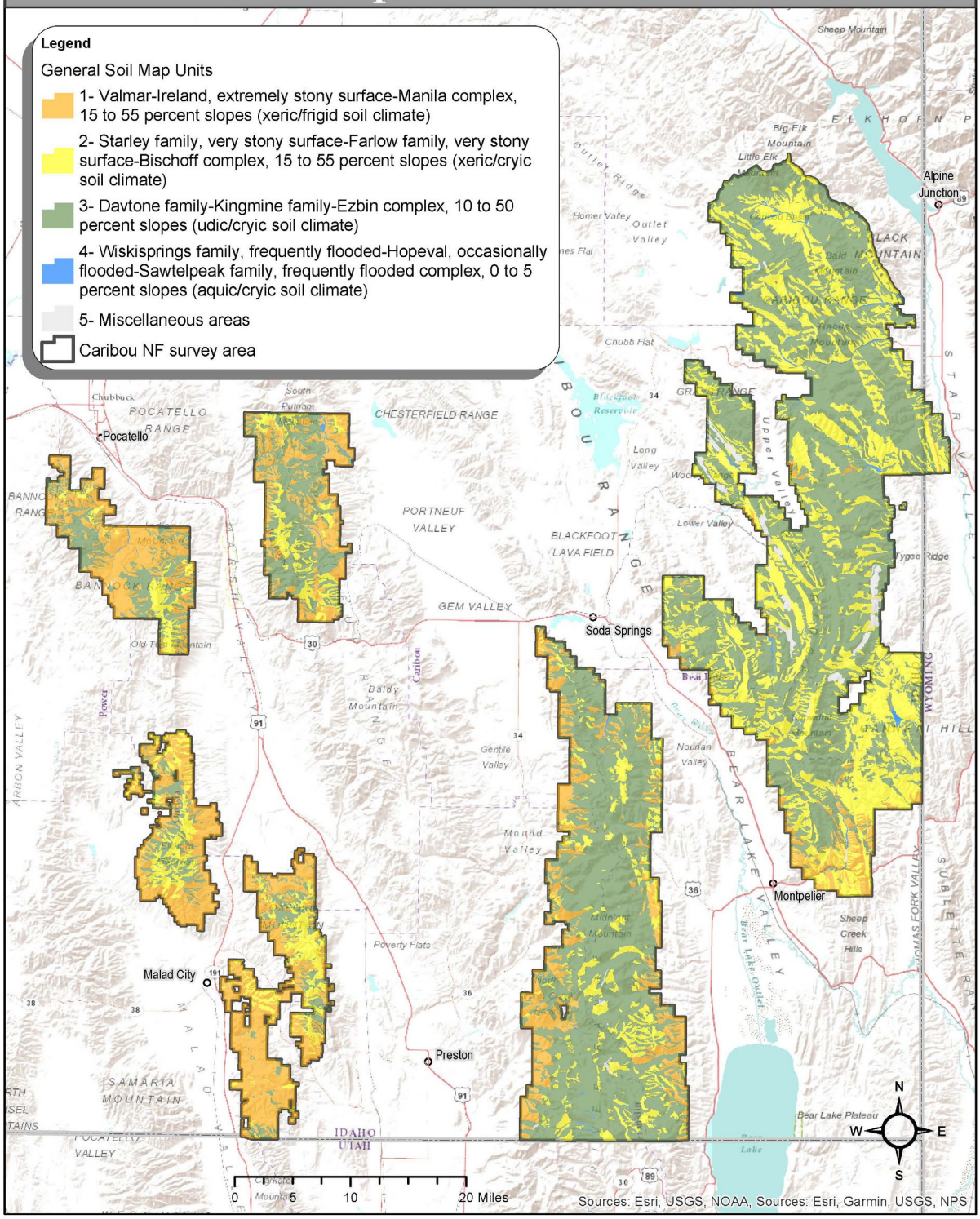
General Soil Map

The general soil map is a broad-scale (1:700,000 scale) “general overview and introduction to the major soils and their pattern of occurrence in the survey area” (Soil Science Division Staff, 2017). The general soil map units are aggregations of the Order 3 data set (1:24,000 scale) available online through the Web Soil Survey. They are summarized by soil moisture and temperature regimes. The general soil map units describe the most common soil/vegetation relationships in the Caribou National Forest.

General Soil Map Units

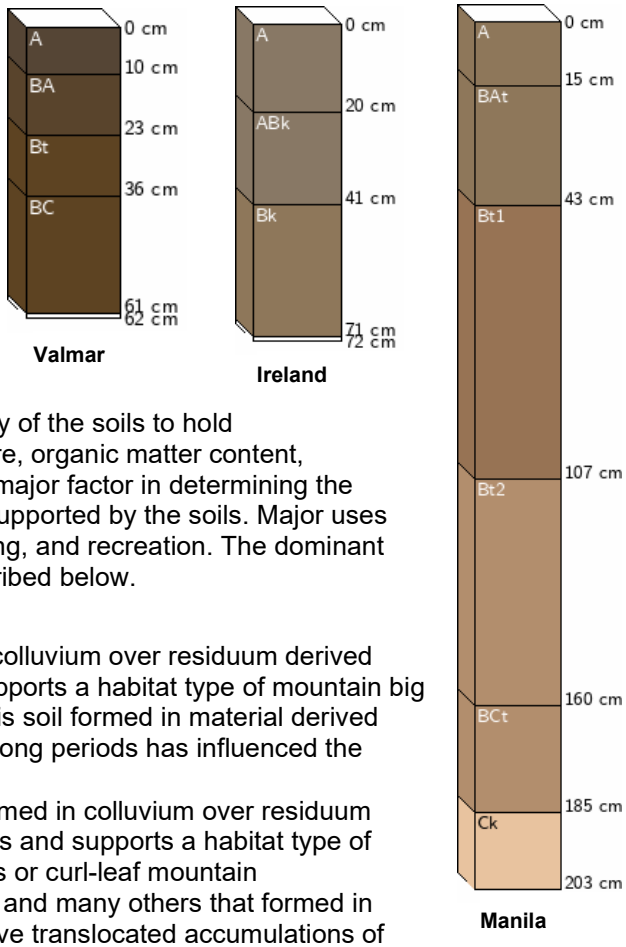
Five general soil map units are described. The diagrams of the soil profiles are from Soil Web Earth (University of California, Davis, Soil Resource Lab, 2020), and the photographs were taken by the field crew.

General Soil Map- Caribou National Forest



1. Valmar-Ireland, extremely stony surface-Manila complex, 15 to 55 percent slopes (xeric/frigid soil climate)

Landscape: Mountains
Moisture regime: Xeric
Temperature regime: Frigid
Percentage of survey area: 19 percent
Elevation: 5,600 to 7,200 feet
Relative effective annual precipitation: 15 to 19 inches



Summary

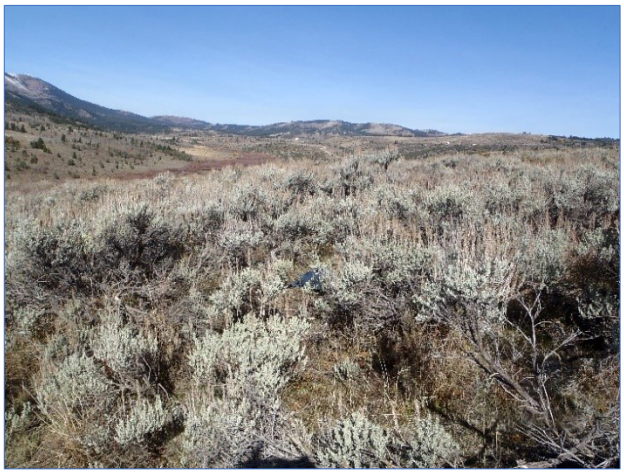
This map unit is the lower-elevation, warmer (frigid temperature regime), and drier (xeric moisture regime) part of the survey area. Summers are hot and dry. Precipitation is received dominantly as rain late in fall, snow in winter, and snowmelt and rain in spring. The ability of the soils to hold moisture into summer varies with the depth, texture, organic matter content, and rock fragment content of the soils, and it is a major factor in determining the amount and type of native rangeland vegetation supported by the soils. Major uses include watershed, wildlife habitat, livestock grazing, and recreation. The dominant soils and native vegetation communities are described below.

Map unit components

- *Valmar.*—This soil formed in loess-influenced colluvium over residuum derived from quartzite. It is on mountain slopes and supports a habitat type of mountain big sagebrush/bluebunch wheatgrass. Although this soil formed in material derived from quartzite, the accumulation of loess over long periods has influenced the properties of the soil.
- *Ireland, extremely stony surface.*—This soil formed in colluvium over residuum derived from limestone. It is on mountain slopes and supports a habitat type of mountain big sagebrush/bluebunch wheatgrass or curl-leaf mountain mahogany/bluebunch wheatgrass. These soils and many others that formed in material derived from limestone or dolomite have translocated accumulations of lime in the subsoil because the effective precipitation is enough to move lime (calcium carbonate) deeper into the soil profile but not flush it out of the profile.
- *Manila*.—This soil formed in loess-influenced colluvium derived from sedimentary and metasedimentary rock. It is on gently sloping or moderately sloping mountain bases and supports a habitat type of mountain big sagebrush/mountain snowberry/bluebunch wheatgrass or mountain big sagebrush/bluebunch wheatgrass. A thick accumulation of translocated clay is in the subsoil.

Area of a Valmar soil that supports a habitat type of mountain big sagebrush/bluebunch wheatgrass. Soil horizons displayed on shovel; surface horizon on right. Gibson Jack Creek area in Bannock Range. Photographs taken May 2019.

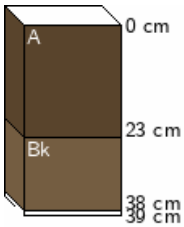
Area of Ireland soil, extremely stony surface, that supports a habitat type of mountain big sagebrush/bluebunch wheatgrass. Soil horizons displayed on shovel; surface horizon on left. Ant Canyon area, Bear River Range. Photographs taken October 2012.



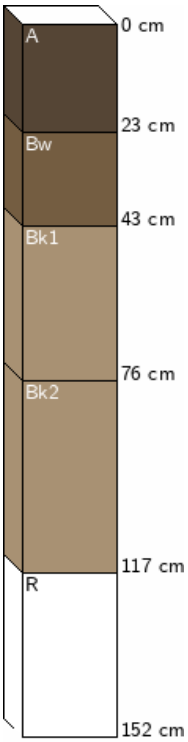
Area of a Manila soil that supports a habitat type of mountain big sagebrush/bluebunch wheatgrass. Soil horizons displayed on shovel; surface horizon on left. Pebble Creek area, Portneuf Range. Photographs taken October 2017.

2. Starley family, very stony surface-Farlow family, very stony surface-Bischoff complex, 15 to 55 percent slopes (xeric/cryic soil climate)

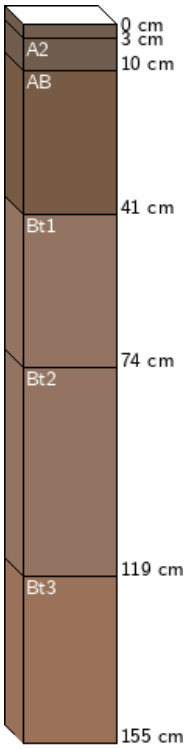
Landscape: Mountains
Moisture regime: Xeric
Temperature regime: Cryic
Percentage of survey area: 25 percent
Elevation: 6,300 to 8,300 feet
Relative effective annual precipitation: 18 to 25 inches



Starley family



Farlow family



Bischoff

Summary

This map unit is at higher elevations, is colder (cryic temperature regime), and receives slightly more effective precipitation (xeric moisture regime) as compared to map unit 1. The soils are dominantly Mollisols that support rangeland vegetation. Because of the dry summers, the ability of the soils to hold moisture is an important factor that largely determines the amount and type of native rangeland vegetation supported by the soils. Major uses include watershed, wildlife habitat, livestock grazing, and recreation. The dominant soils and native vegetation communities are described below.

Map unit components

- *Starley family, very stony surface.*—These soils formed in colluvium over residuum derived from limestone or sandstone. They typically are in convex positions of mountain slopes and support a habitat type of mountain big sagebrush/bluebunch wheatgrass or curl-leaf mountain mahogany. The soils are thin and rocky.
- *Farlow family, very stony surface.*—These soils formed in colluvium over residuum derived from limestone or dolomite. They are on mountain slopes and typically support a habitat type of mountain big sagebrush/mountain brome. These soils are similar to the drier, warmer Ireland soil described in map unit 1, but they generally are deeper to bedrock and have translocated lime deeper in the profile.
- *Bischoff.*—This soil formed in loess-influenced colluvium derived from sedimentary rock. It is on mountain slopes and typically supports a habitat type of mountain big sagebrush/mountain brome. The soil has a thick accumulation (about 38 cm) of organic matter in the soft mineral surface horizon and translocated accumulations of clay in the subsoil. These properties are well suited to holding moisture in the soil into the summer and supporting productive rangeland plant communities.

Area of Starley family in the Bald Mountain area of the Preuss Range that supports a habitat type of mountain big sagebrush/bluebunch wheatgrass. Photograph taken August 2017.

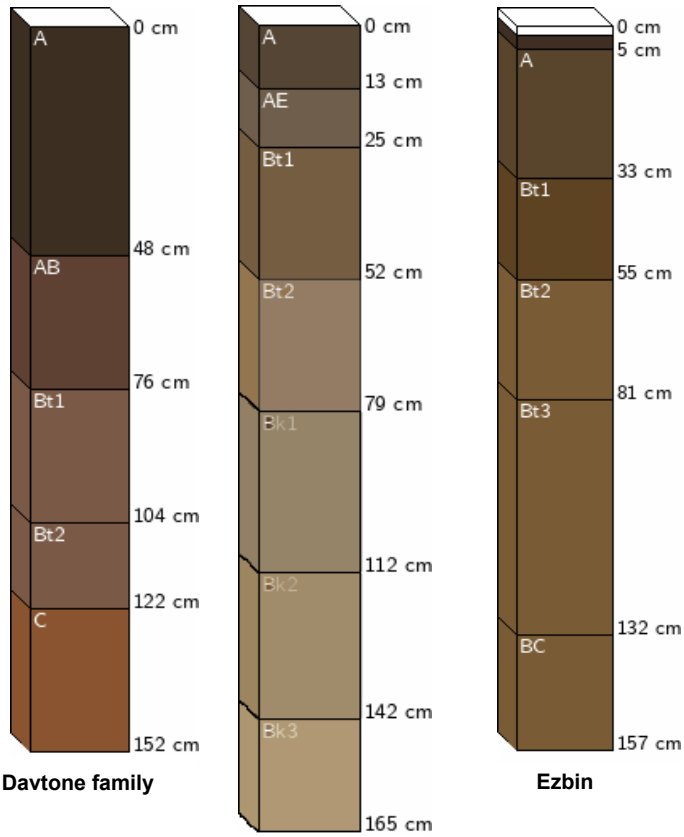
Area of Starley family in the Copenhagen Canyon area of the Bear River Range that supports a habitat type of limber pine/curl-leaf mountain mahogany. Photograph taken August 2015.

Area of Farlow family at the head of Trout Creek Canyon in the Bear River Range that supports a habitat type of mountain big sagebrush/mountain brome. Soil horizons displayed on shovel; surface horizon on right. Photographs taken June 2013.

Area of Bischoff soil in the Jensen Creek area of the Caribou Range that supports a habitat type of mountain big sagebrush/mountain brome. Soil horizons displayed on shovel; surface horizon on left. The pale color of the surface horizon is due to the dry conditions. Photographs taken June 2013.

3. Davtone family-Kingmine family-Ezbin complex, 10 to 50 percent slopes (udic/cryic soil climate)

Landscape: Mountains
Moisture regime: Udic
Temperature regime: Cryic
Percentage of survey area: 55 percent
Elevation: 6,300 to 8,300 feet
Relative effective annual precipitation: 25 to 45 inches



Summary

This map unit consists of the forested portion of the survey area. It receives more effective precipitation (udic moisture regime) and is slightly colder (cryic temperature regime) as compared to map unit 2. About 80 percent of the soils are Mollisols, and most of the rest are Alfisols. Native grasses, forbs, shrubs, and aspen are in the early-seral and mid-seral plant communities of many of the forested habitat types on these soils. Major uses include watershed, wildlife habitat, timber management, and recreation. The dominant soils and native vegetation communities are described below.

Map unit components

- *Davtone family*.—These soils formed in colluvium derived from sedimentary rock and commonly are influenced by loess. They are on mountain slopes and support habitat types of the Douglas-fir and subalpine fir series. These soils are forested Mollisols that have a thick, soft surface mineral horizon that is rich in organic matter content. An accumulation of translocated clay is in the subsoil.
- *Kingmine family*.—These soils formed in colluvium derived from sandstone and other sedimentary rock. They are on mountain slopes. These soils are forested Alfisols. They commonly support habitat types in the subalpine fir (*Abies lasiocarpa*) series and have understory vegetation such as thinleaf huckleberry (*Vaccinium membranaceum*), which prefers acidic soil conditions.
- *Ezbin*.—This soil formed in colluvium derived from sedimentary rock. It is on mountain slopes and supports Douglas-fir and subalpine fir habitat types. This soil is classified as a Mollisol, but it has more rock fragments and a thinner organic-rich surface horizon as compared to the Davtone family.

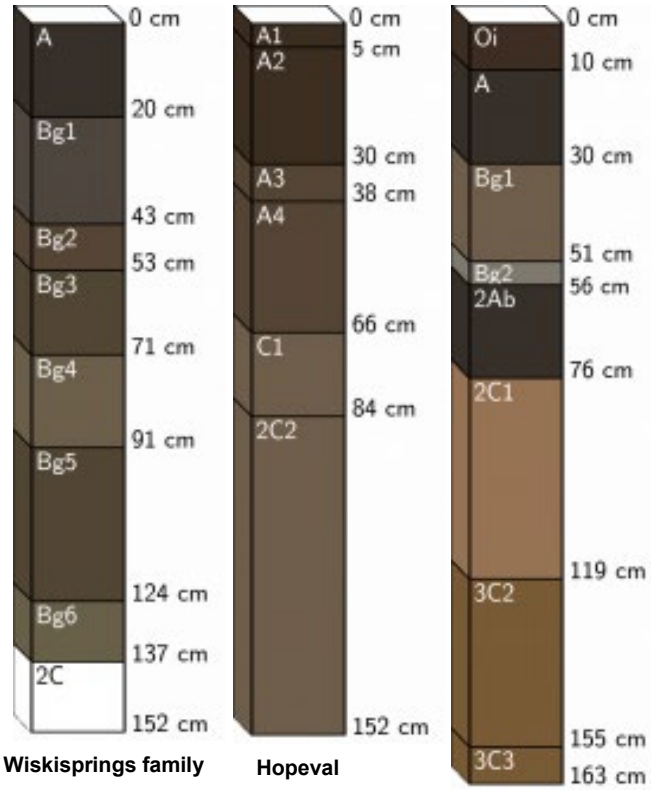
Area of the Davtone family in the Green Basin area of the Bear River Range that supports a habitat type of subalpine fir/mountain sweetroot. Soil horizons displayed on shovel; surface horizon on left.

Area of Kingmine family in the Rasmussen Creek area of the Wooley Range that supports a habitat type of subalpine fir/thinleaf huckleberry. Soil horizons displayed on shovel; surface horizon on left. Photographs taken July 2014.

Area of Ezbin soil in the Skinner Canyon area of the Bear River Range that supports a habitat type of subalpine fir/mountain maple. Soil horizons displayed on shovel; surface horizon on right. Photographs taken June 2013.

4. Wiskisprings family, frequently flooded-Hopeval, occasionally flooded-Sawtelpeak family, frequently flooded complex, 0 to 5 percent slopes (aquic/cryic soil climate)

Willows on a complex of riparian soils on the flood plain of McCoy Creek in the Caribou Range. Photograph taken October 2011.



Landscape: Mountains
Moisture regime: Aquic
Temperature regime: Cryic
Percentage of survey area: Less than 1 percent
Elevation: 5,000 to 8,300 feet

Summary

This map unit makes up less than 1 percent of the survey area, but it is very important because it is a complex of riparian soils that are on flood plains. These soils are adjacent to creeks and commonly are saturated with water (aquic moisture regime). They support willows, sedges, and other riparian vegetation. Major uses include watershed, wildlife habitat, livestock grazing, and recreation. The dominant soils and native vegetation communities are described below.

Map unit components

- *Wiskisprings family, frequently flooded.*—These soils formed in alluvium. They are on flood plains and support riparian willow/sedge ecological sites.
- *Hopeval, occasionally flooded.*—These soils formed in alluvium. They are on flood plains and support riparian willow/sedge ecological sites.
- *Sawtelpeak family, frequently flooded.*—These soils formed in alluvium. They are on flood plains and support wet meadow ecological sites.

Area of Wiskisprings family on the flood plain of Eightmile Creek in the Bear River Range. These soils support willows. Soil horizons displayed on shovel; surface horizon on left. The lower three horizons are saturated with groundwater. Photographs taken September 2013.

5. Miscellaneous areas

Landscape: Mountains
Percentage of survey area: 1 percent

Summary
This map unit includes mine disturbances, natural rock outcroppings and rubble land. No soil properties or native vegetation communities were described for these areas.

Map unit components
- Mine disturbances, including pits, overburden piles, reclaimed areas, open pits, and slag or tailings
- Rock outcrop
- Rubble land

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Major fieldwork completed in 2008–2017 by:

- Carla Rebernak, Idaho Falls, Idaho, Soil Survey Office leader, Natural Resources Conservation Service (NRCS);
- Kara Green, soil scientist, Soda Springs, Idaho, USFS;
- John Lott, forest soil scientist, Idaho Falls, Idaho, USFS (retired);
- Nick Kozlowski, soil scientist, Idaho Falls, Idaho, NRCS;
- Bryce Griffiths, soil scientist, Soda Springs, Idaho, NRCS;
- Klara Varga, botanist, Idaho Falls, Idaho, USFS;
- Katelyn Palmer, soil scientist, Soda Springs, Idaho, NRCS;
- Ben Moore, soil scientist, Dillon, Montana, NRCS;
- Brock Benson, ecological site specialist, Utah, NRCS (retired);
- Rose Lehman, forest botanist, Idaho Falls, Idaho, USFS;
- Ada DeClark, technician, USFS; and
- Ashelee Rasmussen, technician, USFS.

Major National Soil Information System (NASIS) database work by:

- Carla Rebernak, Idaho Falls, Idaho, Soil Survey Office leader, NRCS;
- Kara Green, soil scientist, Soda Springs, Idaho, USFS; and
- Nick Kozlowski, soil scientist, Idaho Falls, Idaho, NRCS.

Project overseers and subject matter experts:

- Bob Spokas, soil data quality specialist, Bozeman, Montana, NRCS (retired);
- Carla Rebernak, Idaho Falls, Idaho, Soil Survey Office leader, NRCS;
- Rose Lehman, forest botanist, Idaho Falls, Idaho, USFS;
- Dan Perkins, acting soil data quality specialist, Pinedale, Wyoming, NRCS;
- Glenn Hoffmann, Idaho Falls, Idaho, Soil Survey Office leader, NRCS (retired); and
- Bryan Christensen, ecological site specialist, Pinedale, Wyoming, NRCS.

Interagency coordination by:

- Jeff Bruggink, regional soil scientist, Ogden, Utah, USFS;
- Dave Marr, forest soil scientist, Idaho Falls, Idaho, USFS;
- Hal Swenson, State soil scientist, Boise, Idaho, NRCS (retired);
- Shawn Nield, State soil scientist, Boise, Idaho, NRCS;
- Chuck Gordon, Soil Survey Region 4 Director, Bozeman, Montana, NRCS (retired); and
- Eva Muller, Soil Survey Region 4 Director, Bozeman, Montana, NRCS.

Original fieldwork completed in 1973–1984 and *Soil Survey of the Caribou National Forest, Idaho* (1990) by:

- Norman Bare, project leader for survey area of Caribou National Forest, USFS;
- Mark Jensen, USFS;
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- John Lott, forest soil scientist, Idaho Falls, Idaho, USFS.

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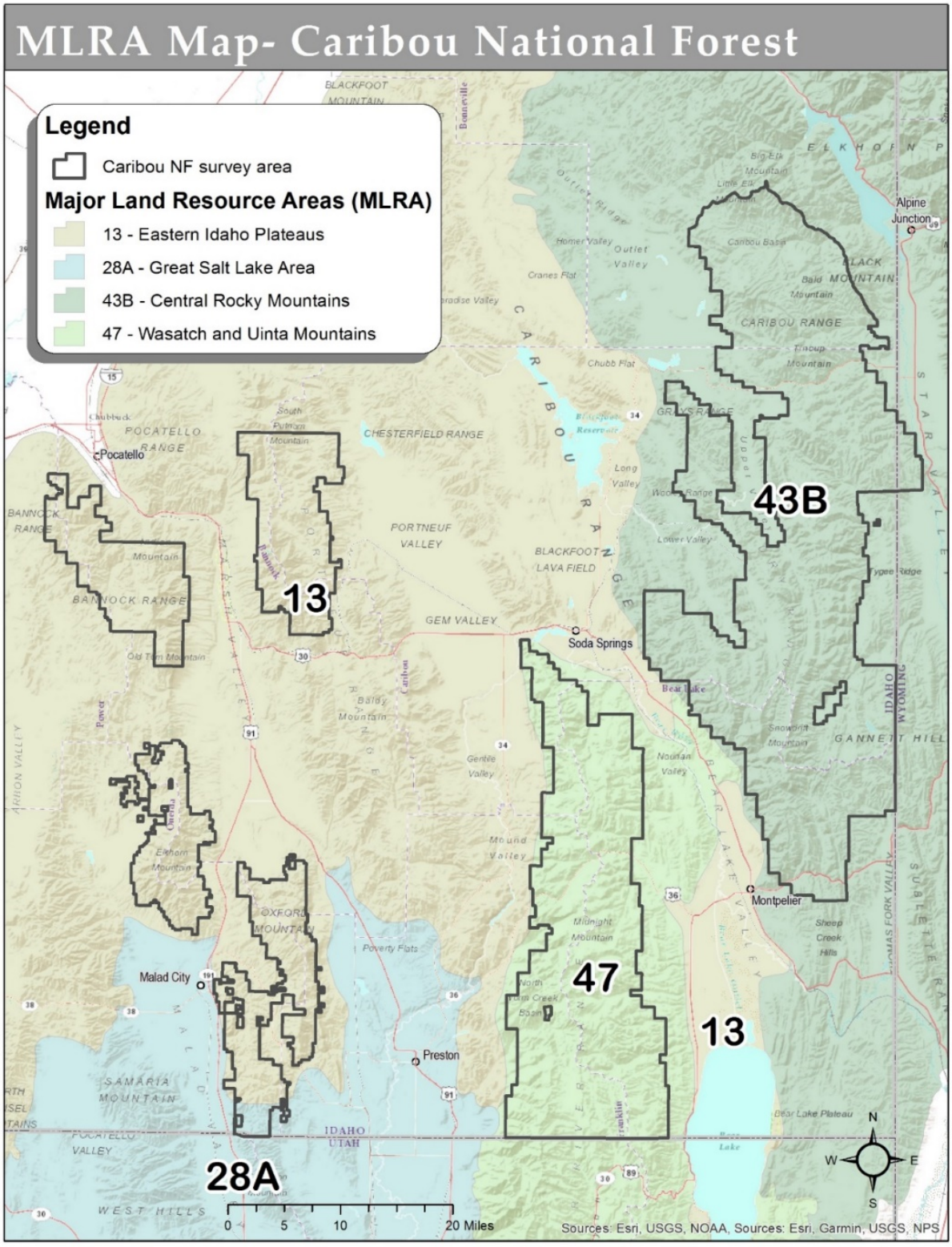
Appendix—Map of Major Land Resource Areas in Caribou National Forest