

Aerial Photo Interpretation on British Columbia Rangelands

T. M. LORD AND ALASTAIR McLEAN

*Soil Scientist and Plant Ecologist, Canada Department of
Agriculture, Research Station, Vancouver and Kamloops.*

Highlight

Following intensive study of soils and plant communities in the Princeton area of southern British Columbia, it became apparent that photo interpretation techniques could be used to greater advantage in soils surveys and land classification than as simply field mapping guides. Significant relationships between soil-vegetation-physiographic units and photo patterns appeared. The area, a topographic low within the Thompson Plateau, contains mainly Chernozemic soils developed under grassland and open tree cover. Six land units were distinguished by combinations of tone, pattern, and texture on aerial photos as determined by topography, nature of bedrock or surficial deposits, drainage, kinds of vegetation, and patterns of micro-features and were related to land use.

This study indicates how some characteristic aerial-photo patterns of vegetation and land forms were used as an aid to soils survey and land classification in the Princeton basin, a local topographic low of some 75 square miles, in southern interior British Columbia.

During the departmental soil survey and mapping of the Princeton district (Green, Lord, and Hortie, 1963) aerial photographs were used mainly as field mapping guides. Following intensive study of soils and plant communities (Lord and Green, 1969) it became apparent that photo-interpretation techniques (Buringh, 1954; Colwell, 1960) could be used to greater advantage in soil surveys and land classification in this region similar to that done in Australia (Gibbens and Downes, 1964).

The basin contains mainly Black and Dark Gray Chernozemic soils under grassland and open tree cover and is surrounded by Podzolic and Brunisolic soil areas (soils nomenclature follows the Canadian classification system (Leahey, 1965)) of the forested plateau.

The vegetative zones of the study area have been classified by McLean (1969) as ponderosa pine, douglasfir, and subalpine fir.

Mathews (1944) and Hills (1962) investigated the glaciation of the Princeton coalfield, while Rice (1960) described the geology of the area. A drumlinized till plain occupies most of the basin area. The few large drumlins are composed of thick glacial till. However, over areas of more gentle relief the till ranges in thickness from about 10 ft to a fraction of a foot on abraded rock ridges. The textures of the till reflect the composition of the underlying sedimentary rocks and lavas, and the nearby granitic intrusives. Extensive gravelly

outwash deposits cover the main valley floor and mantle the beds of former meltwater channels. Terraces, pitted outwash, fans, and alluvial floodplains are the major land forms of the valleys.

Methods

Valley bottomlands and much of the basin area have been soil surveyed in detail (Green et al., 1963). The remainder of the area encompassed within the photo has received a reconnaissance soil survey (Lord and Green, 1969). The vegetation was classified ecologically and the major plant communities described. One aerial photograph (Fig. 1) of the northern section was selected to illustrate soil-vegetation-terrain units.

In order to determine broad patterns of vegetation, drainage, and terrain, the photographs were first studied as a mosaic. Then the major landscape units formed by tonal and textural images of landform, slope, drainage, and vegetation under the stereoscope were delineated on the photograph. The boundaries on this photo-interpretation map were then checked in the field by standard soil survey procedures and observations of vegetation and landform.

Plant nomenclature follows Hitchcock et al. (1955, 1959, 1961, 1964) for the dicots and Davis (1955) for all other plants.

Results and Discussion

The three major landscape units identified and delineated on the photograph (Fig. 1) are:

Unit A (four subunits)—smooth glaciated uplands, grass or tree covered.

Unit B—irregular steeply-sloping valley sides.

Unit C (two subunits)—narrow, irregularly-shaped valley bottoms and terraces associated with drainage courses.

Each unit and subunit is described by its characteristic landform, plant community, and soil pattern and is correlated with its photo image. Two stereograms (Fig. 2) illustrate typical units and subunits; in the lower stereopair the two subunits of Unit C are delineated.

Unit A.

This major unit includes the upland areas of the basin and part of the plateau above the valley steplands. Four subunits are described below.

Subunit A 1.—Occasional large drumlins, oriented in the direction of the southerly ice flow, interrupt the generally subdued rolling landscape. Over most of the area, moderately coarse textured till deposits form a smooth mantle over bedrock.

Photo Pattern.—The uniform light tone, slightly mottled texture, and absence of tree cover help to separate this grassland unit from the treed areas. It is further distinguished from other grasslands or clearings by topographic position, dendritic drainage network, fluted pattern, and lack of current scars.

Soils.—The Black Chernozemic Great Group of soils predominates on the grasslands of the till

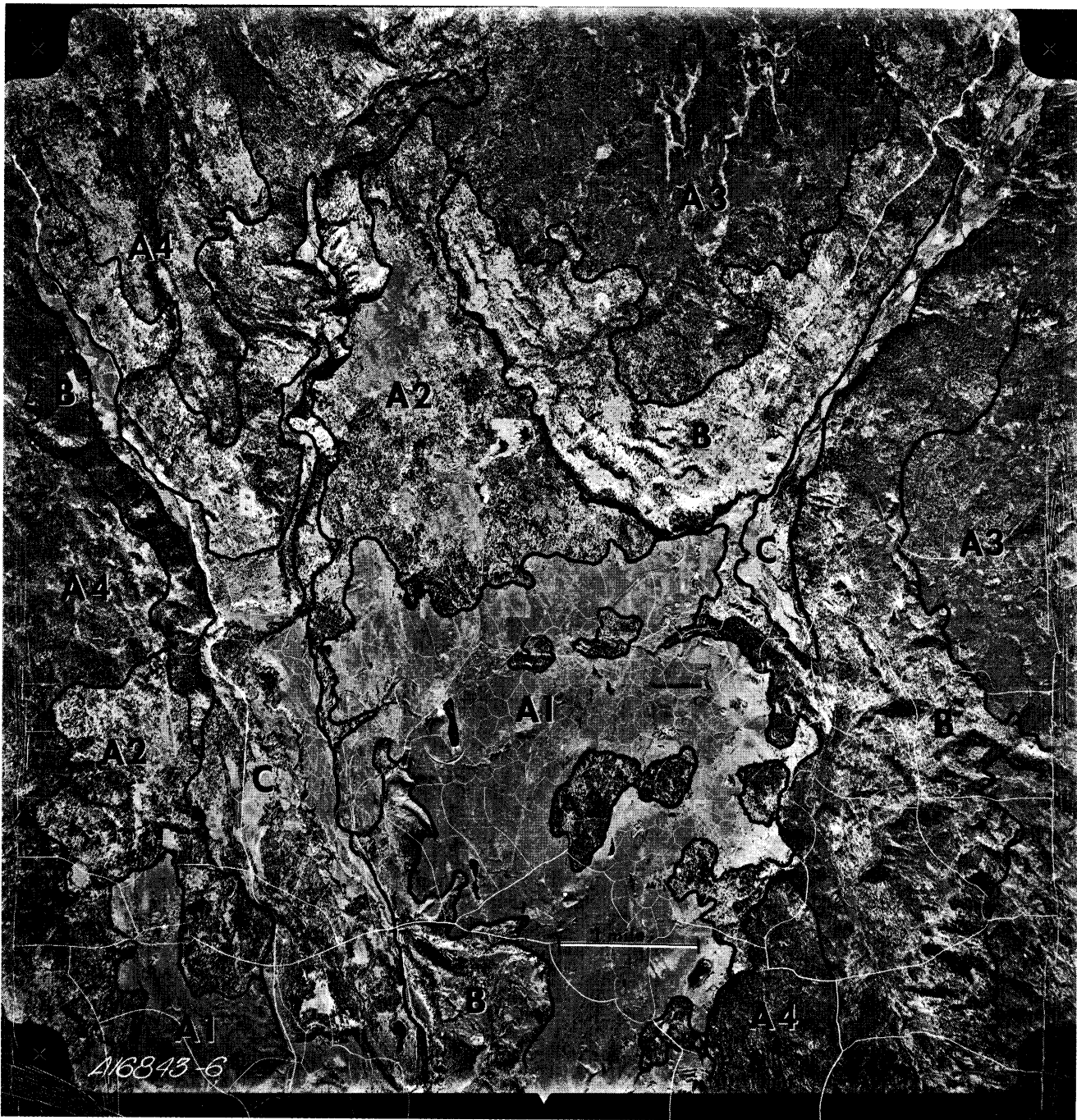


FIG. 1. Vertical photograph showing landscape units and subunits.

plain. Princeton soils are well drained Orthic Black sandy loams and loams of the more strongly drumlinized areas. They are associated with Sellers, an Orthic Dark Brown soil of the dry ridge crests, and Separation, an Orthic Black "cumulic" soil of the lower drumlin slopes. Miner, a Rego Dark Brown soil, and two Dark Gray soils, Roany and Lamont, occur on shallower till. Along drainage ways and margins of ponds and small lakes a

Carbonated Rego Black soil, Corral series, has developed. The relationship of these soils to vegetation and landform is illustrated in Fig. 3.

Vegetation.—The major plant community in this subunit is the fescue-erigonum grassland which, under climax condition is dominated by idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Agropyron spicatum*), along with a wide variety of forbs. The most characteristic species

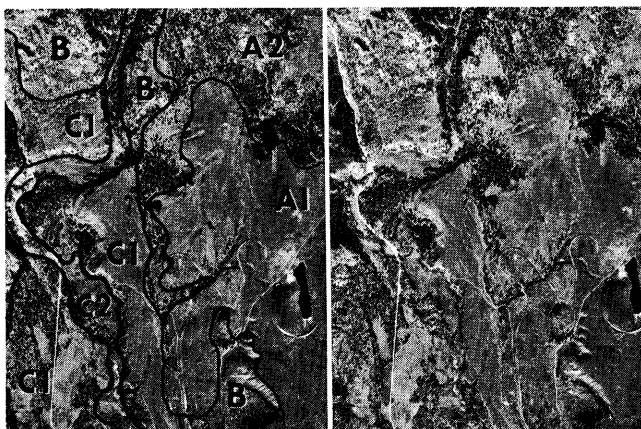
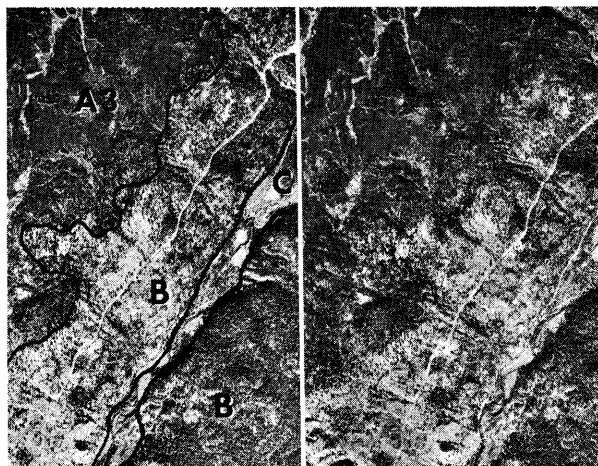


FIG. 2. Two stereograms showing landscape units in Princeton basin. Top: valley terraces and fans (C); irregular, steeply sloping valley sides (B); and forested uplands (A 3). Bottom: till plain with grasslands (A 1), and open woodland (A 2); large terraces (C 1) and recent alluvium (C 2). Photos flown at a scale of 1 : 52,800.

are columbia needlegrass (*Stipa columbiana*), silky lupine (*Lupinus sericeus*), and eriogonum (*Eriogonum heracleoides*).

Another community with very similar ground cover but characterized by open stands of ponderosa pine (*Pinus ponderosa*), is ponderosa pine-idaho fescue which is found mostly on the associated Dark Gray soils. Bluebunch wheatgrass usually dominates over the fescue on the Dark Brown soils because of the somewhat drier sites and fewer forbs are present. Along the drainage ways kentucky bluegrass (*Poa pratensis*) generally dominates, with or without aspen (*Populus tremuloides*). A variety of grasses and forbs is usually present, depending on the grazing pressure, including slender wheatgrass (*Agropyron trachycaulum*), california brome grass (*Bromus carinatus*), sticky geranium (*Geranium viscosissimum*), and wild rose (*Rosa gymnocarpa*).

Correlation.—The delineated photo unit correlated closely with the Chernozemic soils and the plant communities described in the field. Along the steeplands the soil boundary line was sharply defined particularly in cleared fields, but less so in transitions to the open forest.

Land Use.—This subunit supplies productive spring-fall grazing for range cattle, with estimated carrying capacities as high as 1 acre/animal-unit-month. There is also a limited amount of dry farming of hardy crops.

Subunit A 2.—The smooth, gently-sloping land surface is broken by numerous steep-sided gullies and low knolls. Gravelly channel wash and ablation till deposits largely obscure the drumloidal pattern.

Photo pattern.—The light gray background tone, similar to that of the A 1 subunit, is overlain by

Pine-fescue Community

Fescue-eriogonum Community

DARK GRAY SOILS

BLACK SOILS

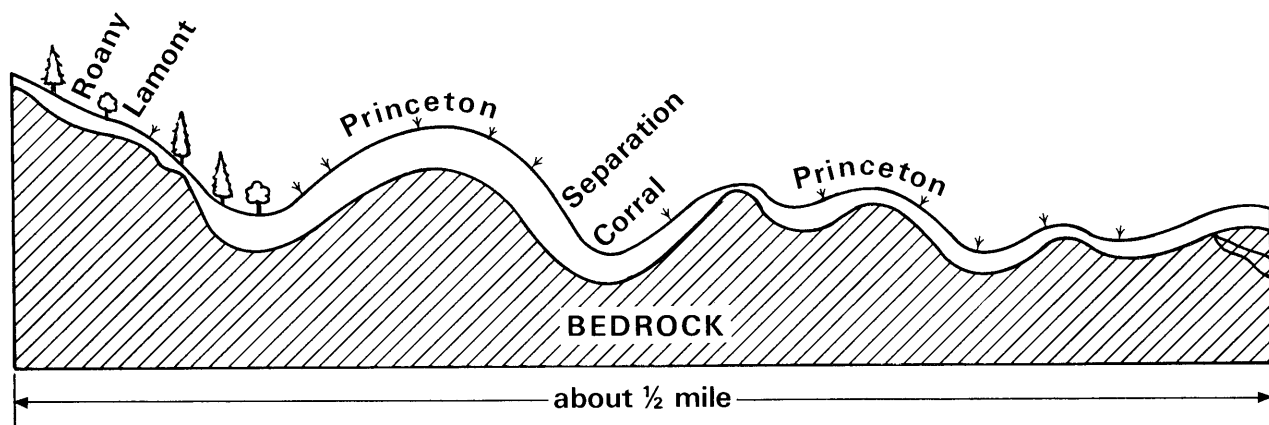


FIG. 3. A schematic section of the grasslands (subunit A 1) showing terrain, major soils, and plant communities.

the darker-toned "speckled" photo image caused by growth of different tree species. Additional diagnostic features are: lack of an integrated drainage pattern, numerous dry gullied channels, and the pattern of farm clearings.

Soils.—Soils of the Podzo Regosol Great Group occupy most of the subunit. Cutanic Podzo Regosols developed on sandy loam and loamy sand till (Shisler series), merge with Dark Gray soils developed on these materials along the grassland boundaries and in forest clearings. Some of the associated soils have morphological features of the Western Brown Forest soils of the USA.

Vegetation.—Plant communities of the douglasfir zone occupy most of this subunit. The forest cover is open to medium dense, and is dominated by douglasfir (*Pseudotsuga menziesii*) associated at lower elevations with ponderosa pine and at higher elevations with lodgepole pine (*Pinus contorta*). Aspen is often a prominent tree of the forest openings on the deeper soils. Two principal plant communities dominate. The drier community, generally at low elevations, is douglasfir-idaho fescue. Pinegrass (*Calamagrostis rubescens*), idaho fescue, and bluebunch wheatgrass characterize the ground cover. This community is most commonly found on the Dark Gray soils. The community on less dry sites is the douglasfir-pinegrass community which is found largely on Cutanic Podzo Regosols and some Orthic Gray Wooded soils. The ground cover is dominated by pinegrass associated with bearberry (*Arctostaphylos uva-ursi*), northwestern sedge (*Carex concinnoides*), and whitetop spiraea (*Spiraea betulifolia*).

Correlation.—The distinctive relief and vegetative pattern of the photo image was borne out by field observations. Clearings within the subunit and along grassland boundaries need careful field checks.

Land Use.—This subunit is well suited to integrated use, producing a medium dense forest which also yields a significant volume of forage. These areas have a low-medium growth potential for douglasfir and ponderosa pine (average site indexes 70 and 80 respectively). Sites without significant tree influence have an average carrying capacity of 5 to 7 acres/animal-unit-month. The subunit is used for summer range for cattle and for the harvest of douglasfir and ponderosa pine.

Subunit A 3.—Glacial flutings and drumloidal forms are characteristic of this subunit.

Photo Pattern.—The dark gray tones, uniform texture, and linear pattern are distinctive features of the photo image. The pattern of modified trellis drainage with narrow irregularly-shaped depressions, light-toned rock outcrops and low ridges are further aids to identification.

Soils.—A catenary sequence of Podzolic soils oc-

curs on the moderately coarse textured till of the drumlinized uplands. Bankeir soils, Orthic Acid Brown Wooded sandy loams, occupy abraded bedrock ridges and crest positions of drumlins. Well-drained Degraded Acid Brown Wooded Mazama soils occur on drumlin slopes. In toe-slope and depressional positions Gleyed Gray Wooded, Cutanic Regosol, and Organic soils are the main soil associates.

Vegetation.—Plant communities of the subalpine fir zone occupy most of this subunit. The major plant community is subalpine fir-pinegrass which is a well-developed ecotone between the douglasfir-pinegrass and subalpine fir-blueberry communities. The community is found mostly on the Acid Brown Wooded soils. The dominant tree at present is lodgepole pine with reproduction indicating a trend towards engelmann spruce (*Picea engelmanni*) and subalpine fir (*Abies lasiocarpa*). Grouse whortleberry (*Vaccinium scoparium*), pinegrass, and twinflower (*Linnaea borealis*) dominate the ground cover.

An important community associated with the subalpine fir-pinegrass on Gleyed Gray Wooded and other imperfectly drained soils is subalpine fir-bunchberry. This community is characterized by dense stands of subalpine fir and engelmann spruce. Lodgepole pine and douglasfir are important seral trees. The ground cover is characterized by bunchberry (*Cornus canadensis*), sidebells pyrola (*Pyrola secunda*) and twinflower.

Correlation.—In part, the placement of the boundary line between this unit and the upper limit of the steepplands is dependent upon slope, aspect, field experience, and photo quality. Under some conditions the two units appear to merge.

Land Use.—The upland portion of this forested subunit usually has a low rating for tree productivity. It is a poor site for the growth of subalpine fir but medium for spruce, lodgepole pine (site index 80), and douglasfir (site index 70). The forage values are low except when the tree canopy is reduced, when the carrying capacity may increase to about 7 acres/animal-unit-month. The associated subalpine fir-bunchberry plant community on imperfectly drained soils is usually rated high for timber production with site indexes in excess of 100 for douglasfir, engelmann spruce, lodgepole pine, and subalpine fir. Forage values are usually low because of the heavy shrub cover.

Subunit A 4.—Although this subunit is not clearly represented on the aerial photograph, it is characterized by a drumloidal landscape, frequently interrupted by rock outcrops and thinly mantled rock ridges.

Photo Pattern.—The photo image is darker and has more contrast than the A 2 subunit but lacks the uniform dark gray tone of the A 3 subunit.

Soils.—Orthic Gray Wooded soils belonging to Connaly series are the major soils developed on sandy loam and loam till. They are mainly associated with Podzo Regosols and Dark Gray soils on the lower boundaries, and with Brunisolic soils at higher elevations.

Vegetation.—A moist phase of the douglasfir-pinegrass community dominates this map unit. Douglasfir is the dominant tree while lodgepole pine is an important seral species. The tree canopy is generally denser than that of the type community. It is also distinguished by a greater abundance of false box (*Pachistima myrsinites*), prince's pine (*Chimaphilla umbellata*) and twinflower.

Correlation.—The boundary area between the Gray Wooded and the lower Regosol unit is transitional and unreliable without close field checks. The upper limits into the Brunisolic zone, however, show a good correlation.

Land Use.—This subunit is related in use to subunit A 2 but because of the better forest growth, mostly of douglasfir and lodgepole, the timber values are higher and forage values lower except on recently logged areas.

Unit B.

This unit has long steep slopes usually associated with valley sides.

Photo pattern.—Irregular light and dark tones are imparted by abrupt changes in vegetation and drainage as well as by rock bluffs and talus slopes. Southerly aspects reflect a more variegated lighter-toned image than do the northerly exposures.

Soils.—Regosol soils occur with rockland on the valley slopes. Alleyne soils, Cutanic Podzo Regosol sandy loams, have developed on coarse colluvium and till under tree cover. Orthic Dark Gray soils of the Darcy series are associated with grass and shrub cover on dry southerly aspects of the steep-lands.

Vegetation.—This unit occurs mostly within the douglasfir zone. A variety of communities may be found, depending on microclimate and soil moisture, such as douglasfir-fescue and douglasfir-pinegrass. On steep south-facing slopes at lower elevations, especially on talus slopes, a douglasfir-bluebunch wheatgrass community is found usually on Regosols. This community is characterized by open stands of slow-growing douglasfir. The ground cover is sparse and consists mostly of bluebunch wheatgrass and clubmoss (*Selaginella wallacei*) with scattered saskatoon service berry (*Ame-lanchier alnifolia*).

Correlation.—These are generally distinct terrain units with sharp boundaries. Following field check confirmation, the photo interpretation units may be used as final map units.

Land Use.—This unit supplies a significant vol-

ume of forage on south- and west-facing slopes where the slope is not too steep or footing unstable for cattle. Timber values vary from poor to medium depending on available moisture but the site is not suited to intensive timber management.

Unit C.

This unit includes glacio-fluvial terraces and alluvial floodplains. Pitted outwash and fans associated with valley deposits are present as minor components. The photo patterns have the even tones and textures reflected by the level topography and surface features of water-laid deposits. The agricultural use of these lands is illustrated by the patterns of fields, roads, and buildings.

Two subunits can be identified.

Subunit C 1.—The glacio-fluvial terraces are composed of thick, bedded, gravelly materials with level surfaces scarred by meander marks and small oxbows.

Photo Pattern.—The level terraces adjoining the till plain have grayish tones modified by lighter streaks and the pattern of sparse tree cover.

Soils.—Major soils belong to the Dark Gray Great Group. These are Whipsaw, a Rego Dark Gray soil and Galena, an Orthic Dark Gray soil. These soils, developed on shallow sandy loam overlying deep gravels, are often associated with Asp series, a Degraded Brown Wooded soil.

Vegetation.—The principal plant community on these benches is ponderosa pine-fescue. The community typically is characterized by savannah-like stands of ponderosa pine; some douglasfir may or may not be present. The ground cover is essentially grassland in nature being dominated by bluebunch wheatgrass, idaho fescue, eriogonum and silky lupine. The removal of trees usually makes little difference to the stand composition. This community is found mostly associated with the Dark Gray soils; associated Degraded Brown Wooded soils usually support the douglasfir-fescue community.

Correlation.—These are well defined units under stereo vision, with excellent ground correlation.

Land Use.—This subunit is suited to integrated use. In most cases the forage values outweigh the timber values. It provides valuable feed for spring and fall grazing which is in critical supply in the region. Where trees do not depress the herbaceous growth the carrying capacity is about 5 acres/animal-unit-month. It is a poor low-medium site for the production of ponderosa pine (site index 65–70). Where stones are not a serious handicap the soil may be irrigated for forage crops.

Subunit C 2.—The recent alluvial terraces occur along stream courses.

Photo Pattern.—Alluvial deposits appear on the photo as narrow, light-and-dark patchwork units

along the meandering streams of valley bottomlands.

Soils.—Well drained Riddell soils are associated with other members of the Rego Dark Gray Subgroup on moderately coarse textured materials. Undifferentiated gravelly Regosols were mapped as a soil complex along stream courses.

Vegetation.—The vegetation on these lower benches has not stabilized or approached climax and as a result is extremely variable. It is generally a complex of cottonwood (*Populus trichocarpa*) and aspen with some douglasfir and spruce reproduction. Western redcedar (*Thuja plicata*) is sometimes found adjacent to the river bank. A variety of shrubs occurs; the most common shrub is snowberry (*Symphoricarpos albus*) on the more stabilized terraces. A number of grasses are found, the most common of which is kentucky bluegrass, especially on areas used as pasture.

Correlation.—The boundaries drawn under the stereoscope correlate well with field checks. The small patchwork pattern of fields and clearings requires close checking of soils and vegetation in order to define final map units. The minor components of the photo pattern, the fans and pitted outwash, are sharply defined in the photo image and on the ground, but the soil and vegetation relationships are frequently complex.

Land Use.—Where the shrub cover is not too dense, this subunit may supply some pasturage. Cleared sites where some topsoil is present and the profile not too cobbly, may produce good tame pasture or hay with irrigation or spring flooding.

Conclusions

Aerial photo interpretation proved to be a useful early step in a soil survey in the Interior Plateau region of southern British Columbia. It was possible to identify photo patterns which correlated well with soil and vegetation units, in a similar way to that used by Dormaar and Lutwick (1966) and the Soils Survey Staff (1966). In our study correlation was usually obtained at the Great Group level. Three major landscape units were distinguished and described in the Princeton basin.

The first unit (A) was the grass- or tree-covered uplands and plateau area which was subdivided into four subunits, each with distinct terrain, soil, and vegetation characteristics.

The first subunit, the till plain at lower elevations, was separated on the photograph by a uniform tone and distinct landform pattern. It was found mostly on Black, Dark Brown, and Dark Gray soils associated with the idaho fescue-erigonum and ponderosa pine-fescue plant communities.

In the second subunit a pattern of gullies and low knolls dissect the till plain. They, however,

lack an integrated drainage pattern and form a light-toned speckled image on the photograph. The soils belonged to the Podzo Regosol group and supported plant communities of the douglasfir zone.

The higher elevations on the till plain formed a third subunit distinguished by tone, texture, and a linear pattern on the photograph. The soils were mostly Acid Brown Wooded associated with the subalpine fir-pinegrass plant community.

The drumloidal landscape of the fourth subunit shows a dark color but with considerable contrast in the photograph. The characteristic Gray Wooded soil supported a moist phase of the douglasfir-pinegrass plant community.

The second major subdivision (B) was considered to be the steeply sloping valley walls. Irregular tones on the photograph are caused largely by abrupt changes in vegetation, slope, and aspect. The dominant soils were Regosols associated with the douglasfir-pinegrass community although Dark Gray soils supporting the douglasfir-fescue community were common on the drier sites.

The third subdivision (C) was that of the valley bottoms and low terraces. The level terraces and surfaces scarred by meander marks and patterns of agricultural use were distinct on the photograph. The terraces adjoining the till plain had a distinctive grayish tone. Dark Gray soils predominated along with Regosols and supported the ponderosa pine-fescue and douglasfir-fescue communities respectively.

Although subunits C 1 and A 1 have similar vegetation and are both areas of chernozem soils, the soil associates, parent materials, and landscape units are quite different and, therefore, have to be separated.

The recent alluvial terraces appeared on the photographs as narrow patchwork units along streams. The soils were mostly Regosols and the vegetation was an unstabilized complex of deciduous trees and shrubs usually with some conifers.

Aerial-photo interpretation was a very useful technique, prior to and in conjunction with a ground survey, in classifying land. Correlation of soils, vegetation and terrain was generally good.

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