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COLUMBIA RIVER WILDLIFE MITIGATION HABITAT EVALUATION PROCEDURES REPORT

Scotch Creek Wildlife Area, Berg Brothers, and Douglas County Pygmy Rabbit Projects

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ABSTRACT

This Habitat Evaluation Procedure study was conducted to determine baseline habitat units (HUs) on the Scotch Creek, Mineral Hill, Pogue Mountain, Chesaw and Tunk Valley Habitat Areas (collectively known as the Scotch Creek Wildlife Area) in Okanogan County, Sagebrush Flat and the Dormaier property in Douglas County, and the Berg Brothers ranch located in Okanogan County within the Colville Reservation .

A HEP team comprised of individuals from the Washington Department of Fish and Wildlife, the Confederated Tribes of the Colville Reservation , and the Natural Resources Conservation Service (Appendix A) conducted baseline habitat surveys using the following HEP evaluation species: mule deer (Odocoileus hemionus), sharp-tailed grouse (Tympanuchus phasianellus), pygmy rabbit (Brachylagus idahoensis), white-tailed deer (Odocoileus virginiana), mink (Mustela vison), Canada goose (Branta canadensis), downy woodpecker (Picoides pubescens), Lewis' woodpecker (Melanerpes lewis), and Yellow warbler (Dendroica petechia).

Results of the HEP analysis are listed below. General ratings (poor, marginal, fair, etc.,) are described in Appendix B.

Mule deer habitat was marginal lacking diversity and quantify of suitable browse species.
Sharp-tailed grouse habitat was marginal lacking residual nesting cover and suitable winter habitat
Pygmy rabbit habitat was in fair condition except for the Dormaier property which was rated marginal due to excessive shrub canopy closure at some sites.
White-tailed deer habitat was in good to excellent condition within the conifer forest cover types; however, the mixed forest cover type was rated marginal because of reduced evergreen tree canopy closure.
Mink habitat was poor lacking suitable over-story canopy and diverse understory vegetation.
Cahada goose habitat was poor-no suitable nest sites or brood pastures.
Downy woodpecker habitat was in excellent condition with the exception of Tunk Valley which rated poor because the site lacked large snags within riparian areas.
Lewis' woodpecker habitat was poor at most sites. Large snags and understory vegetation were lacking; however, the conifer woodland cover type at Scotch Creek was rated fair.
Yellow warbler habitat was in poor to marginal condition due to the absence of suitable amounts of hydrophytic shrubs.

This report is an analysis of baseline habitat conditions on mitigation project lands and provides estimated habitat units for mitigation crediting purposes. In addition, information from this document could be used by wildlife habitat managers to develop management strategies for specific project sites.

INTRODUCTION

The development of the hydropower system in the Columbia River Basin has affected many species of wildlife as well as fish. Some floodplain and riparian habitats important to wildlife were inundated when reservoirs were filled. In some cases, fluctuating water levels caused by dam operations have created barren vegetation zones, which expose wildlife to increased predation. In addition to these reservoir-related effects, a number of other activities associated with hydro-electric development have altered land and stream areas in ways that further impact wildlife. These activities include construction of roads and facilities, draining and filling of wetlands, stream channelization and shoreline riprapping. In some cases, the construction and maintenance of power transmission corridors altered vegetation, increased access to and harassment of wildlife, and increased erosion and sedimentation in the Columbia River and its tributaries.

In 1980, Congress passed the Pacific Northwest Electrical Power Planning and Conservation Act (Northwest Power Act), The Act requires the Bonneville Power Administration to protect, mitigate, and enhance wildlife to the extent it was affected by the development and operation of hydropower projects on the Columbia River and its tributaries. This legislation also created the Northwest Power Planning Council (NPPC). Until this Act, there was little hope that wildlife restoration would take place to address losses associated with some of the federal hydroelectric dams in the state.

Through the 1980s, the NPPC worked with federal and state agencies and Indian Tribes to develop reservoir mitigation plans. The NPPC considered wildlife loss estimates, methods of restoration, private versus public land use, leasing versus willing seller acquisition, impacts to local economies, the role of local government in the planning process, and other concerns.

In 1989, the NPPC amended the Columbia Basin Fish and Wildlife Program and created the Wildlife Rule. The resultant Wildlife Rule included a series of criteria to be used to ensure that public and Tribal concerns are addressed in each mitigation project proposal made by wildlife management agencies (the 1989 Wildlife Rule was revised in 1994).

In 1993, the Washington Department of Fish and Wildlife (WDFW), along with members of the Washington Wildlife Coalition of Resource Agencies and Tribes entered into an Interim Washington Wildlife Mitigation Agreement with the BPA. During the term of this agreement, BPA is to begin funding planning and implementation of wildlife mitigation projects in Washington.

The Scotch Creek Wildlife Area (WDFW), the Hellsgate Big Game Winter Range Project (CCT), and the Douglas County Pygmy Rabbit Project (WDFW) have been approved as wildlife mitigation projects. These projects will begin to address adverse impacts caused by the construction of Grand Coulee and Chief Joseph hydroelectric dams. The projects are funded by BPA and carried out in cooperation with WDFW, CCT, National Biological Service (NBS), Washington Department of Natural Resources (DNR), Natural Resources Conservation Service, Columbia Basin Fish and Wildlife Authority, Bureau of Indian Affairs (BIA), Northwest Power Planning Council, and others. The projects will be consistent with

Section 1003(b)(7) of the NPPC's Wildlife Rule which addresses mitigation for losses due to the Federal Columbia River Power System.

The primary focus of the Scotch Creek Project is the enhancement and protection of shrub-steppe/sharp-tailed grouse habitat and the management of critical mule deer winter range. Likewise, the main objective of the Hellsgate project is to enhance and manage critical mule deer winter range as well as improve shrubsteppe habitat for sharp-tailed grouse and other shrub-steppe obligate species. The Pygmy Rabbit proposal focuses on protection and enhancement of shrub-steppe habitat for pygmy rabbits and sage grouse.

The 13,219 acre Scotch Creek Wildlife Area is comprised of the following four Habitat Areas: 1.) Scotch Creek - 6,800 acres; 2.) Pogue Mountain - 1,159 acres (considered part of Scotch Creek for management purposes); 3.) Tunk Valley - 1,079 acres; and 4.) Chesaw - 4,181 acres. These lands are currently owned by WDFW.

In contrast, the 16,100 acre Hellsgate project started with the acquisition of the William Kuehne Ranch (5,000 acres). In Phase II, the Henry Kuehne Ranch (4,800 acres) was purchased over a three year period and Phase III concludes with the Berg Brothers Ranch (6,300 acres) acquisition.

The three pygmy rabbit projects, totaling 4,060 acres, include the Douglas County Pygmy Rabbit project (240 acres), the Cooperative Resource Management Plan i.e., CRMP (3,500 acres), and the Dormaier property (320 acres). Figure 1 depicts the general locations of the projects.

COLUMBIA RIVER WILDLIFE MITIGATION
HEP EVALUATION PROJECT SITES

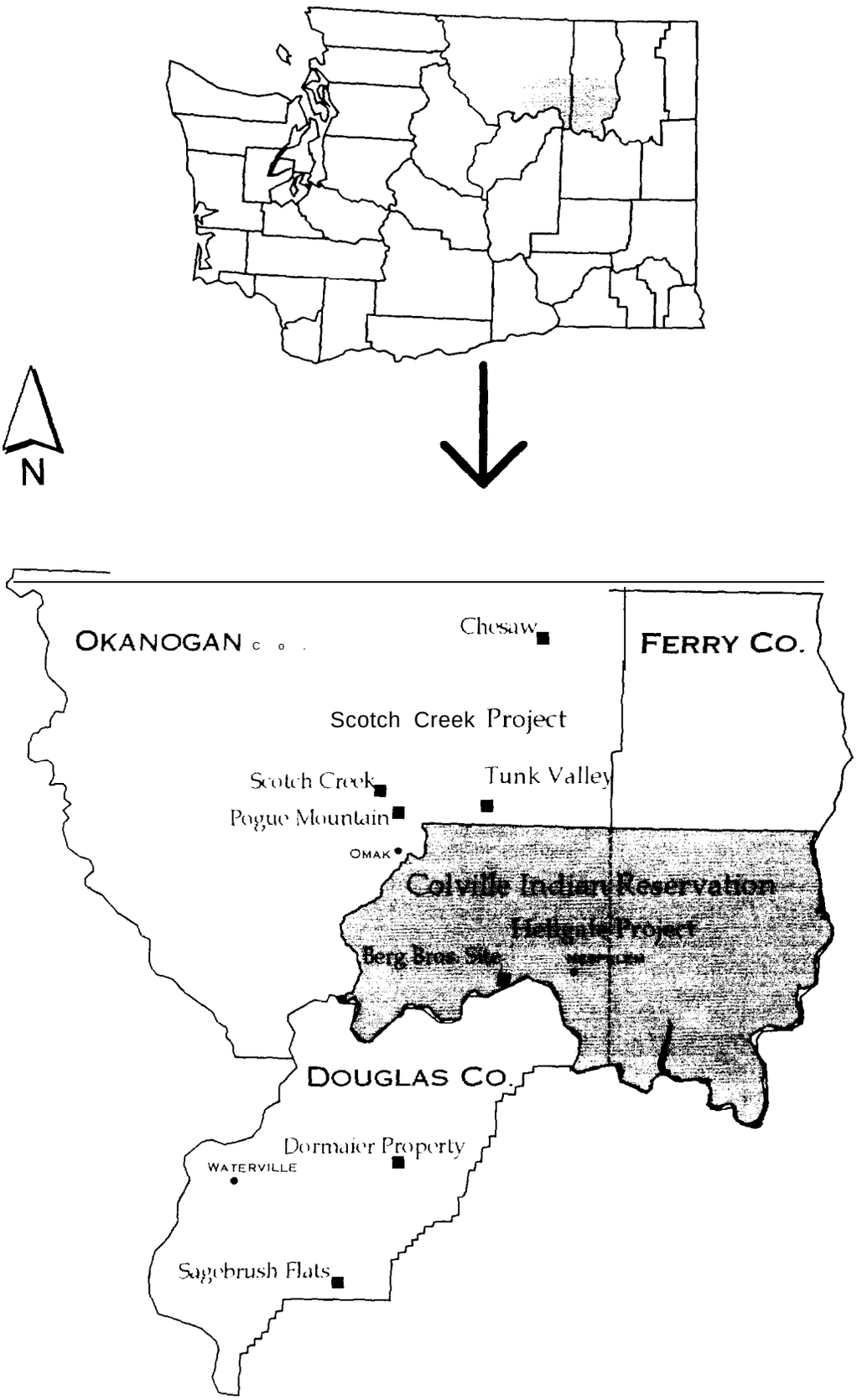

FIGURE 1. HEP Study Project Sites.

HABITAT EVALUATION PROCEDURES (HEP) CONCEPTS

HEP Concepts

HEP was developed by the US Fish and Wildlife Service to document the non-monetary value of fish and wildlife resources. Specifically, the quality and quantity of available habitat for selected wildlife species. HEP provides information for two general types of wildlife comparisons: 1) the relative value of different areas at the same point in time; and 2) the relative value of the same area at future points in time. By combining the two types of comparisons, the impact of proposed or anticipated land and water use changes on wildlife habitat can be quantified.

HEP is based on ecological principles and the assumption that habitat for selected wildlife species can be described as a numerical value known as a Habitat Suitability Index (HSI). This value is derived from an evaluation of the ability of key habitat components to supply the life requisites of selected species of fish and wildlife. Evaluation involves using the same key components to compare existing habitat conditions with optimum habitat conditions for a target species.

The HSI value (ranging from 0.0 to 1.0) is multiplied by the area of available habitat to obtain Habitat Units (HUs) which are, for mitigation purposes, the "currency" used to measure/compare habitat losses and gains.

Along with HEP, the USFWS developed and published "Blue Book Species Models." Four USFWS models were used during this evaluation including: Mink, Yellow Warbler, Downy Woodpecker, and Lewis' Woodpecker. The Lewis' Woodpecker model was modified to evaluate only breeding habitat occurring on the study areas. In addition, six unpublished HSI models were developed and/or modified to evaluate habitat occupied by species of concern, or wildlife species having significant cultural/recreational value. These models include: Sharp-tailed Grouse, Sage Grouse, Mule Deer, Pygmy Rabbit, White-tailed Deer, and Canada Goose (Appendix C).

Selection of evaluation species was based on loss assessments for Grand Coulee and Chief Joseph dams and project specificcover types (Tables 1, 2). In general, a single HEP model is used to represent a guild of species for each cover type. Therefore, HSI values can represent the habitat quality for a range of species occupying the same habitat In this study, however, more than one model was used to evaluate shrub-steppe habitat i.e., sharp-tailed grouse, mule deer, sage grouse, and pygmy rabbit

Table 1: Scotch Creek HEP Versus Loss Assessments

Dam	Loss Assessment Model	Scotch Creek Project HEP Model	Scotch Creek Cover Types
Grand Coulee (WDFW)	Sage Grouse	N/A	N/A
	Sharp-tailed Grouse Mule Deer	Sharp-tailed Grouse Mule Deer	Shrub Land Shrub Grass Grassland Grassland (native like)
	Ruffed Grouse	Downy Woodpecker	Deciduous Forest
	Mourning Dove	Sharp-tailed Grouse	Agriculture
	White-tailed Deer	White-tailed Deer	Mixed Forest Conifer Forest Dense Conifer Forest
	Riparian Forest	Downy Woodpecker	Riparian Forest Forested Wetland
	Riparian Shrub	Yellow Warbler	Riparian Shrub
	Canada Goose Nest Site	N/A	N/A
	----------	N/A	Surface Water
Chief Joseph (WDFW)	Lewis' Woodpecker	Lewis' Woodpecker	Conifer Woodland
	Sharp-tailed Grouse	N/A	N/A
	Mule Deer	Mule Deer[1]	Shrubland
	Spotted Sandpiper	N/A	N/A
	Sage Grouse	Sage Grouse/Pygmy Rabbit[1]	Shrubland
	Mink	Mink	Emergent Wetlands
	Bobcat	N/A	N/A
	Ringnecked Pheasant	N/A	N/A
	Canada Goose	N/A	N/A
	Yellow Warbler	N/A	N/A

'Douglas County pygmy rabbit project.

Table 2: Berg Brothers HEP versus Loss Assessments

Dam	Loss Assessment Model	Berg Brothers Project HEP Model	Berg Brothers Cover Types
Grand Coulee (CCT)	Sage Grouse	N/A	N/A
	Mule Deer	Mule Deer	Shrub-steppe
	Sharp-tailed Grouse	Sharp-tailed Grouse	shrub-steppe
	Elk	Mule Deer	Grassland
	white-tailed Deer	N/A	N/A
	Ruffed Grouse	N/A	N/A
	Pheasant	Sharp-tailed Grouse	Agriculture
	Beaver	Mule Deer	Riparian-shrub
	Sharp-tailed Grouse	Sharp-tailed Grouse	Grassland
Chief Joseph (CCT)	Lewis' Woodpedter	Lewis' Woodpecker	Conifer Woodland
	Sharp-tailed Grouse	N/A	N/A
	Mule Deer	N/A	N/A
	Spotted Sandpiper	Canada Goose	Shoreline
	Sage Grouse	N/A	N/A
	Mink	Miok	Riparian
	Bobcat	N/A	N/A
	Ringnecked Pheasant	N/A	N/A
	Canada Goose	Canada Goose	Shoreline
	Yellow Warbler	Yellow Warbler	Deciduous Woodland

PROJECT ENVIRONMENT

Scotch Creek Habitat Area:

The Scotch Creek unit is the largest contiguous parcel on the Wildlife Area (WA) containing 6,800 acres and is located ten miles northwest of Omak on the Conconully Highway (Figure 2). The elevation varies from approximately 1,600 to 2,800 feet above sea level. The area consists of approximately 300 acres of irrigated agriculture land, 1,500 acres of dry agricultural land converted to pasture and the balance, 5,000 acres, is a combination of rangeland and young forest. Approximately 1,080 acres is subject to a perpetual timber deed. Stands of diffuse, knapweed, Russian knapweed, and cheatgrass are present over most of the native rangeland and young forest areas.

In August 1991, WDFW purchased the Scotch Creek WA primarily to protect remnant critical Columbian sharp-tailed grouse habitat. Funding was provided through the Washington Wildlife and Recreation Program (WWRP). Management objectives for the WA focus on recovery of sharp-tailed grouse habitat/populations.

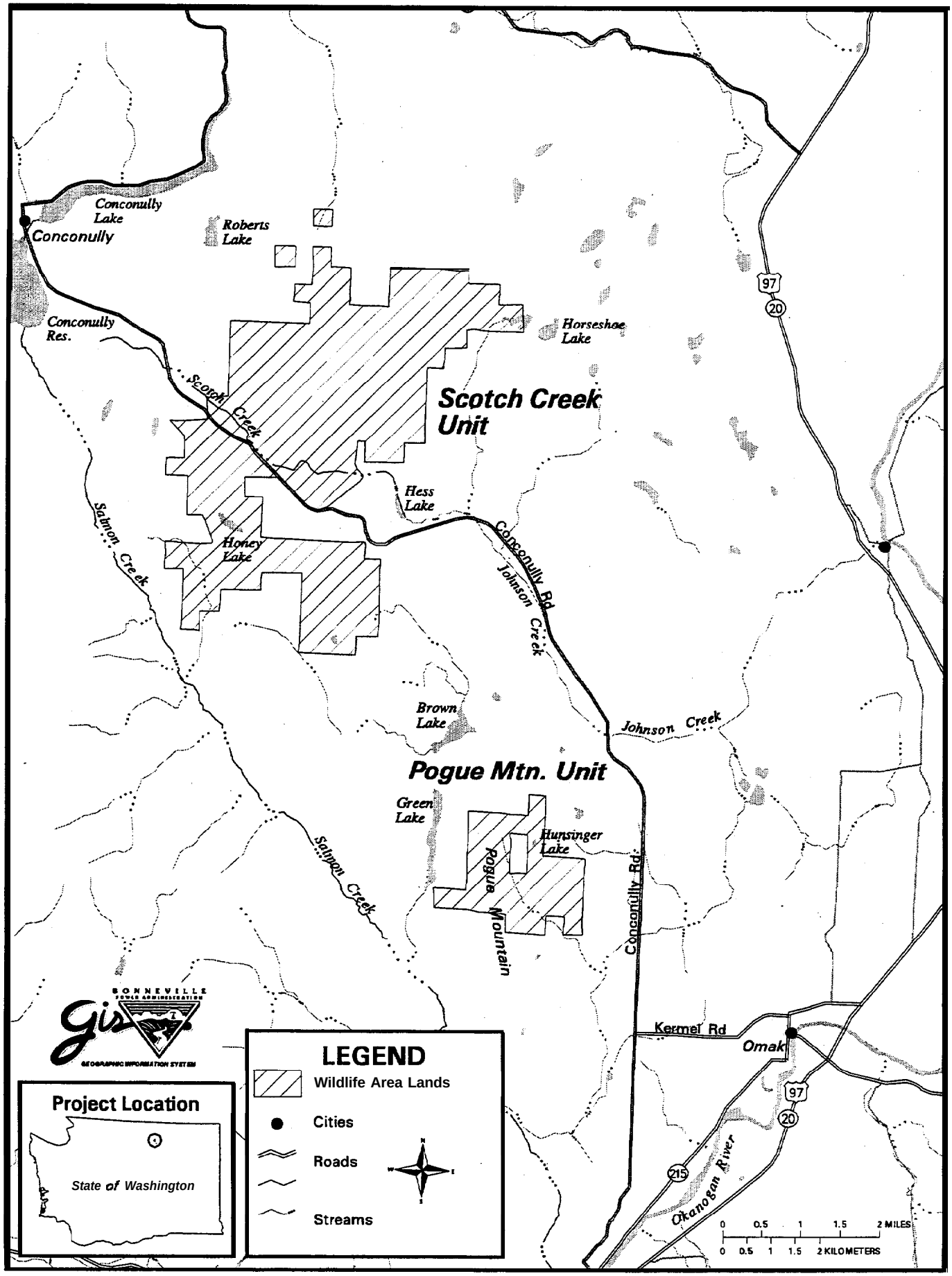

Figure 2: Scotch Creek and Pogue Mountain Habitat Areas

Pogue Mountain Unit:

The 1,159 acre Pogue Mountain unit is located four miles northwest of Omak (Figure 2). Pogue Mountain is a combination of rangeland and young forest (WDFW owns the timber rights). The elevation varies from approximately 1,600 feet to 2,800 feet above sea level. The terrain is comprised of rough, rolling sparse to dense timbered hills and large pockets of open rangeland.

Although there are historical accounts of sharp-tailed grouse on Pogue Mountain, sharp-tailed grouse do not occupy this site at the present time. The project area is mule deer winter range and ruffed grouse can be found in the wetter draws. Fencing is in poor condition. The area is also popular with local residents for off-road vehicle use.

Tunk Valley Habitat Area:

The Tunk Valley Habitat Area is located approximately 12 miles northeast of Omak. Mean precipitation is 12.2 inches and the average annual snowfall is 28 inches.

In August 1991, WDFW purchased the Tunk Valley Habitat Area to protect critical sharp-tailed grouse habitat. Funding was provided through the Washington Wildlife and Recreation Program. The area encompasses a total of 1,079 acres in two parcels (Figure 3).

Over the past 60 years, Tunk Valley has undergone significant change. As a working cattle ranch, much of the uplands were converted from native shrub-steppe grasslands to grain fields of rye or wheat. Later these fields, approximately 300 acres, were seeded to Sherman big bluegrass to accommodate livestock grazing. Both diffuse and Russian knapweed have encroached upon adjoining rangelands. Small conifer stands exist on the steep north slopes in the center of the property and healthy stands of riparian shrubs are present along Tunk Creek and some deep draws. The property is fenced (both border and internal fences) and has several wildlife water guzzlers and a permanent stream.

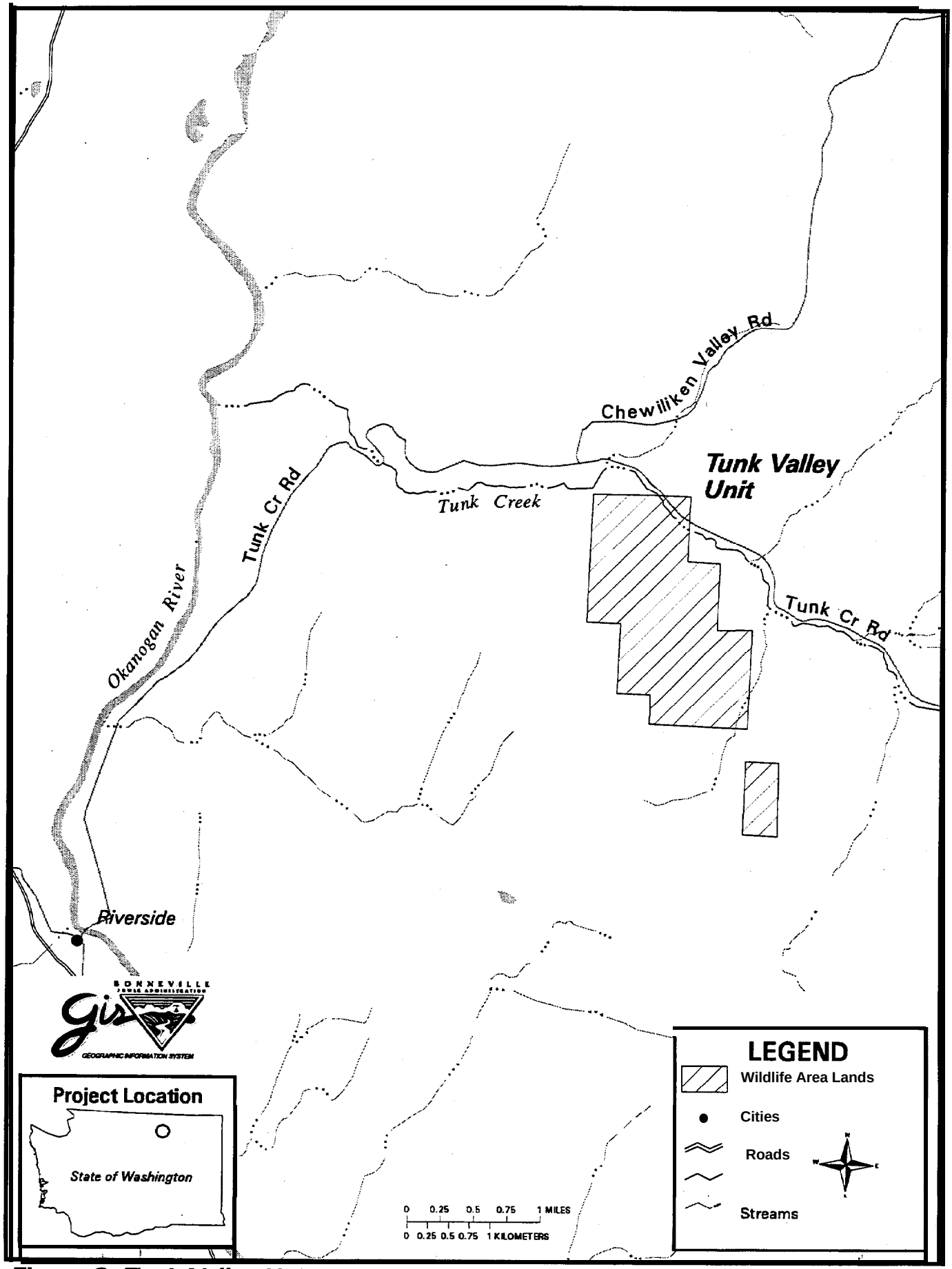

Figure 3: Tunk Valley Habitat Area

Chesaw Habitat Area:

The Chesaw Habitat Area lies in the northeast portion of Okanogan County four miles south of the Canadian border and approximately ten miles west of the Ferry County line. The property is approximately 20 miles east of Oroville and immediately northwest of the small community of Chesaw (Figure 4). The area to the west and south is a combination of rural/recreational home sites and ranches, while to the east predominately national forest lands occur . The Chesaw unit encompasses 4,290 acres of diverse habitats.

In 1991, WDFW purchased what is now the Chesaw Habitat Area primarily for the protection of critical sharp-tailed grouse habitat. Funding for the purchase of this property was provided through the WWRP.

Chesaw is a contiguous irregular shaped parcel, which includes 355 acres in the Conservation Reserve Program (CRP). The remaining 3,935 acres is comprised of 497 acres of forested lands and 3,438 acres of rangeland.

Overall, the property exhibits relatively gentle topography over much of the area with lower elevations near 3,200 feet and higher reaches at 4,200 feet. The property has complete perimeter fencing plus cross fencing. Water on the property is available from five springs, two lakes, and several streams.

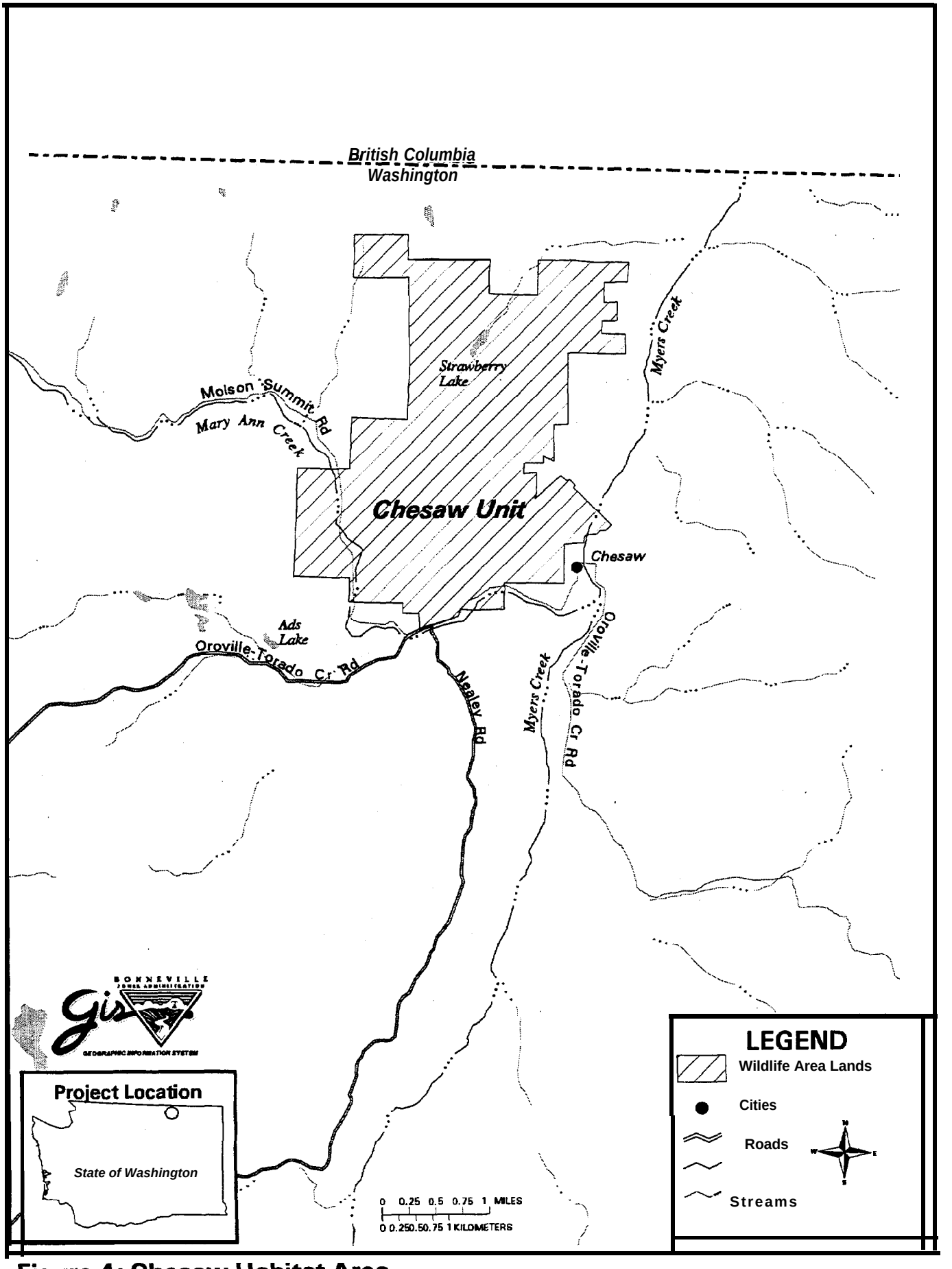

Figure 4: Chesaw Habitat Area

Berg Brothers Ranch Project Site:

The 6,300 acres that make up this former working cattle ranch are primarily rangelands. Starting at the north shoreline of the Columbia River, the land rises in a series of benches up to Whitmore Mountain on the west and Hamilton Ridge on the east (ranging from 1,200 to 2,400 feet in elevation) (Figure 5). Hopkins Canyon, the largest drainage, bisects the property north and south. Other than Rufus Woods Lake (the Columbia River above Chief Joseph Dam), there are few sources of water for wildlife. Some springs and, in wet years, small lakes occur along the north end of Hopkins Canyon.

Land along the Columbia River is fertile and supports a variety of irrigated agricultural crops as well as dryland wheat. Settlements over the last 100 years consisted of small ranches and homesites. The lack of permanent water for both agricultural and domestic use caused most of these settlements to be abandoned.

In the past, the Berg Brothers grazed sheep over much of the Colville Reservation north of the project lands. Today, however, the Berg Brothers Ranch consists of five individual homesteads consolidated into one cattle ranch. The original ranch home site was built in 1952 and was located in the center of the property. It consisted of a small house, a barn, and some outbuildings. The only water source was a spring that dried up every summer. Water had to be hauled in for domestic and livestock use. In 1968, this site was abandoned in favor of a new location which had a year round water supply. Over time a barn and various outbuildings were added.

The climate is very dry. Precipitation of less than 10 inches of rain a year is normal. Snow makes up most of this moisture and falls in late winter. The spring rains are infrequent and of short duration. The land does not support abundant vegetation except along the intermittent water courses. Temperatures range from lows in the 20s in winter to highs of over a 100 degrees in summer. Generally, winds are from the southwest. Severe winter weather is moderated somewhat by the presence of Rufus Woods Lake.

The soils of the area are lake sediment deposits resulting from eroded granite bedrock. They are extremely well drained sandy loams, course sands, and gravel. Most of the area soils lack an abundance of organic matter in the top layer. Some of these soils could support agricultural crops if water was available. The area is primarily grassland. Shrub-steppe vegetation occurs where moisture accumulates on the sides of draws. In wet areas, deciduous vegetation and Ponderosa pines occur.

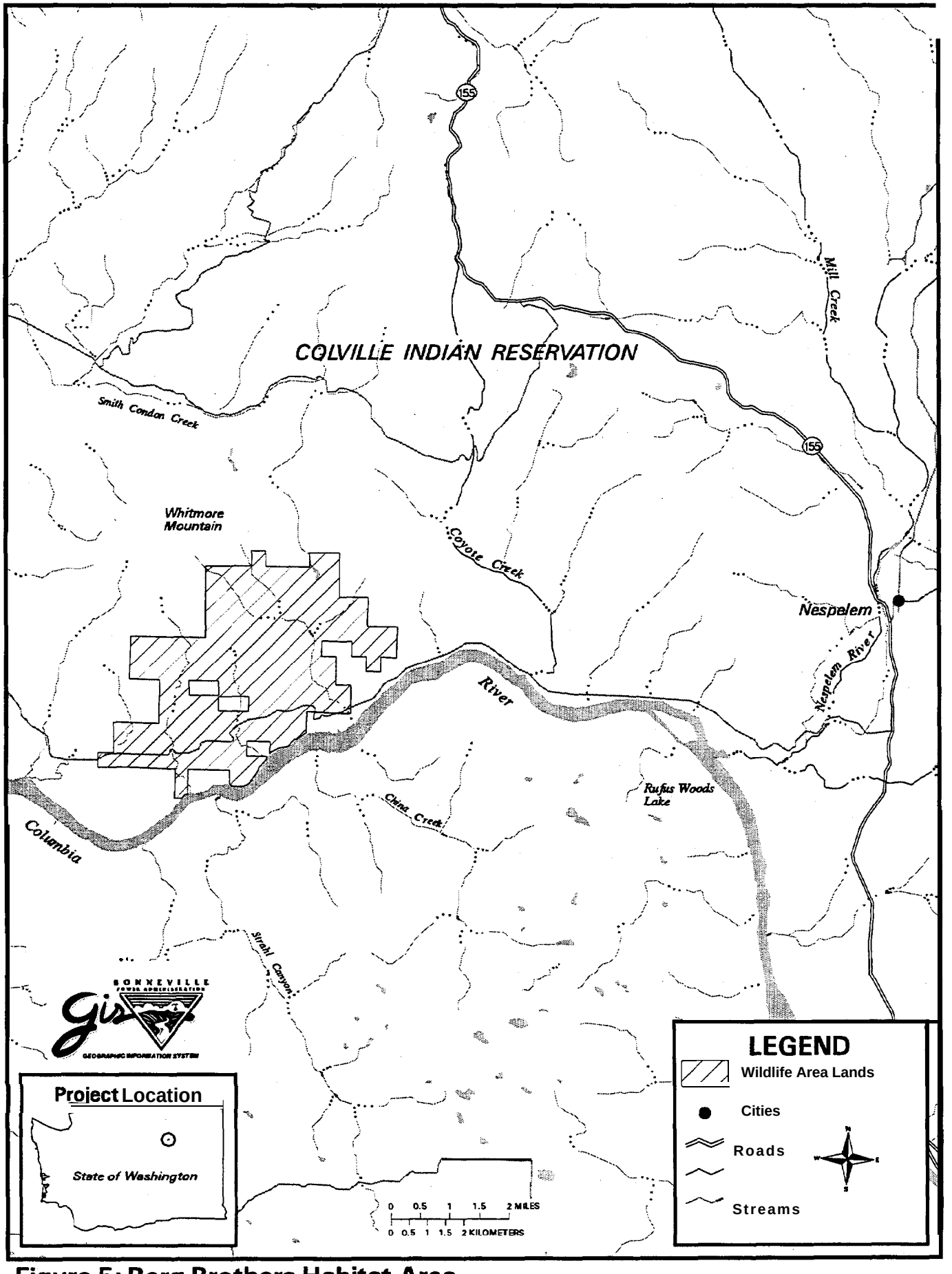

Figure 5: Berg Brothers Habitat Area

Douglas County Pygmy Rabbit Project:

The Douglas County Pygmy Rabbit Project is comprised of three parcels. These include property owned by WDFW at Sagebrush Flat (240 acres); the Sagebrush Flat Cooperative Resource Management Plan (CRMP) proposal area owned and managed by DNR (3,500 acres); and the 320 acre Dormaier project site purchased by BPA. WDFW will manage the three parcels as a single project known collectively as the Douglas County Pygmy Rabbit Project. Individual project sites are described below.

WDFW Sagebrush Flat Project:

WDFW's Sagebrush Flat parcel is located in southeast Douglas County approximately 10 miles northwest of Ephrata (Figure 6). The area directly east of the project is owned by DNR and is comprised of primarily shrub-steppe habitat. Other adjacent lands are privately owned and are either small grain croplands or range.

WDFW acquired the Douglas County Pygmy Rabbit site with WWRP funds for the protection and enhancement of pygmy rabbit habitat. The 240 acre site consists of 100 acres of agricultural land and 140 acres of shrubland. The agricultural land was seeded to native-like vegetation in 1995. In contrast, typical plant species found within the shrubland cover type include: big sagebrush, three-tipped sagebrush, stiff sagebrush and rabbit brush along with Idaho fescue, bluebunch wheatgrass, cheatgrass, buckwheat, yarrow, and balsam root. Soil types classified by NRCS are Heyton, Renslow-Zen association, Touhey, and Zen-Bakeoven-Lickskillet. These soils, except Bakeoven and Lickskillet soils which are very cobbley and include rock outcrops, are loamy, deep and well drained (Beieler 198 1).

Topography is relatively flat (<10 percent slope). Drainages, low rolling hills, and shallow draws make up the general landscape. Elevation ranges from 1,640 to 1,800 feet. Climatic factors include cold winters and hot, dry summers. Annual precipitation is between nine and 11 inches--most of which occurs during the winter and early spring.

Sagebrush Flat Cooperative Resource Management Plan (CRMP):

The 3,500 acre CRMP project lies in southern Douglas County 10 miles northwest of Ephrata adjacent to the Douglas County Pygmy Rabbit project site (Figure 6). The area is owned by DNR; however, WDFW is negotiating with the DNR to acquire ownership of the site.

The single largest known concentration'of pygmy rabbits in Washington State occurs on Sagebrush Flat. As a result, WDFW will focus habitat enhancement and protection efforts on activities which primarily benefit pygmy rabbits. The area is now managed for livestock use under a planned grazing system. WDFW intends to continue a planned livestock grazing strategy with some modifications such as additional cross fencing and dispersed livestock watering stations.

The CRMP project is comprised of approximately 3,200 acres of shrub-steppe habitat (shrubland cover type) and 300 acres of the agricultural cover type. Vegetation, soils, topographic, and climatic features are nearly identical to those found at the Douglas County Pygmy Rabbit project site.

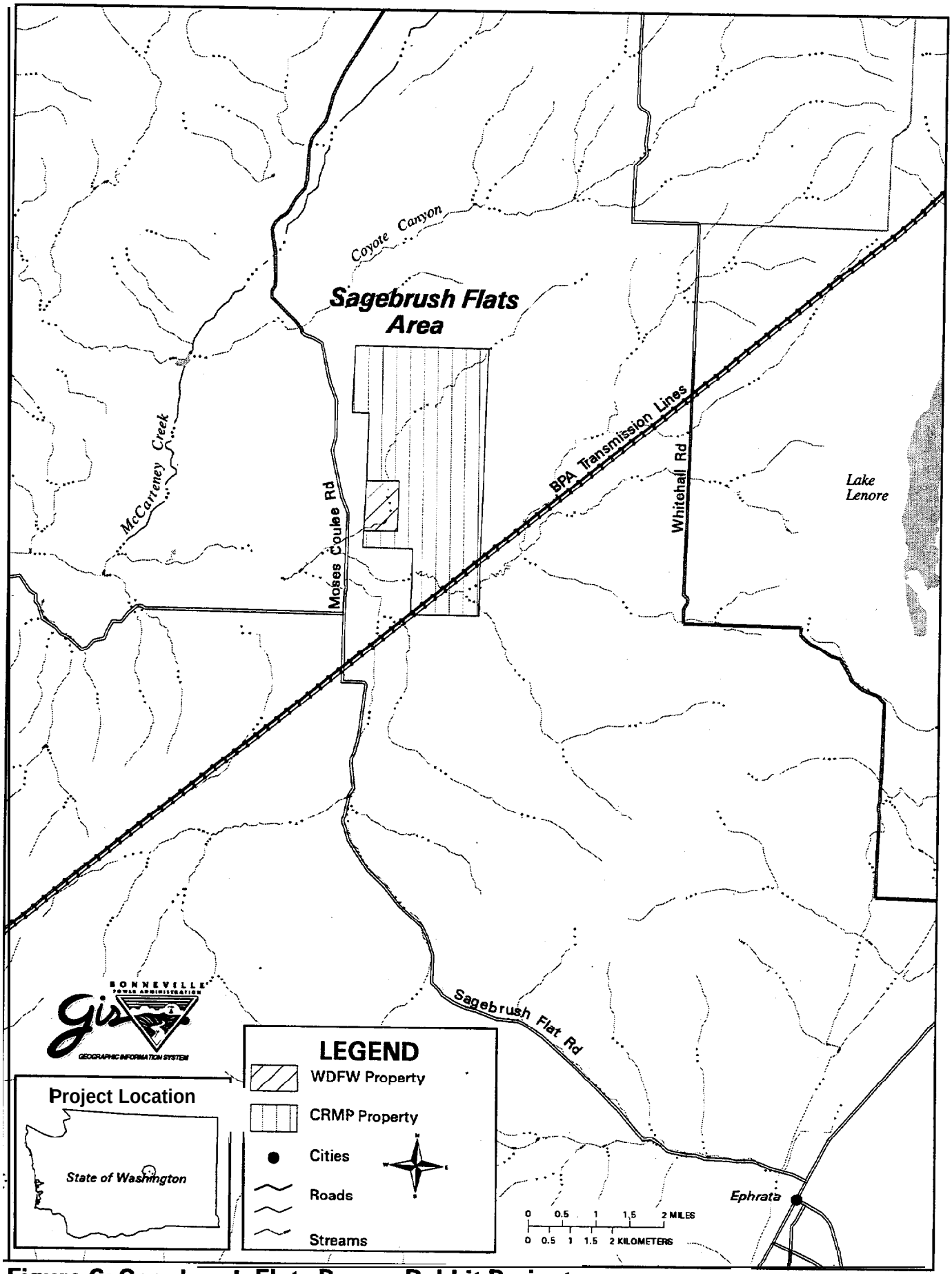

Figure 6: Sagebrush Flats Pygmy Rabbit Projects

Dormaier Pygmy Rabbit Project:

The Dormaier project site is comprised of 320 acres of shrub-steppe habitat located three miles east of Jameson Lake in Douglas County (Figure 7). This project site was purchased by Bonneville Power Administration in 1994 as partial mitigation for habitat losses associated with the construction of Grand Coulee and Chief Joseph Dams.

The site was acquired by BPA (recommended by WDFW) primarily for its value as pygmy rabbit habitat. At this juncture, few active burrow sites occur on the site. The lack of herbaceous understory (Ron Freese, WDFW, pers. commun.) coupled with high shrub canopy cover (>30 percent) in some areas may account for the low number of pygmy rabbits present.

Vegetation, soils, topographic, and climatic factors are similar to those found at the other pygmy rabbit project sites with the exception of elevation, which ranges from 2,187 feet to 2,250 feet above sea level.

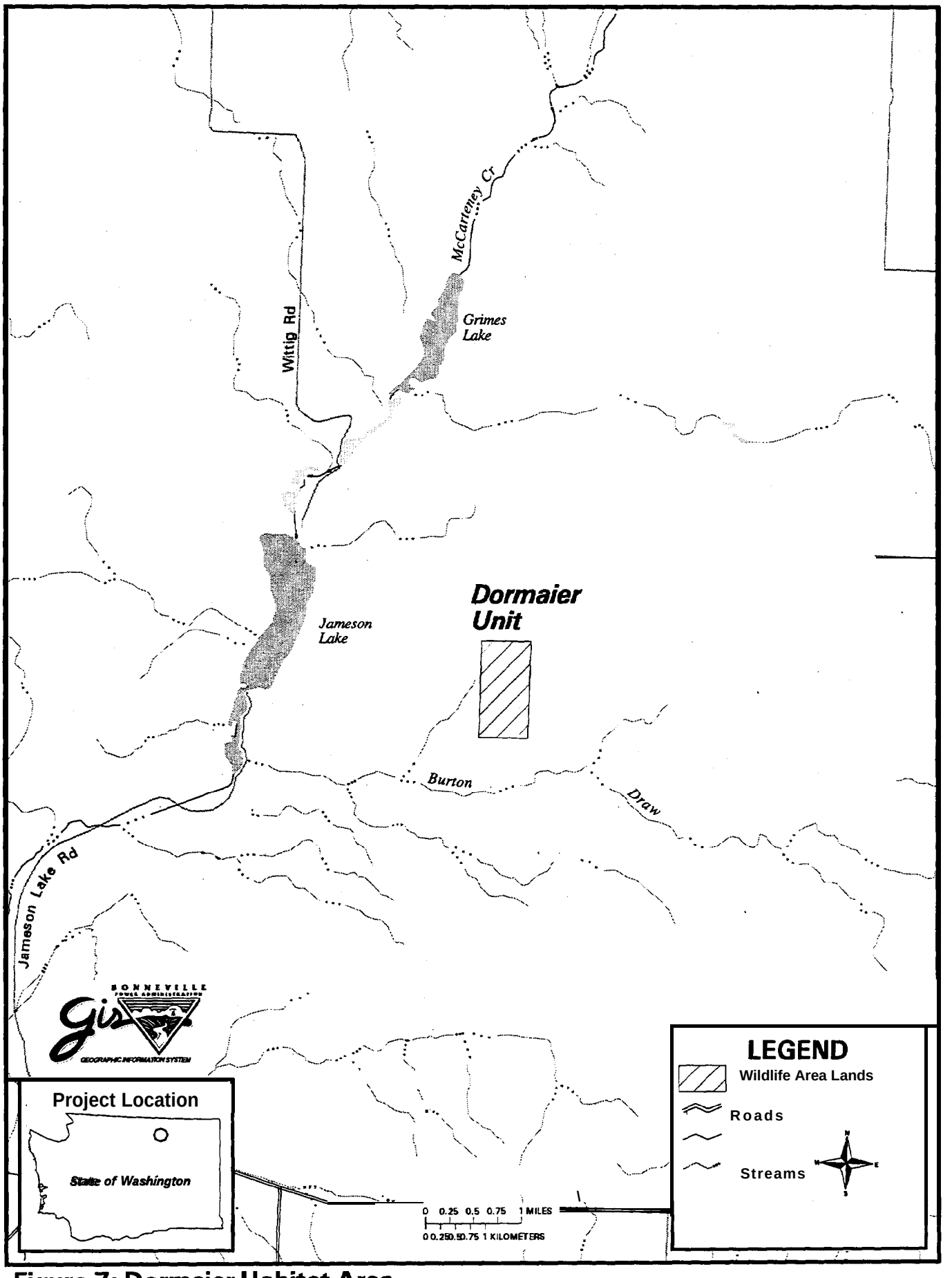

Figure 7: Dormaier Habitat Area

DESCRIPTION OF COVER TYPES

The term "cover type" refers to an area of land or water with similar physical, chemical, and biological characteristics that meet a specific standard of homogeneity (U.S. Department of Interior, 1980). For example, the grassland cover type includes all areas comprised of grass and forbs having less than five percent shrub canopy closure. The specified standard of homogeneity is "comprised of grass and forbs having less than five percent shrub canopy closure".

The use of cover types allows the HEP evaluation team to: 1) identify and select appropriate evaluation species models; 2) extrapolate data from sampled areas to non-sampled areas, thus, reducing the amount of sampling necessary; and 3) interpret HEP data.

A total of 21 cover types were identified on project lands; however, cover types comprising <1 percent of a specific study area were not delineated as separate polygons (Appendix D).

Cover types used in this report include: Agriculture, Conifer Forest, Conifer Woodland, Dense Conifer Forest, Deciduous Forest, Deciduous Woodland, Mixed Forest, Riparian Forest, Forested Wetland, Emergent Wetland, Riparian, Riparian Shrub, Surface Water, Shrub-steppe, Grassland, Grassland-native like, Shrub-grass, Shrubland, Exposed/Shoreline, Talus/Rock, and Urban. Cover types were defined as follows:

Agriculture: Areas that are in crop production and/or managed primarily for revenue generation. Includes various grain or hay crops as well as mowed forb land.

Conifer Forest: Stands of pine and/or fir trees comprised of 770 percent conifers with 40-70 percent canopy closure.

Conifer Woodland: Characterized by open stands or clumps of pine/fir species comprised of >70 percent conifers with 20-40 percent canopy closure.

Dense Conifer Forest: Closed stands of pine/fir trees comprised of >70 percent conifer with >70 percent canopy cover.

Deciduous Forest: More than 70 percent deciduous trees with 40-70 percent canopy cover. Includes primarily quaking aspen, willow spp., black cottonwood, and water birch.

Deciduous Woodland: Comprised of >70 percent deciduous trees with 20 to 40 percent canopy closure.

Mixed Forest: Stands comprised of not more than 70 percent conifer, or 70 percent deciduous trees with 40 to 70 percent canopy cover.

Riparian Forest: Includes both conifer and deciduous trees in stands greater than 40 percent canopy cover located in riparian zones.

Forested Wetland: Wetlands dominated by tree species.

Emergent Wetland: Wetlands dominated by vegetation species that have root systems adapted to water saturated soils such as cattail, sedges, etc.

Riparian: Broad cover class characterized as habitat adjacent to aquatic systems. Riparian habitat begins at the high water mark and extends to that portion of the landscape that is influenced by, or that directly influences, the aquatic ecosystem.. This includes floodplains.

Riparian Shrub: Comprised of hydrophytic shrubs in riparian zones such as red osier dogwood, alder, and willow spp.

Surface Water: Ponds, lakes, reservoirs, rivers, and streams.

Shrub-steppe: Habitat comprised of multiple cover types i.e., grassland, grassland-native like, shrub-grass, and shrubland. Primarily xeric sites occupied by shrubs and herbaceous vegetation interspersed with bare ground, litter, and rock outcrops. Shrub-steppe areas are dominated by shrub species such as bitterbrush, sagebrush, rabbit brush, serviceberry, and currant, but may also have some trees (<20% tree canopy closure). Grass and forbs include bluebunch wheatgrass, needle and thread, **Idaho** fescue, Basin wildrye, balsam root, and cheatgrass.

Grassland: Grass/forbs comprised of <5 percent shrub canopy closure. Includes CRP fields.

Grassland-Native Like: Grass/forbs such as bluebunch wheatgrass, fescue, balsam root, and cheatgrass with <5 percent shrub canopy closure. Does not include CRP fields.

Shrub-Grass: Grass/forbs with 5 to 15 percent shrub canopy closure.

Shrubland: Grass/forbs with 715 percent shrub canopy closure.

Exposed/Shoreline: Sand, ash, mudflat, beach, rock outcrops, bare ground, cobble, boulder, gravel.

Talus/Rock: Talus field or slope.

Urban: Residential, urban, industrial, farm buildings.

Table 3 lists cover types and acreages for each project site. Figure 8 through 13 depicts typical examples of cover types (grassland, shrub-grass, shrubland, riparian shrub, conifer forest, and conifer woodland).

Table 3: Project Area Cover Types and Acreages

Project Area	Cover Type	Acres
Scotch Creek	Grassland	111
	Grassland-Native Lake	993
	Shrub-Grass	3,737
	Shrubland	1209
	Emergent Wetland	198
	Riparian Forest	15
	Riparian Shrub	48
	Conifer Forest	194
	Conifer Woodland	26 1
	Forested Wetland	88
	Agriculture	436
	Deciduous Forest	10
	Total Acres	**7,300**
Chesaw	Grassland	562
	Grassland-Native Like	2,729
	Shrub-Grass	192
	Shrubland	198
	Emergent Wetland	80
	Riparian Forest	104
	Riparian Shrub	25
	Forested Wetland	14
	Conifer Forest	125
	Dense Conifer Forest	49
	Mixed Forest	205
	Surface Water	7
	Total Acres	**4,290**
Tunk	Grassland	82
	Grassland-Native Like	87
	Shrub-Grass	647
	Shrubland	159
	Riparian Forest	60
	Riparian Shrub	14
	Conifer Forest	17
	Conifer Woodland	21
	Total Acres	**1,087**
Pogue Mountain	Grasslaud-Native Like	5
	Shrub-Grass	207
	Shrublaod	499
	Emergent Wetland	21
	Riparian Shrub	11
	Conifer Forest	181
	Conifer Woodland	419
	Dense Conifer Forest	14
	Mixed Forest	35
	Agriculture	18
	Exposed	4
	Total Acres	**1,414**
Douglas co. Pygmy Rabbit	Shrubland	3,660
	Agriculture	400
	Total Acres	**4,060**
Berg Brothers	Agriculture	540
	Conifer Woodland	150
	Deciduous Woodland	32
	Grassland-Native Like	3.108
	Riparian Shrub	452
	Riparian	41
	Shrub-grass	1,950
	Shoreline	20
	Total Acres	**6,293**

Figure 8. Grassland Cover Type

Figure 9. Shrub-grass Cover Type

Figure 10. Schrubland Cover Type

Figure 11. Riparian Shrub Cover Type

Figure 12. Conifer Woodland Cover Type

Figure 13. Conifer Woodland Cover Type

METHODS

Study Design

WDFW and CCT mitigation staff collaborated on this HEP analysis in order to reduce survey costs, standardize evaluation techniques and results, and minimize duplication of effort. HEP team leaders designed this study based on the strategy outlined below:

1. Form a "core" HEP team.
2. Determine study goals and objectives.
3. Delineate study area boundaries.
4. Assemble available information (maps, soils data, aerial photos, land use and wildlife information).
5. Delineate cover types.
6. Select, develop and/or modify HEP models.
7. Form field data collection team.
8. Develop site specific study design.
9. Collect field data.
10. Analyze field data
11. Report findings.

The "core" HEP team was comprised of Paul Ashley (WDFW), Matt Berger (CCT), and Morie Whalen (WDFW). The teams primary goal was to determine baseline habitat conditions and estimate habitat units on proposed project lands. Another important objective was to standardize cover type descriptions, habitat variable measurement techniques, and survey results. The team developed a pygmy rabbit HEP model to evaluate potential pygmy rabbit habitat (no model existed for pygmy rabbits), and also significantly modified draft mule deer, white-tailed deer, and sharp-tailed grouse HEP models in order to reflect study area habitat conditions and target species behavior/needs (USFWS recommends modifying HEP model variables as necessary to reflect local habitat conditions and wildlife requirements).

Study area boundaries were determined from project proposals submitted to BPA and then delineated on 1:24,000 US Geological Survey (USGS) maps. Project area information was obtained from a variety of sources including the NRCS, Department of Natural Resources (DNR), WDFW Wildlife Area Managers and Biologists, WDFW Wildlife Area Management Plans, CCT data bases, CCT Wildlife Managers, tribal members and ranchers. Maps, soils data, aerial photos, LANDSAT imagery, land use details, hydrological, and wildlife information was compiled, if available, for each project site.

Wildlife habitat cover types were defined in accordance with WDFW, CCT, and USFWS guidelines. Cover type information was plotted on 1:24,000 GIS maps (cover types encompassing less than 1% of the study area were not delineated as separate polygons). HEP model selection was based on project area cover types and the models used in the loss assessments for Grand Coulee and Chief Joseph Dams.

A field data collection team, comprised of personnel from WDFW, CCT, NRCS and USFWS (Appendix A), was assembled and briefed on study goals and objectives, HEP concepts and models, and proposed project areas. Study design and measurement techniques were modified by the HEP field team for each site.

Survey start points were determined prior to field data collection whenever possible. Transect route azimuths were randomly selected (random numbers table) and actual transect locations were recorded on a Trimble "Scout" Global Position System (GPS) unit.

The HEP field team collected habitat variable data using the techniques described in Table 4. Field data was collected using standard measurement techniques (Hays and Seitz, 1981), (Robe1 et. al., 1970).

Survey Sampling Techniques

Table 4 Field Survey Sampling Techniques

SPECIES	TECHNIQUE	VARIABLES
Sharp-tailed Grouse	Robel Pole	Visual Obstruction Readings
	Micro Plot	% Grasses and Forbs
	Cover Maps	Distance Between Cover Types
	Aerial Photos/Topo Maps	% Grain Crops
	Clinometer	% Slope
	Forage Cover Pole	% Obstruction of Stems from winter forage
Mule Deer	Line Intercept	% Preffered Shrubs / % Evergreen Veg. > 5
		% Total Shrub Crown cover
	Tape Measure	Shrub Height
	Topographic Maps	Variable Topography
	Aerial Photos / Maps	% Grain Crops I Road Density
	Compass	Aspect
Yellow Warbler	Line Intercept	Deciduous Shrub Crown Cover <16.5' Tall
		Crown Cover of Hydrophytic Shrubs
	Tape Measure	Average Height of Dec. Shrub Canopy Cover
Lewis' Woodpecker	Line Intercept	% Tree Canopy > 16.5 ft. Tall
		% Shrub Crown cover <16.5ft.Tall
	DBH Tape / Quadrat	# of Snags > / = 12" DBH/ acre
Downy Woodpecker	Bitterlich Method	Basal Area
	DBH Tape / Quadrat	#of Snags > 6" DBH /acre
Mink	Aerial Photos /Maps	% of Year Water Present
	Line Intercept	% Canopy Cover <100 yds. of Wetland
		% Canopy Cover < 3 ft. of Water
Canada Goose	Observation /Tape	Height of Herbaceous Ground Cover
	Aerial Photos /Maps	Distance to Open Water
	Ocular Estimation	Shoreline Habitat Quality
White-tailed Deer	Hiding Cover Pole	%Horizontal Concealment
	Aerial Photos /Maps	Width of Cover Type
	Line Intercept	% Conifer and % Preferred Shrub Cover
	Ocular	Shrub Composition and Diversity
	Micro Plot	% Herbaceous Cover
	Aerial Photos / Maps	% Grain Crops and Road Density
	Densiometer	% Evergreen Tree Canopy Cover
	Clinometer	Tree Height
Pygmy Rabbit	Clinometer	% Slope
	Soil Maps	Soil Depth /Type
	Line Intercept	Canopy Cover, Shrub Height/Age Class
	Micro Plot	% Grasses, Forbs, and Exotic Flora species
	Topography Maps	Physiography

Selected habitat measurement instruments/techniques are described within the following paragraphs. Additional information is contained in Appendix E.

Bitterlich's Variable Radius Method (Chambers et al 1983)

This method is an effective means of obtaining basal area and density of tree species. It is a plotless method of selecting sample trees on the basis of size rather than frequency of occurrence. A point sample is used and trees are selected for tallying with the use of an optical wedge, prism, or angle gauge. The probability of tallying any given tree is proportional to its stem basal area (BA). Trees are tallied in a complete circle around the investigator using an optical wedge, prism, or angle gauge of a preselected basal area factor (BAF). The BAF used in this study was 10. Optical prisms or wedges are held directly over the sample point. A tree is counted when its stem is not completely offset when viewed through the wedge or prism sighted at breast height. All other trees are ignored. In sloping terrain, compensation must be made for the effect slope has in decreasing the sighting angle. This method was used to determine the total basal area per acre or total number of trees tallied x BAF.

Robe1 Pole (Robel et al 19701

The Robe1 pole consists of a 2 meter (m) x 2.54 centimeter (cm) PVC pipe divided into four decimeter (dm) increments and a 1m "sighting" pole connected to the large pole by a 4 m cord. One person holds the large pole vertical and plumb, while another person stretches the 4 m cord tight and level between poles and sights over the top of the small pole towards the base of the 2 m vertical pole. Visual Obstruction Reading (VOR) is obtained by noting the point of total visual obscurity rounded to the nearest .5 dm. Measurements were taken at 30 m intervals along the transect route from 4 directions (two parallel and two perpendicular to the transect azimuth). This data was averaged to give a mean VOR for that specific point. This method and the microplot readings were taken at the same point along the transect.

Winter Forage Cover Pole (Sharp-tailed Grouse)

The sharp-tailed grouse cover pole is constructed from a 4 m x 2.54 cm section of PVC pipe divided into 60 cm increments. The cover pole is designed to quantify the amount of winter forage available to sharp-tailed grouse by estimating percent obstruction from stems of preferred forage species (aspen, waterbirch, rose, snowberry, etc.) at each increment level. The pole is held plumb and vertical. Percent obscurity is estimated for each increment from four directions (two parallel and two perpendicular to the transect azimuth) from a distance of 5 m at each transect point. The distance between transect measurement points is predicated on the length of the transect. A mean value is calculated for each increment. Total winter forage values for each transect are determined mathematically by combining the mean scores from each transect point as discussed within the draft sharp-tailed grouse model (Appendix C). Transects should be conducted in early spring prior to green-up.

Hiding Cover Pole (White-tailed Deer)

The white-tailed deer hiding cover pole consists of a 1.5 m x 2.54 cm PVC pipe divided into three .5 m increments (Griffith and Youtie, 1988). The cover pole is designed to measure horizontal hiding cover provided by vegetation and landscape features. Measurements are taken at 30 m intervals

along the transect line. The pole is held vertical and plumb while an observer estimates percent obscurity for each .5 m pole increment from four directions (two parallel and two perpendicular to the transect azimuth) from a distance of 15 m. Both vegetation and landscape features (rocks, depressions, stumps etc.) provide hiding cover and are assumed to be of equal value. Each .5 m increment is equal to 33.3% of the total value (100%). Percent obscurity for each point is determined by estimating the percent obscurity for each of the three .5 m increments from four directions and then averaging the values for each increment. The cover value for each transect point is equal to the mean of the three .5 m increments. Percent obscurity for the transect is determined by calculating a mean from the values obtained at each point along the transect.

Micro Plot square (Daubenmire 1959)

This is a .1m^2 metal rectangular frame delineated into smaller rectangles and is used to estimate the percentage of vegetative cover within the frame's boundary. Legs were attached at the four comers to raise the frame 10 cm above the ground. Vegetation cover percentages were taken at points 4 m from the transect line perpendicular to the transect azimuth. The microplot square was placed to the left of the line at every sample point. Measurements were then averaged to provide mean percent grass and forb ground cover.

Running Mean

This sampling procedure utilizes an averaging method to avoid over or under sampling a cover type. A "decision tree" (Appendix E) was developed to assist in determining when enough samples were taken during a particular transect. This procedure was utilized in conjunction with the Robe1 pole and microplot square..

Line Intercept (Canfield 1941)

This method is used to measure the basal area or canopy cover of herbs, shrubs, or trees. A meter tape is stretched out in a random direction to form a straight line. Data collectors move along the tape and project plant canopies (or basal areas) vertically to the tape and record the length of intercept and the plant species involved. If individual plants overlap, each is measured separately. After completing the transect, the tape is rewound and another compass heading is taken for the next transect. The line intercept method is most appropriate in conditions in which it is easy to lay out straight lines. This method gives quite accurate results.

Clinometer

Clinometers are used to determine tree height and percent slope.

Densiometer

Densiometers are used to estimate tree canopy closure. The instrument consists of a 2 inch diameter concave or convex mirror, mounted in a wood case, engraved with 24 - 1/4 inch squares.

Ocular Estimation

Group consensus by qualified biologists regarding a habitat variable, cover type, or area.

Model Assumptions

A wide variety of birds, mammals, amphibians, and reptiles, including several threatened and sensitive wildlife species, inhabit and/or utilize project lands on a seasonal basis. Wildlife distribution, diversity, and abundance is largely dependent upon the availability of suitable habitat. HEP model variables are used to estimate the quality as well as quantity of specific habitat attributes such as shrub canopy closure, tree height, and Visual Obstruction Readings (VOR).

In addition to measuring specific habitat variables and following model guidelines/formats, the following assumptions were made in order to clarify implied model attributes and/or modify the models to fit conditions found at project sites. No additional assumptions were considered regarding the Lewis' and downy woodpecker models.

Yellow Warbler (Dendroica petechia):

1. The reproductive value for this species is equal to the HSI value (all life requisites will be met if reproduction habitat variables are present and of sufficient quantity/quality).

Mink (Mustela vison):

1. The model could be used to evaluate riparian habitat quality regardless of the presence/absence of mink at the site (the model is used to measure habitat variables, not the presence/absence of mink).

Pygmy Rabbit (Brachylagus idahoensis):

1. Suitable habitat and soil conditions are present and/or the potential for development of suitable habitat exists on the study areas (pygmy rabbits require mature and seedling/young sagebrush plants for food/cover as well as loose, stone free soils in which to excavate burrows).
2. Active/abandoned agricultural fields, with suitable soils, could be enhanced to support pygmy rabbits (sagebrush and native-like vegetation could be planted on these areas to provide food/cover).

Canada Goose (Branta canadensis):

1. Open water is not a limiting factor in this area (the Columbia River is adjacent to the study site(s)).

Mule **Deer** (Odocoileus hemionus):

1. Water is not a limiting factor on winter range (water is present in browse and available from streams, rivers etc.).
2. The area is large enough to support resident and/or migratory populations (mule deer were present, or utilize the site on a seasonal basis).
3. Winter food values can be estimated by measuring shrub browse diversity and quantity (winter food is comprised primarily of shrub browse).
4. Grass and forbs do not contribute significantly towards a mule deer's winter dietary needs (palatable grass and forbs are not present/available in sufficient quantities during winter).
5. Winter wheat/alfalfa crop values are additive. Optimum HSI can be obtained without these crops (agricultural crops are not required to sustain mule deer'populations during winter. Nutritional needs can be provided exclusively by shrub browse).
6. Deep snow conditions reduce the value calculated for food (deep snow impedes mule deer movement and covers forage).

White-tailed Deer (Odocoileus virginiana):

1. The area has been and/or at present is potential white-tailed deer habitat (the model was developed to measure habitat variables used by white-tailed deer, not the presence/absence of white-tailed deer).
2. Prolonged heavy snow accumulations will lower the overall HSI (deep snow impedes white-tailed deer movement and covers forage).
3. Water is not limiting (water is available in forage, streams, rivers etc.).

Sharp-tailed Grouse (Tympanuchus phasianellus):

1. Habitat at lek sites is not as critical to nesting sharp-tailed grouse as the habitat within 1.25 miles of the lek (sharp-tailed grouse rarely nest on lek sites, because these sites are usually open areas with little cover in which to hide nests. Most nesting activity occurs within 1.25 miles of a lek).
2. Residual nesting vegetation should be measured prior to spring green-up (sharp-tailed grouse initiate nesting prior to spring green-up).
3. Winter forage occurring below 4 m is of greater value than forage at canopy levels > 4 m (understory bud and berry producing shrubs such as snowberry and rose also provide better concealment/winter cover than taller, open aspen stands etc).
4. Standing wheat/stubble fields can be a food source if located adjacent to suitable cover (exposed unharvested wheat and/or grain left on the ground in stubble fields may be used for food if escape/hiding cover is located nearby).
5. Sharp-tailed grouse can fly up to one mile from nesting/brood rearing sites to adequate winter forage without reducing the HSI for distance traveled to winter areas (one mile is not a significant flight distance for sharp-tailed grouse; however, flying over areas with little cover may expose the grouse to increased predation and/or discourage the use of suitable winter habitat).

RESULTS/DISCUSSION

Sharp-tailed Grouse/Mule Deer

Habitat suitability indices for sharp-tailed grouse and mule deer were similar for all sampled areas. Sharp-tailed grouse residual nesting cover was marginal, lacking both vertical and horizontal structure due largely to past and present livestock grazing/farming practices. Native bunchgrasses and forbs within the native-like grassland, shrub-grass, and shrubland cover types (shrub-steppe) have decreased substantially in many areas, while the presence of non-native vegetation such as cheatgrass and knapweed have increased significantly.

Livestock grazing on the Berg Brothers project site (CCT) is currently limiting the amount and quality of residual nesting cover. At present, WDFW does not allow grazing on the Scotch Creek Wildlife Area.

Grasslands (CRP and other areas with introduced grass/forbs species) were marginal. These fields were planted with crested wheatgrass and other grass species that provide little residual nesting cover for sharp-tailed grouse. In addition, the agriculture cover type was rated poor due to crop homogeneity and lack of nesting structure.

Sharp-tailed grouse winter forage habitat was either non-existent or poor on most study areas. Winter forage is primarily found in the riparian shrub cover type and macrophyllous draws. Both the riparian shrub cover type and macrophyllous draws lacked shrub diversity and budding and fruit bearing understory (<4 m). There was also little evidence of shrub/tree regeneration at most sites. In addition, shrubs located on hillsides and ridges were decadent and "hedged" by livestock. Shrubs such as serviceberry and hawthorn were also more prevalent on ridges and slopes at Scotch Creek and the surrounding area prior to 1950 than at the present time (Schroeder, pers. comm. 1995).

Mule deer habitat suitability was poor in the grassland and agriculture cover types and marginal in shrub-grass areas. The best mule deer rating (fair) occurred at Chesaw within the shrubland cover type. Survey results indicated that low shrub diversity and minimum quantities of suitable shrub browse species were the two primary limiting factors for mule deer within the study areas.

Sharp-tailed grouse and mule deer baseline HEP results are summarized in Table 5. Projected HSIs and HUs are listed in Appendix F.

Table 5: **Sharp-tailed** Grouse and Mule Deer Baseline HEP Survey Results

Project Area	COVER TYPE	ACRES	HEP MODEL	BASELINE HSI	BASELINE HUs
Scotch Creek	Grassland	111	Sharp-tailed Grouse	.2	22
			Mule Deer	0	0
	Grassland Native-like	993	Sharp-tailed Grouse	3	298
			Mule Dar	0	0
	Shrubgrass	32.37	Sharp-tailedGrouse	2	647
			Mule Dar	2	647
	Shrubland	1,209	Sharp-tailed Grouse	.3	363
			Mule Dar	A	484
	Emergent Wetland	198	Sharp-tailed Grouse	2	40
			Mule Dar	0	0
	Agriculture	436	Sharp-tailedGrouse	0	0
Chesaw	Grassland	562	Sharp-tailedGrouse	.1	56
			Mule Deer	0	0
	Grassland Native-like	2,729	Sharp-tailed Grouse	.2	546
			Mule Deer	0	0
	Shrubgrass	192	Sharp-tailed Grouse	.1	19
			Mule Dar	2	38
	Shrubland	198	Sharp-tailed Gmuae	2	40
			Mule Deer	.5	99
Tunk	Grassland	82	Sharp-tailed Grouse	.3	25
			Mule Deer	0	0
	Grassland Native-like	87	Sharp-tailed Grouse	3	26
			Mule Deer	0	0
	Shrubgrass	647	Sharp-t&d Grouse	3	194
			Mule Deer	3	194
	Shrubland	1.59	Sharp-tailedGrouse	3	48
			Mule Deer	3	48
Pogue Mountain	Grassland Native-like	5	Sharp-tailed Grouse	3	2
			Mule Deer	0	0
	Shrubgrass	207	Sharp-tailed Grouse	2	41
			Mule Deer	.2	41
	Shrubland	499	Sharp-tailed Grouse	2	100
			Mule Deer	.5	250
	Agriculture	18	Sharp-tailed Grouse	.1	2
Berg Brothers	Grassland	3,108	Sharp-tailed Grouse	.4	1,243
			Mule Deer	.2	715
	Shrubgrass	1,950	Sharp-tailed Grouse	.3	585
			Mule Deer	.3	585
	Riparian Shrub	452	Mule Deer	.6	271
	Agriculture	540	Sharp-tailed Grouse	.2	108

White-tailed Deer/Lewis' Woodpecker

White-tailed deer habitat was in good to excellent condition within the conifer forest and dense conifer forest cover types, but marginal within the mixed forest cover type (less evergreen canopy reduces the amount of snow intercept/thermal cover resulting in a lower HSI). At most sites pruning shrubs taller than five feet would increase the amount of browse and hiding cover available to white-tailed deer. Increasing shrub diversity would also improve the habitat in these areas.

The small amount of white-tailed deer habitat provided by the conifer forest, dense conifer forest, and mixed forest cover types (< 650 total acres for all study areas) and the absence of brushy riparian areas may be the most significant factors limiting white-tailed deer populations on the Scotch Creek Wildlife Area.

Conifer woodlands were evaluated with the Lewis' woodpecker model. The highest rating, fair, occurred at Scotch Creek while all other sites were in poor condition lacking large snags and understory vegetation.

White-tailed deer and Lewis' woodpecker baseline HSIs and HUs are listed in Table 6. Projected HSIs and HUs are described in Appendix F.

Table 6: White-tailed Deer and Lewis' Woodpecker Baseline HEP Survey Results.

PROJECT AREA	COVER TYPE	ACRES	HEP MODEL	BASELINE HSI	BASELINE HUs
Scotch Creek	Conifer Forest	194	White-tailed Deer	.7	136
	Conifer Woodland	261	Lewis' Woodpecker	.5	131
Chesaw	Conifer Forest	125	White-tailed Deer	.5	63
	Dense Conifer Forest	49	White-tailed Deer	.8	39
	Mixed Forest	205	White-tailed Deer	.3	62
Tunk	Conifer Forest	17	White-tailed Deer	.4	7
	Conifer Woodland	21	Lewis' Woodpecker	.1	2
Pogue Mountain	Conifer Forest	181	White-tailed Deer	.9	163
	Dense Conifer Forest	14	White-tailed Deer	.9	13
	Mixed Forest	35	White-tailed Deer	.2	7
	Conifer Woodland	419	Lewis' Woodpecker	.1	42
Berg Brothers	Conifer Woodland	150	Lewis' Woodpecker	.2	30

Yellow Warbler/Mink

Yellow warbler and mink habitat was rated poor to marginal at all study sites due to limited deciduous shrub crown cover, low percent of hydrophytic shrubs within the over-all shrub canopy, and the lack of suitable over-story canopy closure.

The absence of deciduous/hydrophytic shrubs within the riparian shrub cover type was the primary limiting factor for yellow warblers. In the few shrub dominated riparian areas, yellow warbler HSIs were low because hydrophytic shrubs were not present and/or shrub structure was not suitable i.e., shrubs were less than 6 feet tall or greater than 16 feet in height,

Mink habitat lacked diverse understory, which supports the minks prey base, as well as overstory hiding cover at all study areas. In addition, the absence of year round surface water on the Berg Brothers site further reduced the HSI on that project area.

HEP baseline HSIs and HUs are depicted in Table 7. Projected HSIs and HUs are described in Appendix F.

Table 7: Yellow Warbler and Mink Baseline HEP Survey Results.

PROJECT AREA	COVERTYPE	ACRES	HEP MODEL	BASELINE HSI	BASELINE HUs
Scotch Creek	Riparian Shrub	48	Yellow Warbler	0	0
Chesaw	Riparian shrub	25	Yellow Warbler	.4	10
	Emergent Wetland	80	Mink	.2	16
Tunk	Riparian shrub	14	Yellow Warbler	.3	4
Pogue Mountain	Riparian shrub	11	Yellow Warbler	.2	2
	Emergent Wetland	21	Mink	.1	2
Berg Brothers	Deciduous Woodland	32	YellowWarbler	.4	13
	Riparian	41	Mink	.2	8

Downy Woodpecker/Canada Goose

Downy woodpecker habitat i.e., riparian forest and forest wetland cover types, was rated excellent in all study areas except the Tunk Valley site which was poor due to the absence of large snags. A recent insect infestation in the Chesaw area killed many mature aspen stands, thus, creating optimum downy woodpecker habitat. As these snags deteriorate and fall, the HSI for downy woodpeckers will decrease unless replacement snags are created.

Canada goose habitat within the exposed/shoreline cover type, was poor due to the lack of suitable nesting. habitat and brood pastures. HEP baseline HSIs and HUs for downy woodpeckers and Canada geese are listed in Table 8. Projected HSIs and HUs are described in Appendix F.

Table 8: Downy Woodpecker and Canada Goose Baseline HEP Survey Results.

PROJECT AREA	COVER TYPE	ACRES	HEP MODEL	BASELINE HSI	BASELINE HUs
Scotch Creek	Riparian Forest	15	Downy Woodpecker	1.0	15
	Forested Wetland	88	Downy Woodpecker	1.0	88
Chesaw	Riparian Forest	104	Downy Woodpecker	.8	83
	Forested Wetland	14	Downy Woodpecker	1.0	14
Tunk	Riparian Forest	60	Downy Woodpecker	.1	6
Berg Brothers	Exposed/Shoreline	20	Canada Goose	.2	4

Pygmy Rabbit, Mule Deer, and Sage Grouse (Douglas County Pygmy Rabbit Project)

Douglas County project sites were evaluated with the pygmy rabbit, mule deer, and sage grouse models. These sites are comprised of the shrubland and agriculture cover types.

Pygmy rabbit shrubland habitat was in fair condition at Sagebrush Flat and marginal at the Dormaier site. Excessive shrub canopy closure (>35%) on abandoned fields lowered the HSI rating at the Dormaier project site.

Mule deer received the highest HSI, fair, at the Dormaier project site and was considered poor on the remaining areas as a result of low shrub diversity and the absence of winter thermal cover. Likewise, the HSI was poor for all three species on the agriculture cover type.

Property encompassed by the Sagebrush Flat CRMP and the Dormaier site were rated as fair sage grouse habitat within the shrubland cover type; however, WDFW's parcel located at Sagebrush Flat was evaluated as marginal sage grouse habitat due to lower sagebrush canopy closure

HEP baseline HSIs and HUs for the Douglas County projects are listed in Table 9. Projected HSIs and HUs are described in Appendix F.

Table 9: Douglas County Pygmy Rabbit Project Baseline HEP Survey Results.

PROJECT AREA	COVER TYPE	ACRES	HEP MODEL	BASELINE HSI	BASELINE HUs
WDFW Property	Shrubland	140	Pygmy Rabbit	.6	84
			Mule Deer	.1	14
			Sage Grouse	.4	56
	Agriculture	100	Pygmy Rabbit	0	0
			Mule Deer	0	0
			Sage Grouse	0	0
Sagebrush Flat CRMP	Shrubland	3,500	Pygmy Rabbit	.6	2,100
			Mule Deer	.2	700
			Sage Grouse	.5	1,750
Dormaier	Shrubland	320	Pygmy Rabbit	.4	128
			Mule Deer	.5	160
			Sage Grouse	.5	160

SUMMARY

Shrub-steppe habitat within the study area is in fair condition at best while riparian cover types need protection from further degradation as well as extensive enhancement measures to improve conditions for wildlife. Forest cover types ranged from marginal to excellent. Woodlands were rated as poor or fair. Likewise, agriculture and exposed/shoreline cover types were considered poor and marginal respectively.

The quality of sharp-tailed grouse habitat is primarily limited by the poor condition of riparian habitat types and the absence of macrophyllous draws which provide winter forage. Improving nesting/brood rearing habitat on rangelands is possible but may be limited by soil parameters and topographic features in some areas. Replanting CRP fields and abandoned croplands to native-like vegetation could significantly improve the nesting potential on those sites.

Mule deer and white-tailed deer habitat could be enhanced by pruning existing shrubs and increasing shrub diversity. Planting shrubs and controlled burns are two techniques that could be used to improve shrub browse diversity.

Sharp-tailed grouse, mink, yellow warbler, and to a lesser extent downy woodpecker habitat could be improved significantly by protecting/enhancing riparian cover types. Enhancement of riparian zones should be a top priority of project managers. Improvements to Canada goose habitat are limited by physical barriers such as sandy cliffs along the Columbia river.

Increasing shrub canopy closure and the number of large snags would improve Lewis' woodpecker habitat. Snags should be protected and/or created when feasible at densities not less than one snag per acre with a minimum DBH of 12".

Pygmy rabbit and sage grouse habitat should be protected from over grazing, wild fires, development, and further habitat fragmentation/degradation. Potential enhancements include reducing shrub canopy closure on selected areas, increasing native grass and forbs, and eliminating non-native vegetation.

GLOSSARY

DEFINITIONS:

Age Classes: A grouping of trees according to age, usually in broad categories, used for growth projections.

Agricultural Cover: Areas dominated with vegetation which has been planted and/or is treated with annual tillage, a modified conservation tillage, or other land management practice.

Breeding Site: The immediate area and features associated with producing and rearing young (e.g. nest tree, den, lek, etc.).

Breeding Area: The area necessary to support reproduction and rearing of young; includes breeding sites and may include a disturbance buffer.

Browse: That part of the current leaf and twig growth of shrubs, woody vines, and trees available for animal consumption.

Canopy Cover: The portion of ground, usually expressed as a percentage, that is occupied by the perpendicular projection down on to it of the aerial parts of the vegetation or the species under consideration. The additive cover of multiple strata or species may exceed 100%.

Cavity: A hollow excavated in trees usually by birds or other natural phenomena; used for roosting and nest sites by many mammals and birds.

Closed Tree Canopy: A class of vegetation that is dominated by trees with interlocking crowns (forming 60 - 100% crown cover).

Cover Type: An area of land or water with similar physical, chemical, and biological characteristics that meet a specified standard of homogeneity.

CRP: Conservation Reserve Program i.e., agricultural land taken out of production and planted to grasses, forbs, and legumes. Farmers enter into a 10 year contract with the US Department of Agriculture and are paid to stop producing crops. The enrolled acreage cannot be farmed, grazed or burned until the end of the contract period.

DBH: Diameter at breast height (4.5 feet).

Deciduous Cover: Vegetation classes where 75% or more of the vegetation is made up of tree or shrub species that shed foliage in response to an unfavorable season. There is usually one “leaf - off’ season per year.

Diversity: The distribution and abundance of different plant and animal communities within a given area.

Erosion: Detachment and movement of soil or rock fragments by wind, water, ice, and gravity.

Evaluation Species: Species chosen to represent general habitat types and habitat requirements of wildlife using those habitats.

Evergreen Cover: Trees or shrubs which maintain leaves all year (conifers, sagebrush, etc.).

Forage: The edible vegetation produced seasonally or annually in a given area that is consumed by wildlife and livestock.

Foraging Area: Feeding areas that are regularly used by individuals or groups of animals.

Guild: A group of wildlife species that share common habitat requirements/ecological characteristics.

Habitat: The natural environment of a plant or animal.

Habitat Area: A sub unit of a Wildlife Area i.e., the Tunk Habitat Area is a sub unit of the Scotch Creek wildlife Area.

Habitat Evaluation Procedure (HEP): Ecological based procedure that describes habitat by a set of measurable habitat variables important to the evaluation species. The value of an area to a given species is the product of the size of the area times the quality of the area for that species or Habitat value = Habitat quantity x Habitat quality.

Habitat Suitability Index (HSI): The numerical value of habitat quality expressed in index form from 0 to 1 .O whereas 0 is the lowest habitat quality measurement and 1 .O is optimum habitat.

Habitat Units (HUs): The HSI x Area = HU, or one HU is equal to one acre of optimum habitat for a given species.

Herbaceous: A class of vegetation dominated by non-woody plants known as herbs (graminoids, forbs and ferns).

Herb: Non-woody vascular plants such as grasses, grass-like plants and forbs.

Historic: Refers to that period of time for which written records exist.

Hydrophyte: A plant which has evolved with adaptations to live in aquatic or very wet habitats, e.g. cattail, water lily, etc.

Lek: An assembly area where sage and sharp-tailed grouse engage in courtship behavior.

Life Requisite: Food, water, cover, reproductive, or special requirements of an evaluation species supplied by its habitat.

Macrophyllous Draws: Ravines/draws containing deciduous shrubs.

Mitigate: To alleviate or make less severe. When habitat damage is unavoidable or has already occurred, it is the action needed to reduce and/or compensate for losses to wildlife and habitat.

Mitigation: Recovering and sustaining lost habitat and species productivity as a result of the construction and operation of the federal and non-federal hydropower system.

Mitigation Credit: Number of HUs gained through land acquisitions, conservation easements, and habitat improvements on mitigation lands.

Monitoring: Periodic evaluation of mitigation lands to assess the effectiveness of mitigation measures. Initial collection of baseline data with routine monitoring of habitat quality and wildlife population trends every five years is proposed.

Noxious Weeds: Undesirable plant species.

Operation and Maintenance (O&M): Activities and expenditures required to maintain project lands/habitat in desired condition. This includes weed control, range and forest management, agricultural practices, etc.

Perennial Stream: A stream that flows year round.

Shrubs: Woody plants that generally exhibit several erect, spreading, or prostrate stems; and have a bushy appearance.

Shrub-steppe: A class of vegetation defined by areas dominated by shrubs generally greater than 0.5 m tall with individuals or clumps not touching to interlocking. Shrub canopy cover is generally greater than 5% while tree cover is less than 20%.

Snag Habitat: Areas that are characterized by the presence of standing dead or dying trees that are used by various wildlife species to satisfy one or more life requisites.

Tree: Woody plants that generally have a single stem, grow larger than 16 feet tall and have more or less definite crowns.

Variables: Factors that describe habitat in terms of the needs of the evaluation species.

Vegetation Cover: Vegetation that covers or is visible at or above the land or water surface.

Vegetation Typing: Delineation of plant communities on aerial photographs.

Winter Range: Habitat used by wildlife species during the winter months to provide shelter and food.

Xeric: Habitat having a low or inadequate water supply i.e., dry areas.

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APPENDIX A

HEP TEAM MEMBERS AND AFFILIATION

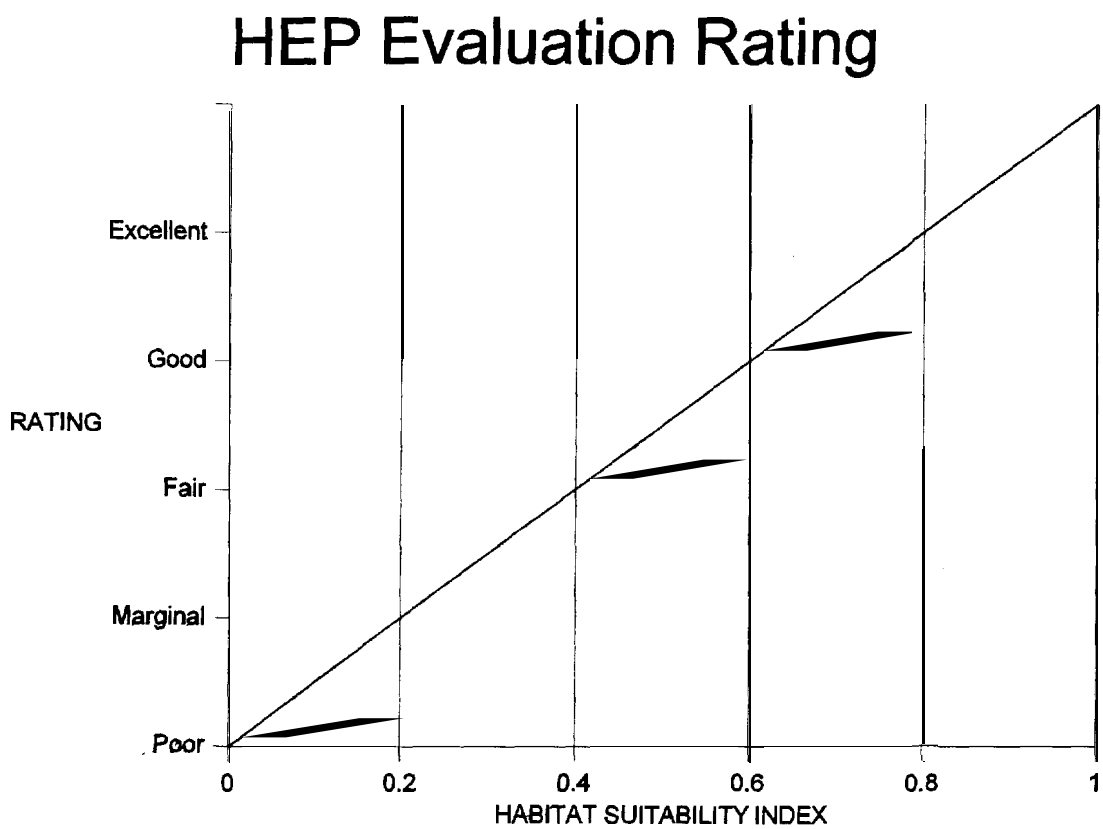
APPENDIX A

HEP TEAM MEMBERS AND AFFILIATION

Paul R. Ashley	Fish Biologist IV	Washington Department of Fish and Wildlife
Matthew Berger	Wildlife Biologist I	Colville Confederated Tribes
Morie Whalen	Wildlife Biologist III	Washington Department of Fish and Wildlife
Elizabeth English	Wildlife Biologist III	Washington Department of Fish and Wildlife
Robert Gillaspy	Range Management Specialist	National Resources Conservation Service
Steven L. Judd	Wildlife Biologist III	Colville Confederated Tribes
Pete Lopushinsky	Wildlife Area Assistant Manager	Washington Department of Fish and Wildlife
Jim Olson	Wildlife Area Manager II	Washington Department of Fish and Wildlife
Ron Fox	Habitat Development Manager	Washington Department of Fish and Wildlife
Don Garrett	Habitat Development Specialist	Washington Department of Fish and Wildlife
Juli Anderson	Wildlife Area Manager I	Washington Department of Fish and Wildlife

APPENDIX B

HEP EVALUATION RATING


HEP Evaluation Rating
Excellent
Good
RATING
Fair
Marginal
Poor
0
0.2
0.4
0.6
0.8
1
HABITAT SUITABILITY INDEX

APPENDIX C

HABITAT EVALUATION PROCEDURE MODELS

SHARP-TAILED GROUSE HEP MODEL DRAFT 03/31/96-mo

Paul R Ashley-W&h. Dept. of Fish and Wildlife (360) 664-878

COVER TYPES: Grassland, Shrub-grass, Shrubland (Shrub-ste

GEOGRAPHIC AREA: Eastern Washington

DEFINITIONS

SHGR: Sharp-tailed Grouse
NBI: Nesting/Brood RearingIndex
WFI: Winter Food Index
Ni: Percent of Area in Cover Type "i" expressed in decimal form
HC: Height Catagory
LHSI: Lower Height Suitability Index
MHSI: Mid Height Suitability Index
UHSI: Upper Height Sultabilii Index
WFHI: Winter Food Height Suitability Index
WFG: Winter Food Index - Grain

HABITAT VARIABLES

Nesting/Brood Rearing (NBI)

SIV1: Mean VOR of residual vegetation
SIV2: Percent slope-general landscape
SIV3: Distance between nesting/winter habit

Winter Food/Cover (WFI)

SIV4: Percent VOR preferred winter forage species
SIV5: Presence/absence of grain crops
SIV6: Distance to roosting, loafing, and hiding cover
SIV7: Suitability **index for winter food value from grain**
SIV6: Percent equivalent area providing winter food/cover

MODEL EQUATIONS

NBI = [SIV1 (SIV2 x Ni x SIV3)1/3] 112
WFI = [(V2 x V8) 1/2 x V4] 1/2 + V7 (NOT TO EXCEED 1 .O)
HSI = (NBI x WFI) 112

Unlike previous models, this model does not focus on Lek sites and is meant to be used to evaluate potential SHGR habit. It is assumed that proposed sites are of sufficient size to support a sharp-tailed grouse population. Application of this model should occur prior to spring "green-up" to evaluate residual vegetation. In addition, a modified Robel pole was used to measure WFHI catagories. It is assumed that winter forage species occurring below four meters have a greater value to shgr than those at upper canopy levels. The availability of grain cover types is addiie and not necessary to achieve optimum winter habitat conditions within the context of thii model.

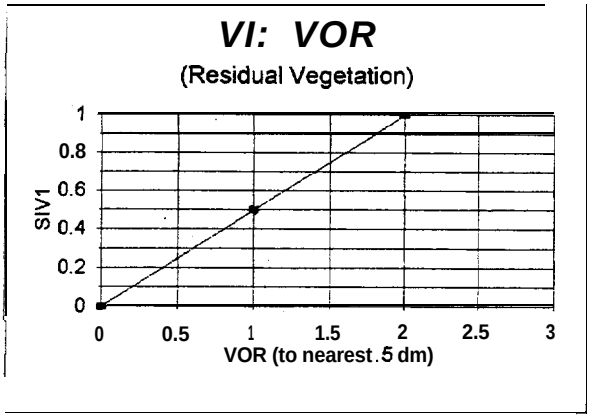
SHARP-TAILED GROUSE HEP MODEL DRAFT

Nesting/Brood Rearing Habitat Suitability Index (NBI)

SIV1: Mean VOR of Residual Vegetation (dm)

Coordinates

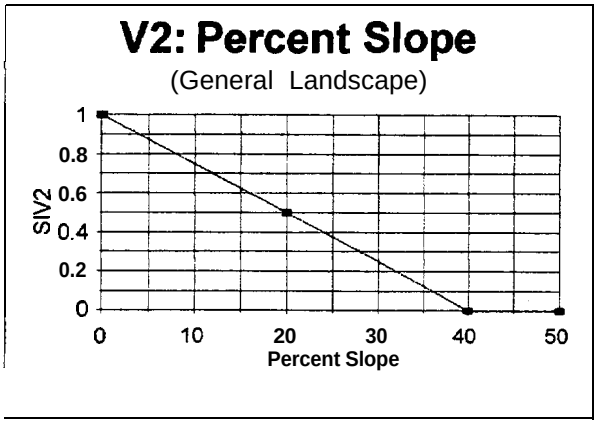
X	0	1	2	3
Y	0	0.5	1	1



SIV2: Percent Slope - General Landscape

Coordinates

X	0	20	40	50
Y	1	0.5	0	0

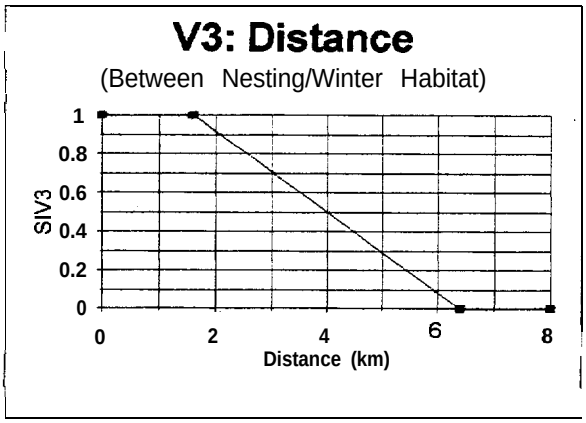


NBI (Continued)

SIV3: Distance Between Nesting/Winter Habitat

Coordinates

X	0	1.6	6.4	8
Y	1	1	0	0



Ni: Percent of Area in Cover Type "i" expressed in decimal form

Suggested Equation for NBI:

[SIV1 (SIV2 x Ni x SIV3)1/3] 112

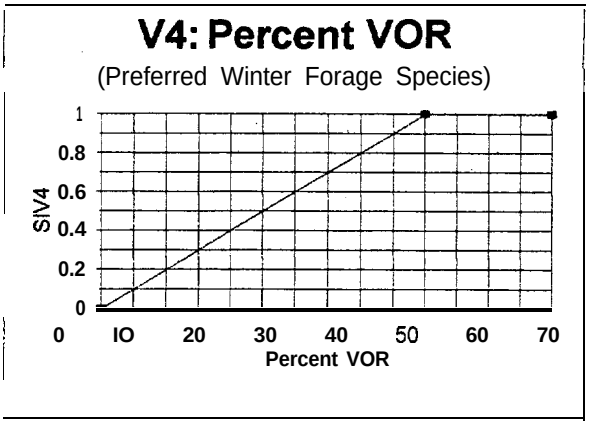
SHARP-TAILED GROUSE HEP MODEL DRAFT

Winter Food/Cover Index (WFI)

SIV4: Percent VOR Preferred Winter Forage Species*

Coordinates

X	0	50	70
Y	0	1	1



"Preferred forage species include but are not limited to: aspen, bittercherry, chokecheny, hawthorn, narrowleaf cottonwood, rose, Russian olive, serviceberry, silver buffaloberry, snowberry, waterbirch, and willow.

DEFINITIONS

HC: Height Catagory (Pole increments = 60cm each i.e., approximately 2 ft.)
LHSI: Lower Height Suitability Index
MHSI: Mid Height Suitability Index
UHSI: Upper Height Suitability Index
WFHI: Winter Food Height Index
WFG: Winter Food Index - Grain

INSTRUCTIONS : Use SIV4 to obtain HSI for HCs 1 through 6.

To determine HSI for HCs 1 through 4, estimate % VOR for each height catagory; determine HSI; calculate mean LHSI (HC1+HC2+HC3+HC4)/4 and multiple mean by 1.3 to obtain a weighted LHSI.

To determine HSI for HCs Sand 6, estimate % VOR for each height catagory; determine HSI; calculate mean MHSI (HC5+HC6)/2 and multiply mean by .5 to obtain a weighted MHSI.

HCs equal to or > than 7 (UHSI) are assigned a value of .1 regardless of VOR. UHSI is additive (see equation below).

WFHI Equation: (LHSI + MHSI)/2 + UHSI

SHARP-TAILED GROUSE HEP MODEL DRAFT

Winter Food Index - Grain (WFG)

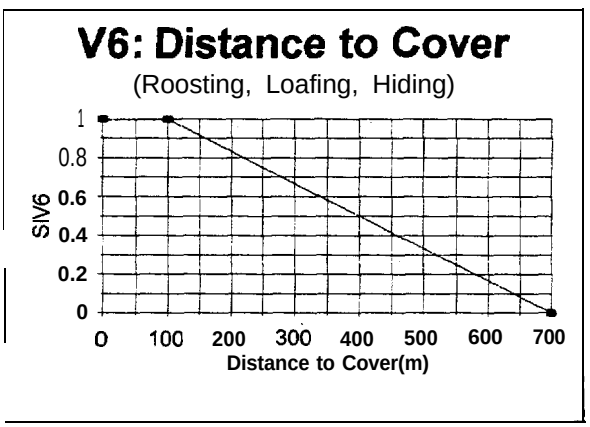
SVI5: Presence/Absence of Grain' Crops

	HSI
Present	0.2
Absent	0

SVI6: Distance to Roosting, Loafing, and Hiding Cover (m)

Coordinates

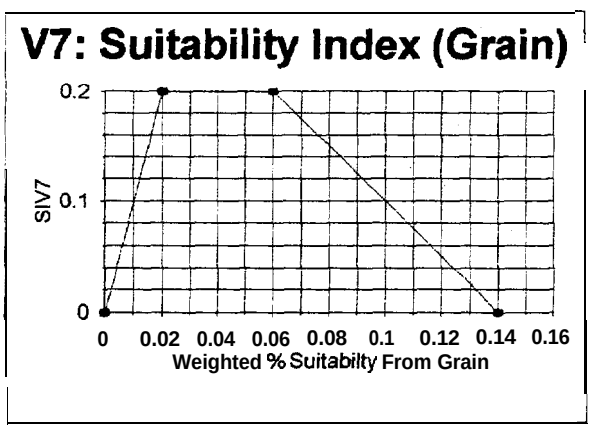
X	0	100	700
Y	1	1	0



SIV7: Suitability Index for Winter Food Value from Grain

Coordinates

X	0	0.02	0.06	0.14
Y	0	0.2	0.2	0



SHARP-TAILED GROUSE HEP MODEL DRAFT

Instructions for Determining HSI for WFG

1. If grain is present (standing or stubble), SVI5 value is .2
   Go to step 3.
2. If grain is absent, SIV5 value is 0. Do not continue.
3. Determine mean distance to cover (SIV6).
4. Determine percent of area in grain crop cover type (Ni) and express in decimal form.
5. Multiply SVI5 x SVI6 x Ni to obtain weighted SI.
6. Compare product from step 5 to SIV7 graph to determine HSI.
7. Round off to nearest tenth (0, .1, .2).

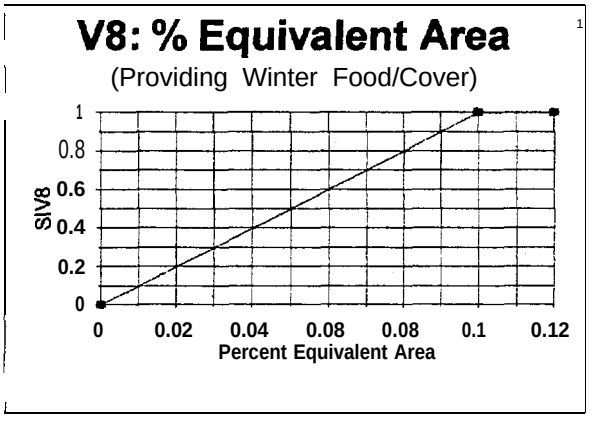
WFG Assumptions:

1. WFG is additive to overall winter food value and does not exceed .2
2. Ten to thirty percent of area in grain cover type is optimum.
3. If more than 70 percent of the area is in grain, HSI is 0.
4. Value of grain cover type is dependent upon distance to cover.
5. Slope is not limiting in grain cover type.
6. Snow depth/conditions may render grain cover type useless.

SIV8: Percent Equivalent Area Providing Winter Food/Cover.

Coordinates

X	0	0.1	0.12
Y	0	1	1



WFI = [(V2 x V8) 1/2 x V4] 1/2 + V7*

* Not to exceed 1 .O

MODEL EQUATION: (NBI x WFI) 1/2

SHARPTAILED GROUSE HEP MODEL DRAFT

SUGGESTED MEASUREMENT TECHNIQUES

SIV1: Mean VOR of residual vegetation
Robel Pole

SIV2: Percent slope-general landscape
Clinometer/Topo Map

SIV3: Distance between nesting/winter habitat
Arial Photo/GIS - Topo maps

Winter Food/Cover (WFI)

SIV4: Percent VOR preferred winter forage species
Modified Robel Pole

SIV5: Presence/absence of grain crops
Arial Photo/GIS - Topo maps

SIV6: Distance to roosting, loafing, and hiding cover
Arial Photo/GIS - Topo maps

SIV7: Suitability index for winter food value from grain

SIV8: Percent equivalent area providing winter food/cover

MULE DEER HEP MODEL AUTHOR DRAFT 18 JUN 96-modified 01/97

WINTER HABITAT

PAUL R ASHLEY - WDFW - COLUMBIA RIVER WILDLIFE MITIGATION TEAN

COVER TYPE(S): Grassland, Shrub-grass, Shrubland (Shrub-steppe)

DEFINITIONS:

WFI: Winter Food Index

WCI: Winter Cover Index

ASSUMPTIONS:

It is assumed that the availability of open water is not a limiting factor on mule deer winter range. It is also assumed that average snowfall data is available for the area under evaluation and that the influence of snow conditions can be directly related to the value calculated for food. It is further assumed that the food value can be estimated by measuring the standing crop of vegetation. An additional assumption is that the study area is of sufficient size to support a resident and/or migratory winter mule deer population.

This model is designed for shrub-steppe habitat, but may also be adequate to assess other cover types such as ponderosa pine savanah etc.

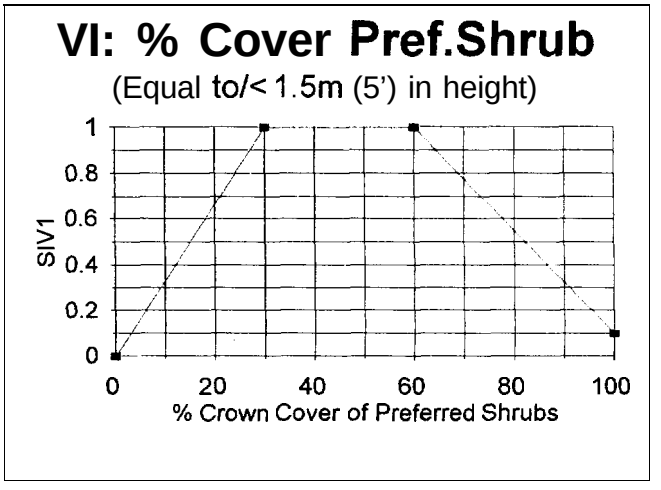
MEASUREMENT TECHNIQUES
SIV1: Line Intercept (graduated rod, tape measure, micro plot)
SIV2: Line Intercept (graduated rod)
SIV3: Direct Count
SIV4: Arial Photo, Maps
SIV5: Line Intercept (graduated rod, tape measure)
SIV6: Topo Maps, Clinometer, Direct Observation
SIV7: Road Density
SIV8: Arial Photo, Topo Map, Direct Observation

DRAFT MULE DEER WINTER HABITAT HEP MODEL

VI : Percent Crown Cover of Preferred Shrubs Equal to or < 1.5m (5') in height (not including small conifers).

Coordinates

X	0	30	60	100
Y	0	1	1	0.1

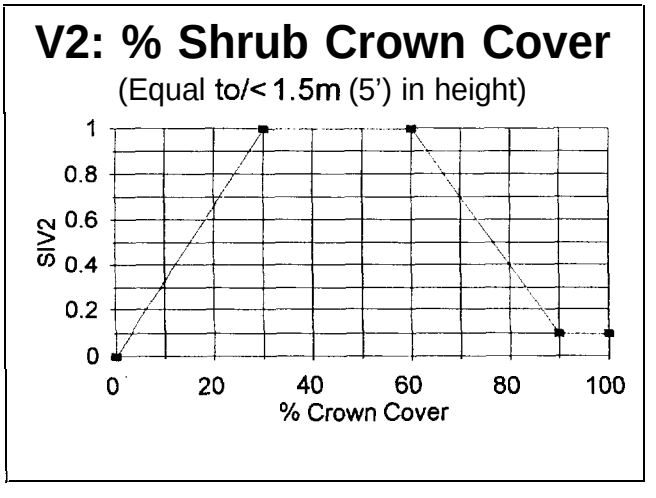


Preferred Shrubs include but are not limited to: Big Sagebrush, Willow, Serviceberry, Snowberry, Choke Cherry, Rose spp. Water Birch, Red Osier Dogwood, Nine Bark, Aspen, Alder, Squaw Currant, Bitterbrush, Ceanothus.

V2: Percent Crown Cover Equal to or < 1.5m (5') in Height.

Coordinates

X	0	30	60	90	'100
Y	0	1	1	0.1	0.1



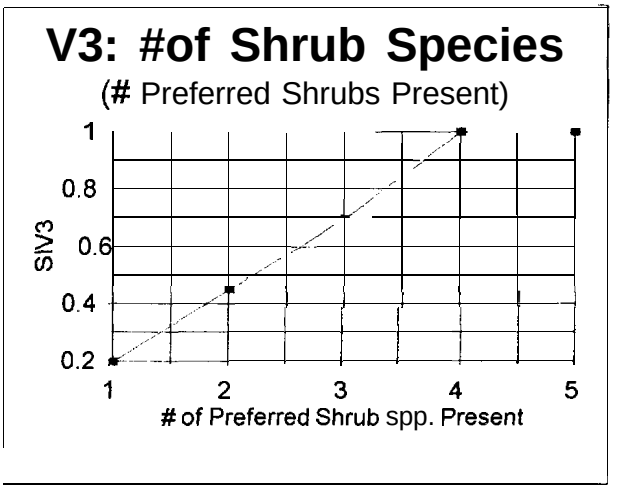
DRAFT MULE DEER WINTER HABITAT HEP MODEL

WINTER HABITAT

V3: Number of Preferred Shrub Species

Coodinates

X	1	2	3	4
Y	0.2	0.45	0.7	1

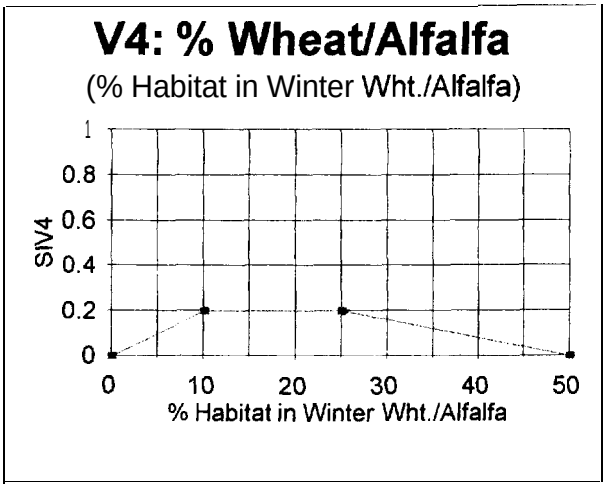


WINTER HABITAT

V4: Percent of Available Habitat in Winter Wheat/Alfalfa

Coordinates

X	0	10	25	**50**
Y	0	0.2	0.2	**0**



WINTER FOOD INDEX (WFI) EQUATION:

WFI = [VI (V2 x V3)1/2] 1/2 + V4*

. The percent of available mule deer habitat in winter wheat/alfalfa (SIV5) may serve to slightly increase the SI value; however, the structure of the WFI equation permits an optimum value to be obtained in the absence of winter wheat and alfalfa. SIV5 is additive. If the WFI exceeds 1.0, round value down to 1.0.

Percent crown cover of preferred shrubs (SIV1) has the greatest influence in determing the winter food value. The values calculated for percent shrub crown cover (SVI2), number of shrub species of preferred shrubs present (SIV3) and percent herbaceous cover (SIV4) are assumed to carry equal weight.

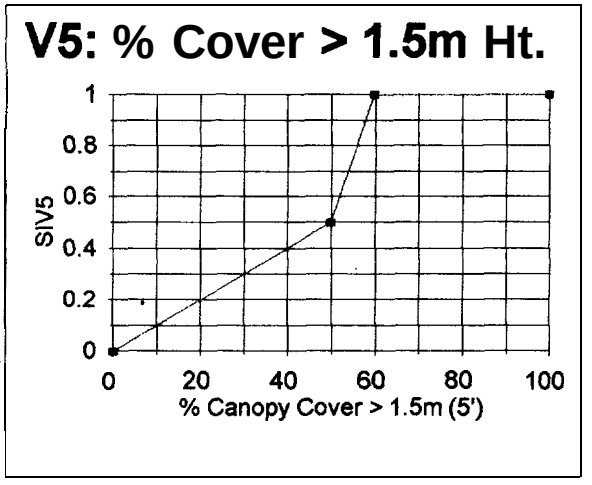
If the average snow depth exceeds 60.9 cm (24 inches) for extended periods of time, the life requisite value for food should equal zero. If persistent snow cover ranges from 30.4 cm (12 inches) to 60.9 cm (24 inches), the life requisite value should be adjusted downward.

DRAFT MULE DEER WINTER HABITAT HEP MODEL

V5: Percent Canopy Cover of Evergreen Woody Vegetation greater than 1.5m (5') in height.

Coordinates

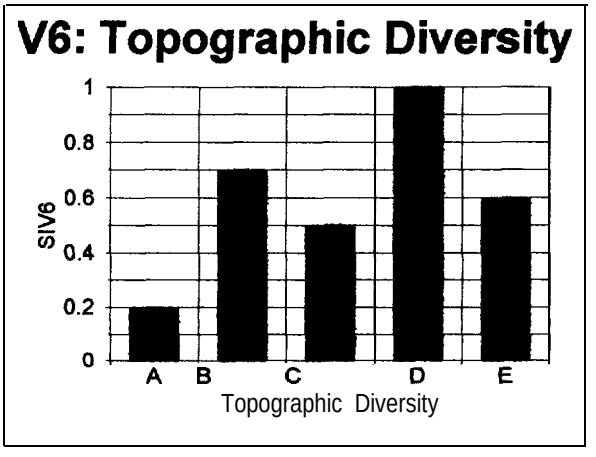
X	0	50	60	100
Y	0	0.5	1	1



V6: Topographic Diversity (Consider Entire Project Area)

Coordinates

X	A	B	C	D	E
Y	0.2	0.7	0.5	1	0.6



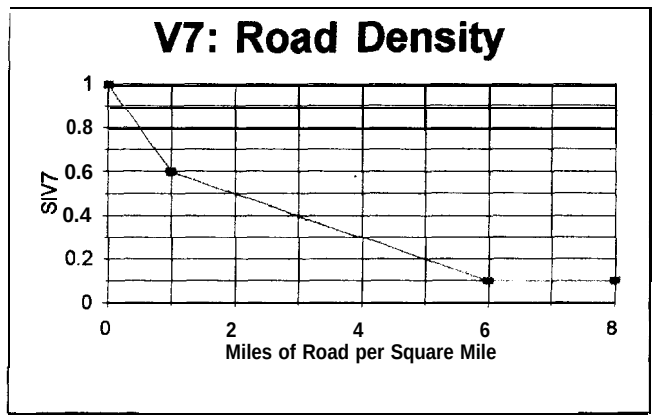
A) Level terrain (0 - 5% slope), flat or nearly so - little to no physical diversity (.2).
B) Level terrain (0 - 5% slope), area broken by drainages (.7)
C) Rolling terrain (5 - 25% slope) (.5).
D) Broken terrain (5 - 25% slope) ridges, rims and/or drainages present (1).
E) Mountainous (> 25% slope) (.6).

DRAFT MULE DEER WINTER HABITAT HEP MODEL

V7: Road Density (Roads open for public use)

Coordinates

X	0	1	6	8
Y	1	0.6	0.1	0.1



WINTER COVER INDEX (WCI) EQUATION:

WCI = (V5 + V6)/2 x V7

V8: Aspect

	Compass Azimuth*	General Direction	Suitability Index
A)	300 - 120	NW to SE	0.1
B)	299 - 241	NW to SW	0.3
C)	240 - 121	SW, S, SE	1

* Must compensate for local declination

MULE DEER WINTER HABITAT HSI EQUATION:
HSI = [(WFI x SIV8 x WCI)] 1/3

PYGMY RABBIT HSI MODEL AUTHOR DRAFT 03/27/96

Paul R Ashley - Washington Department of Fish and Wildlife - (360) 6648782

COVER TYPE(s): Grassland, Shrub-grass, Shrubland (shrub-steppe) Agriculture*

GEOGRAPHIC AREA: Eastern Washington (Columbia Plateau)

DEFINITIONS
PYGR Pygmy Rabbit(s)
Threshold Variables (TV): Variables of such magnitude that the absence of a single TV will disqualify a potential site as PYGR habitat.
HSI 1: Soil/Topographic Variables.
HSI 2: Cover Variables
HSI 3: Food Variables
Potential PYGR habitat: Heterogeneous habitat types such as "Biscuit and Swales" whereas the entire project site may not be suitable PYGR habitat.

THRESHOLD VARIABLES
TV 1: Is the soil texture silty/sandy loam?
TV 2: Is the soil depth equal to or >60cm (24")
TV 3 : Is big sagebrush (Artemesia tridentata) present or does potential to establish big sagebrush exist?
TV 4: Is the proposed site a minimum of 65ha (160) acres) of potential pygr habitat?
TV 5: Is there a minimum of 25ha (60 acres) of suitable contiguous habitat within the proposed Site (TV 4)?

HABITAT VARIABLES
soil/Topographic (HSI 1)
V 1: Soil Depth
V 2: Percent Slope (General Area)
V 3: Presence/Absence of Micro Relief (Drainages)
cover (HSI 2)
V 4: Presence/Absence of Potential Burrow Site Patches
V 5: Percent Crown Cover of Big Sagebrush (Artemesia tridentata)
V 6: Mean Height of Sagebrush
V 7: Visual Obstruction Reading (VOR)
Food (HSI 3)
V 8: Big Sagebrush Age Class
V 9: Percent of Ground Cover Comprised of Perennial (native) Grass and Forbs
V10: Percent of Ground Cover Comprised of Exotic Annuals (cheatgrass etc.)

SUGGESTED MODEL HSI EQUATION: (HSI 1 x HSI 2 x HSI 3) 1/3
* Can be used to evaluate habitat types which may be developed as and/or allowed to return to shrub-steppe habitat.

PYGMY RABBIT HSI MODEL DRAFT 03/27/96

THRESHOLD VARIABLES (TV)

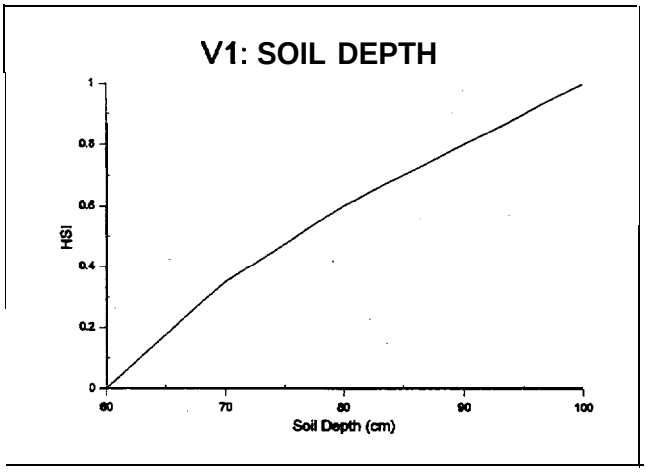
TV 1: Is the soil texture silty/sandy loam?	YES	NO
TV 2: Is the soil depth equal to or >60cm (24")?	YES	NO
TV 3: Is big sagebrush present or can it be established?	YES	NO
TV 4: Is the proposed site equal to or >65ha (160 acres)?	YES	NO
TV 5: Is there at least 25ha (60 acres) of contiguous suitable habitat within the proposed site (TV 4)?	YES	NO

INSTRUCTIONS:

Circle "Yes or NO" as appropriate. If "Yes", move to next TV. If "No", stop - site not suitable for pygmy rabbits. IMPORTANT: A "No" response to any TV will disqualify a site for consideration as pygr habitat. If all responses are "Yes", go to variables and determine Habitat Suitable Index (HSI) for pygmy rabbits.

HSI 1: Soil/topographic variables

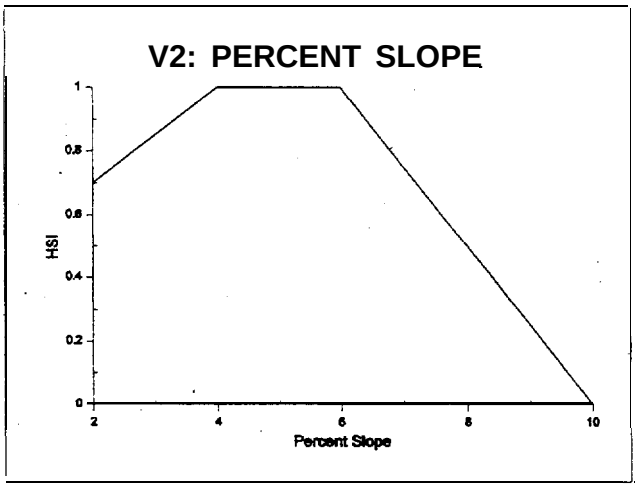
V1: SOIL DEPTH (cm)



Coordinates

X	Y
60	**0**
75	.5
100	1

V2: SLOPE



Coordinates

x	Y
0	.7
4	1
6	1
8	.5
10	0

V3: Presence/Absence of Micro Relief'

Present: 1 .O
Absent: .1

HSI 1 Equation:

HSI 1 = [V1(V2xV3)½]½

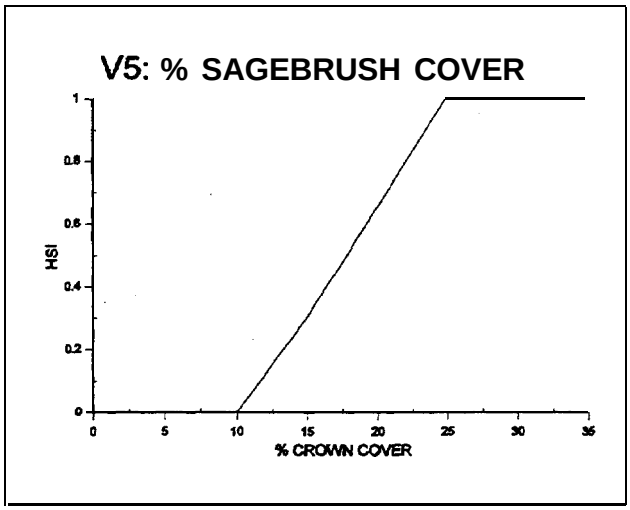
[1] Comprised of sandy/silt loam soils; micro slopes less than 45%, drainages <6' deep.

HSI 2: Cover variables

V4: PRESENCE/ABSENCE OF POTENTIAL BURROW SITE PATCHES [2]

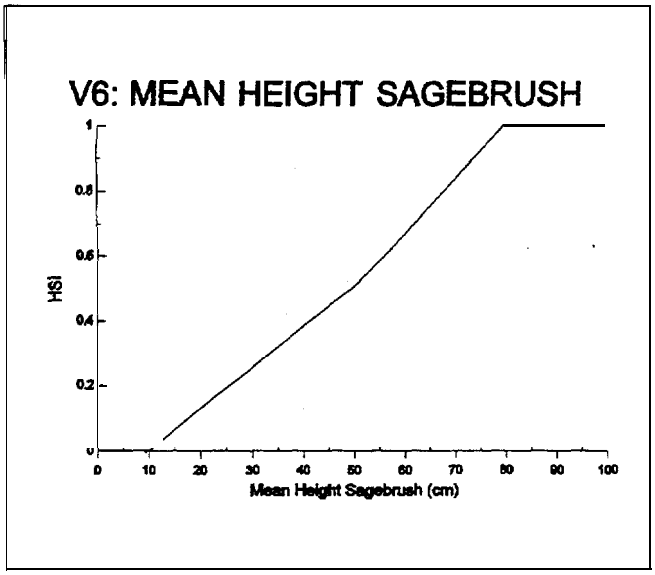
Present: 1.0
Absent: .1

V5: PERCENT CROWN COVER OF BIG SAGEBRUSH - GENERAL LANDSCAPE



Coordinates	
x	Y
10	0
25	1
35	1

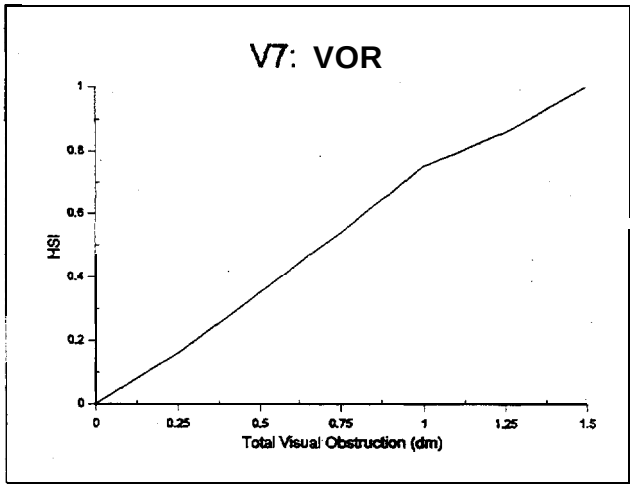
V6: MEAN HEIGHT OF SAGEBRUSH **(cm)**



Coordinates	
x	Y
IO	0
50	.5
80	1

[2]Potential burrow site patches are micro sites interspersed within the general landscape; comprised of sagebrush stands that are of a greater mean canopy cover than the general area (>25% mean crown cover) and are ≥ 15m in diameter.

V7: VISUAL OBSTRUCTION READING (VOR)



Coordinates

x	Y
.12	**0**
1	.75
1.5	1

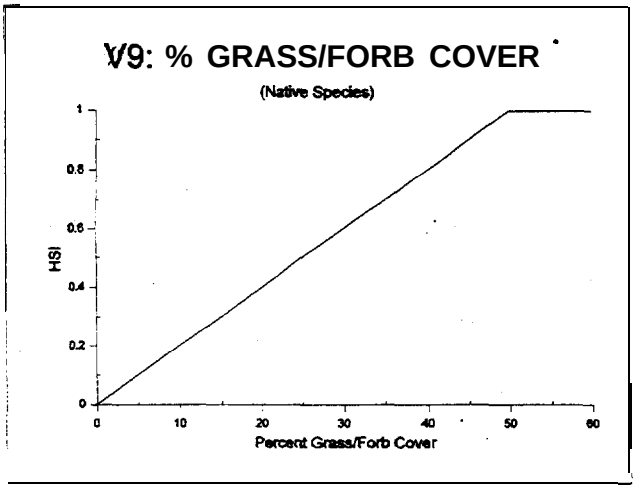
HSI 2 Equation: HSI 2 = (V4xV5xV6xV7)¼

HSI 3: Food Variables

V8: BIG SAGEBRUSH AGE CLASS

CLASS	HSI
Mature[3]	0.5
Almost Mature	0.2
Seedling/Young	0.3
Decadent	0.0
Potential Total	1.0

V9: PERCENT GROUND COVER PERENNIAL NATIVE GRASS AND FORBS

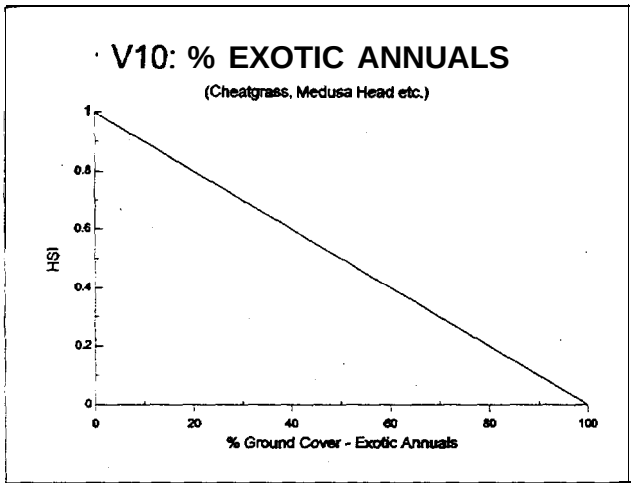


Coordinates

x	Y
0	0
25	.5
50	1

[3] Minimum Class required to support pygmy rabbits. Additional classes are additive (see shrub type sheet).

V10: PERCENT OF GROUND COVER COMPRISED OF EXOTIC ANNUALS



Coordinates	
x	Y
0	1
50	.5
100	0

HSI 3 Equation:

HSI 3 = (V8xV9)½ x V10

MODEL EQUATION: (HSI 1 x HSI 2 x HSI 3)⅓

SHRUB TYPE

1
Seedling

HSI: .3

2
Young

.3

3
Almost Mature

.2

4'
Mature

.5

4
Mature

.5

5

HSI: 0

6

Decadent

7

YELLOW WARBLER BASELINE HEP ANALYSIS 1996

YELLOW WARBLER BREEDING HSI _____ HABITAT UNITS _____

LOCATION: _____ DATE _____

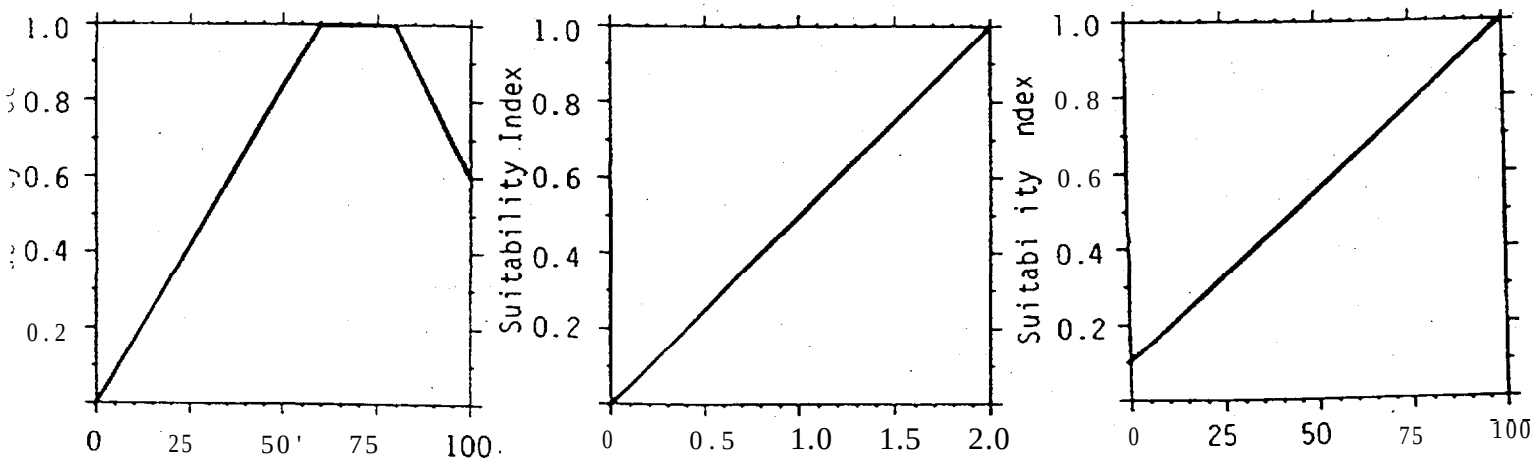
HEP TEAM: P. Ashley, M. Berger, M. Whalen, _____

HSI for YELLOW WARBLER is equal to the calculated value for reproduction.

SIV1. Percent deciduous shrub crown cover {the % of ground shaded by vertical projection of the canopies of woody vegetation < 5 m (16.5 ft) in height}. Suggested sampling technique is line intercept.

SIV2. Average height of deciduous shrub canopy (the average height from the ground to the top of those shrubs that comprise the uppermost shrub canopy). Suggested sampling technique graduated rod.

SIV7. Percent of deciduous shrub canopy comprised of hydrophytic shrubs (the relative percent of the amount of hydrophytic shrubs compared to all shrubs, based on canopy cover). Suggested sampling technique is line intercept.



V_1 Percent deciduous shrub crown cover.

V_2 Average height of deciduous shrub canopy. (m)

V_3 Percent of deciduous shrub canopy comprised of hydrophytic shrubs.

Reproduction Equation = $(Vi \times V2 \times V3)1/2^3$ power.

Schroeder, R.L. 1982. Habitat suitability index models: yellow warbler. U.S. Dept. Int.,Fish Wildl. Serv. FWS/OBS-82/10.27 7 pp.

LEWIS' WOODPECKER BASELINE HEP ANALYSIS 1996

LEWIS' WOODPECKER BREEDING HSI _____ HABITAT UNITS _____

LOCATION: _____ DATE _____

HEP TEAM: P. Ashley, M. Berger, M. Whalen, _____

HSI for LEWIS' WOODPECKER is equal to the lowest value calculated for reproduction or summer food.

Summer Food

SIV1. Percent tree canopy {the % of ground shaded by vertical projection of the canopies of woody vegetation > 5 m (16.5 ft) in height}. Suggested sampling techniques are transect and line intercept.

SIV2. Percent shrub crown cover {the % of ground shaded by vertical projection of the canopies of woody vegetation < 5 m (16.5 ft) in height}. Suggested sampling techniques are line intercept and quadrat.

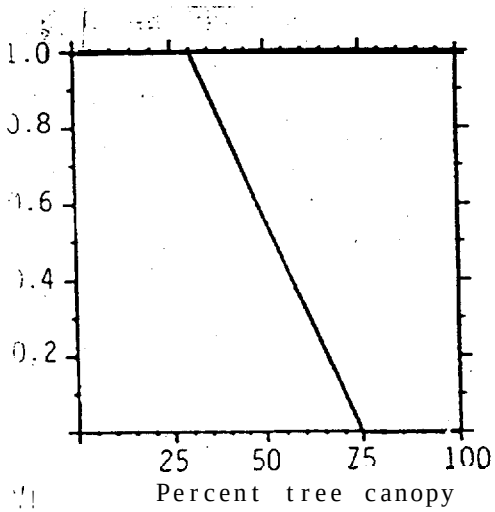
Reproduction

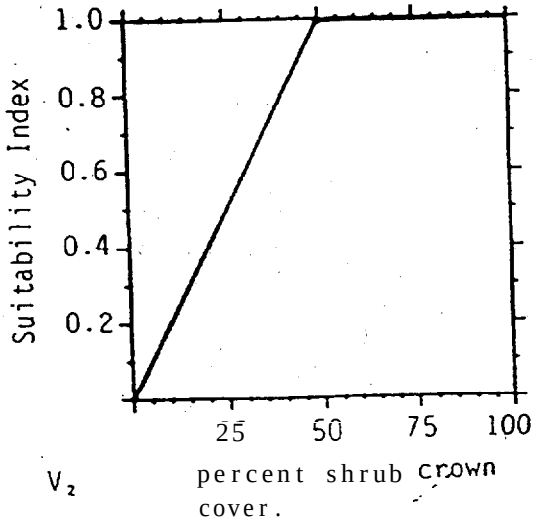
SIV7. Number of snags $\geq$ 30.5 cm (12 inches) dbh per 0.4 ha (1 acre) {the number of standing dead trees or partly dead trees at least 30.5 cm (12 inches) dbh and at least 9.1 m (30 ft) tall}. Suggested sampling technique is quadrat.

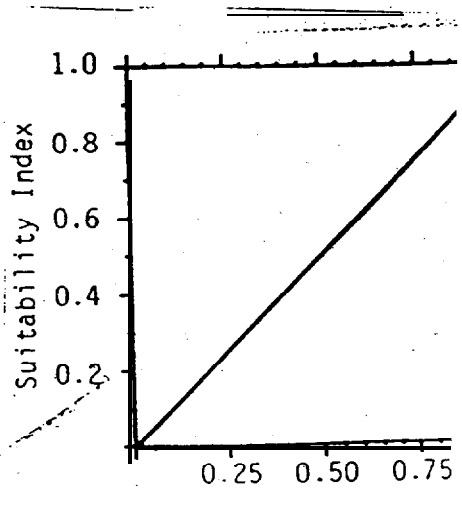
Equations

Summer Food = (V1 x V2)1/2

Reproduction = V7







Sousa, P.J. 1982. Habitat suitability index models: Lewis' woodpecker. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.32. 14pp.

MINK BASELINE HEP ANALYSIS 1996

MINK YEAR ROUND SYNOPSIS HSI _____ HABITAT UNITS _____

LOCATION: _____ DATE _____

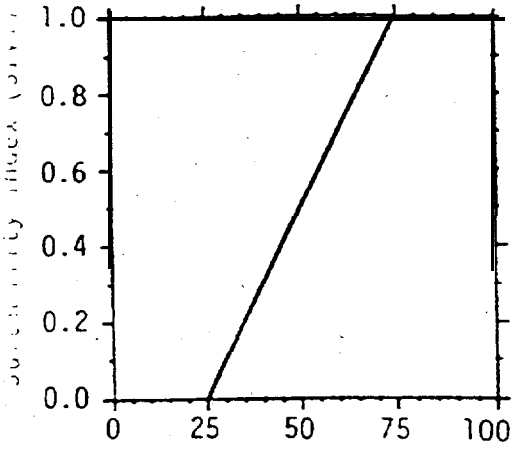
HEP TEAM: P. Ashley, M. Berger, M. Whalen, _____

HSI for MINK is equal to the lowest value calculated for water or cover.

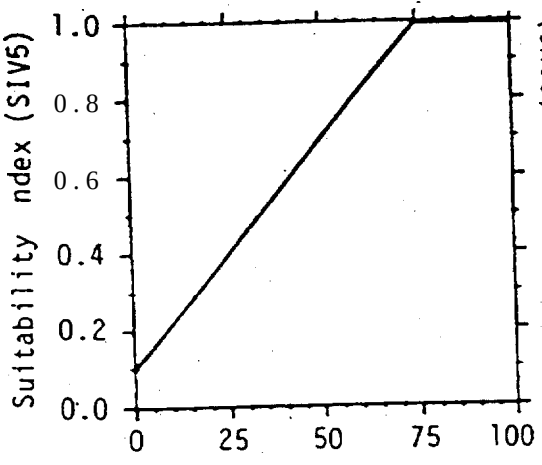
SIV1. Percent of year with surface water present (the percent of the year in which cover types have surface water present) Suggested sampling techniques involve on site inspection and historic records.

SIV5. Percent canopy cover of trees and shrubs within 100 m (328 ft) of the wetland's edge (%surface within 100 m of wetland's edge that is shaded by vertical projection of the canopies of all woody vegetation). Suggested sampling technique is the line intercept method.

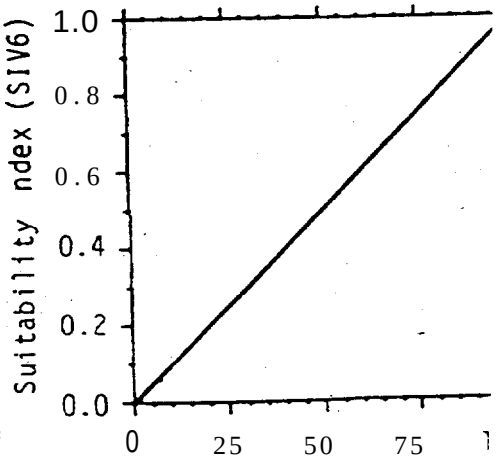
SIV6. Percent shoreline cover within 1 m (3.3 ft) of the water's edge (estimate of the vegetative and structural complexity at the land/water's edge). Cover may be provided by overhanging or emergent vegetation, undercut banks, logjams, debris, exposed roots, boulders or rock crevices. Suggested sampling techniques involve on site inspection and line intercept method.



Percent of year with surface water present



Percent canopy cover of trees and shrubs within 100 m of the wetland's edge



Percent shoreline cover

Allen, A.W. 1986. Habitat suitability index models: mink, revised. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.127). 23 pp. [First printed as: FWS/OBS-82/10.61, October 1983.]

Life requisite	Cover type	Life requisite value
Food	EF,DF,EFW,DFW	V_1
Reproduction	EF,DF,EFW,DFW	V_2

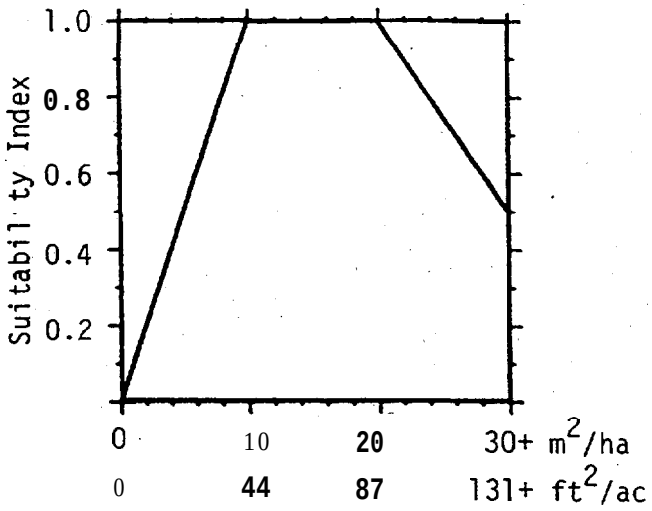
HSI determination. The HSI for the downy woodpecker is equal to the lowest life requisite value.

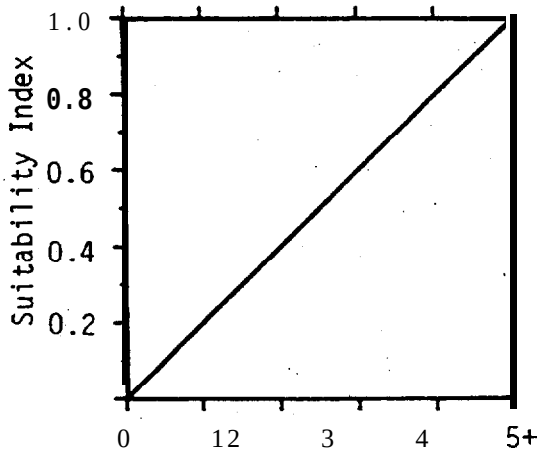
Application of the Model

Definitions of variables and suggested field measurement techniques (Hays et al. 1981) are provided in Figure 2.

Variable (definition)		Cover types	Suggested technique
V_1	Basal area [the area of exposed stems of woody vegetation if cut horizontally at 1.4 m (4.5 ft) height, in m^2/ha ($ft^2/acre$)].	EF,DF,EFW,DFW	Bitterlich method
V_2	Number of snags > 15 cm (6 inches) dbh/0.4 ha (1.0 acre) [the number of standing dead trees or partly dead trees, greater than 15 cm (6 inches) diameter at breast height (1.4 m/4.5 ft), that are at least 1.8 m (6 ft) tall. Trees in which at least 50% of the branches have fallen, or are present but no longer bear foliage, are to be considered snags].	EF,DF,EFW,DFW	Quadrat

Figure 2. Definitions of variables and suggested measurement techniques.

Cover type	Variable		Suitability graph
EF,DF, EFW,DFW	V_1	Basal area.	

EF,DF, EFW,DFW	V_2	Number of snags > 15 cm dbh/0.4 ha (> 6 inches dbh/ 1.0 acre).	

Life requisite values. The life requisite values for the downy woodpecker are presented below.

WHITE-TAILED DEER HEP MODEL (DRAFT) 05/96

COVER TYPES: Conifer Forest, Dense Conifer Forest, Riparian Forest, Mixed Forest, and Deciduous Forest.

REGION: Eastern Washington and North Idaho.

APPLICATION: This model was designed to evaluate year-round white-tail deer habitat. Prolonged/deep snow conditions (> 24" (6 dm)) will reduce the over-all HSI rating and in some cases may render the area unsuitable during winter periods. Model users must consider local conditions when applying this model.

VARIABLES:
SIV1 : Percent Horizontal Concealment
SIV2: Percent Conifer Canopy Cover ≥ 35 Feet Tall (10.5m)
SIV3: Width of Cover
SIV4: Density of Roads Open to the Public per Square Mile (1 .6km^2)
SIV5: Percent Preferred Shrub Canopy Cover < 5 Feet Tall (1.5m)
SIV6: Preferred Shrub/Tree Composition
SIV7: Shrub Browse Diversity
SIV8: Percent Palatable Herbaceous Cover
SIV9: Percent of Area Comprised of Winter Wheat/Alfalfa

EQUATIONS:

Cover: $(V1 \times V2 \times V3 \times V4)^{1/4}$

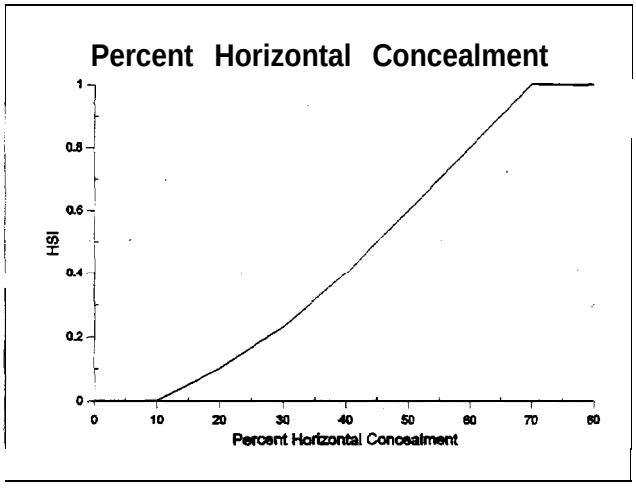
Food: $\frac{(2(V5 + V7) + V6 + V8)}{6} + V9$

HSI = (Cover HSI x Food HSI)½

Model Modified from "Wildlife Mitigation and Restoration for Grand Coulee Dam - Blue Creek Project Phase 1". Christopher Merker, April 1993. 107 pp. Modified by P. Ashley (WDFW), M. Berger (CCT), and M. Whalen (WDFW), May 1996.

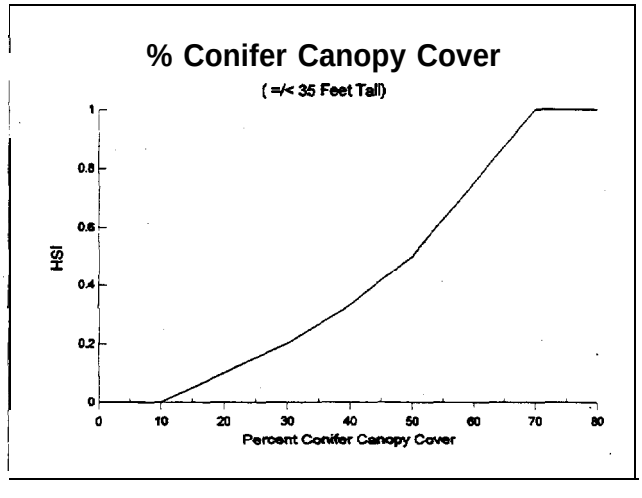
COVER

SIV1 : Percent Horizontal Concealment



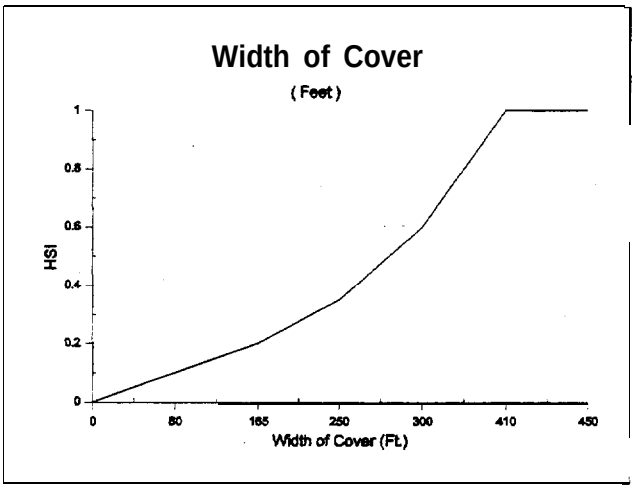
Jageman, 1984, considered hiding cover to be optimum when 90% of an adult standing deer (lm tall at shoulder) is hidden from view at 61m (200 ft.). This model assumes optimum conditions if 70% of a standing adult deer is obscured from view at 15m (45 ft.). A cover pole (2.5cm x 1.5m, divided into .5 meter increments representing 33% horizontal cover each) is used to estimate horizontal cover.

SIV2: Percent Conifer Canopy Cover ≥ 35 Feet (10.5m) Tall



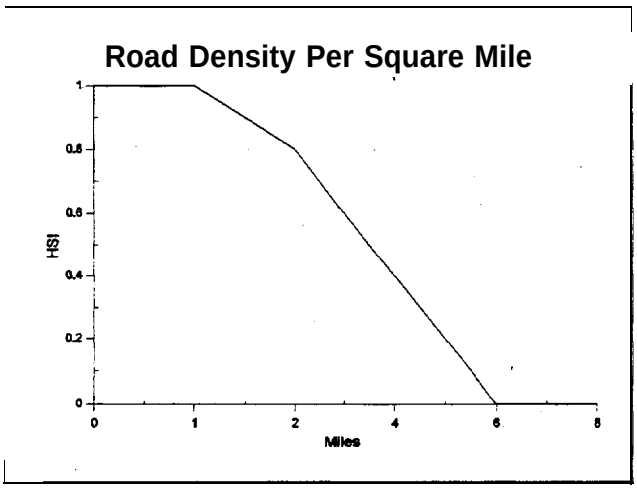
Overstory canopy cover (thermal cover) is used by deer to help maintain/regulate body temperatures during winter and hot summer periods and is considered optimum if canopy closure is greater than 70%.

SIV3: Width of Cover



Width of cover between openings or fields within a study area is considered optimum if the cover is greater than 410 feet wide (125 meters).

SIV4: Density of Roads Open to the Public per Square Mile (1 .6km^2)



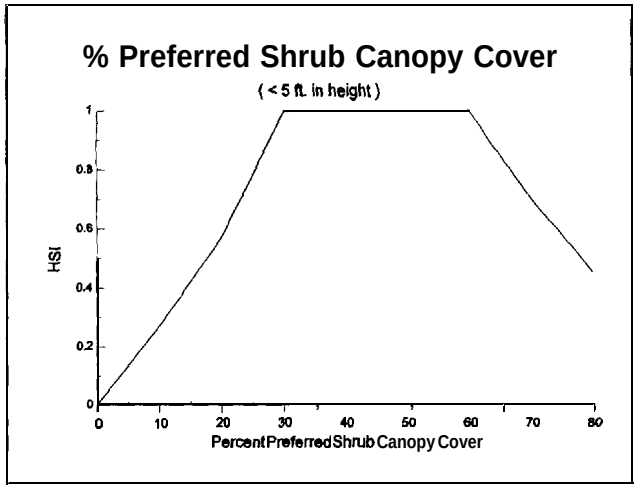
COVER HSI EQUATION:

(V1x V2 x V3 x V4)¼

WHITE-TAILED DEER HEP MODEL (DRAFT) 05/96

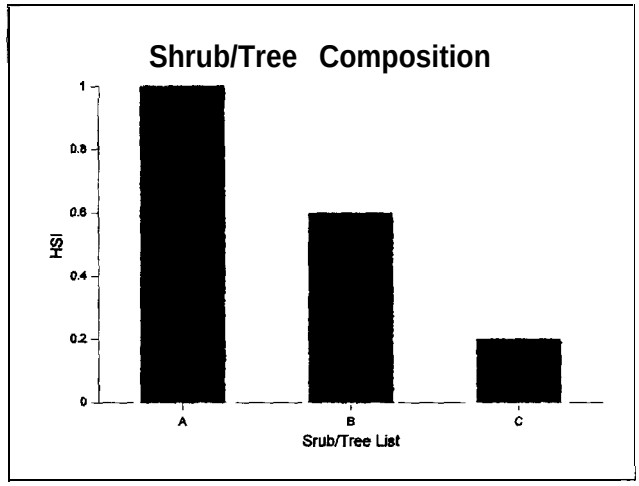
FOOD

SIV5: Percent Preferred Shrub Canopy Cover < 5 Feet Tall (1.5m)



Preferred shrubs] include: ceanothus, willow sp., serviceberry, chokecherry, red-osier dogwood, maple, kinnikinnick, pachistima, Oregon grape, snowberry, hawthome, spirea, ninebark, oceanspray, alder, mock orange, elderberry, thimbleberry, and Menziesia.

SIV6: Preferred Shrub/Tree Composition



This variable describes the type of browse in the area. If the area contains preferred forage species, then it receives a high rating. Shrub/tree composition groupings[2] are described below:

Group A: Western red cedar, ceanothus, willow, serviceberry, chokecherry, red-osier dogwood, maple, kinnikinnick, pachistima, and Oregon grape.

Group B: Cottonwood, snowberry, aspen, ponderosa pine, grand fir, hawthome, spirea, and white pine.

Group C: Ninebark, oceanspray, alder, blackberry, mock orange, lodgepole pine, elderberry, Menziesia, thimbleberry, bitterbrush, sagebrush, and western larch.

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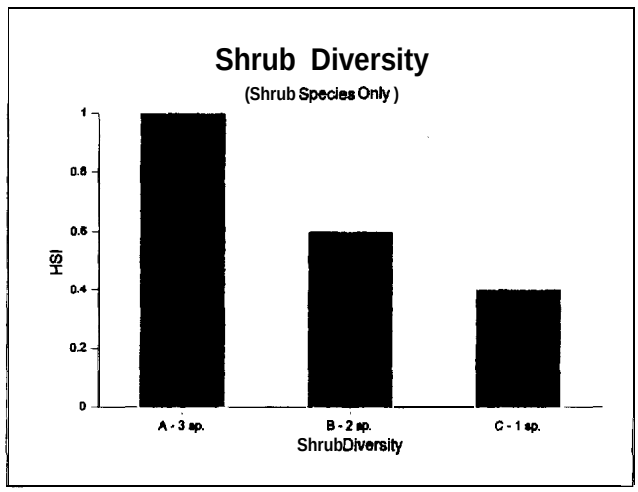
[1]This list may need to be modified to reflect local habitat conditions and browse preferences.

[2]Select the grouping which best describes the study area.

SIV7: Shrub Browse Diversity

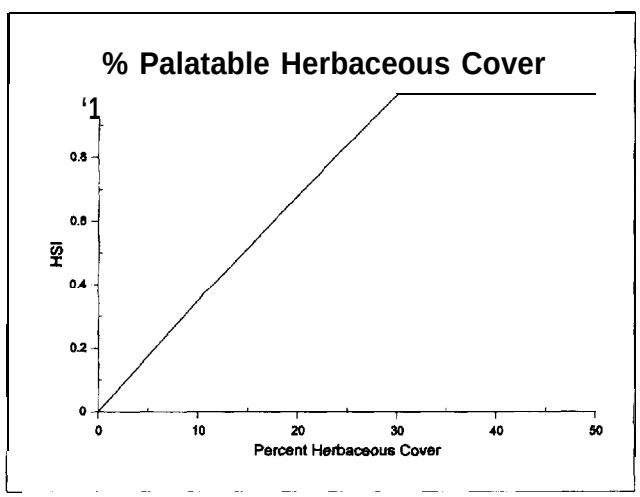


This variable describes shrub browse diversity. Consider only shrub species when determining the HSI for this variable. To be counted within a grouping, a single shrub species must be a minimum of 10% of the preferred shrub canopy closure (SIV5). For example, if the preferred shrub canopy closure is 30%, then any individual shrub species would have to be at least 3% of the total preferred shrub canopy closure to be counted.

This will help to reduce inflated HSIs for this variable in situations where the browse is predominantly a single shrub species and only a few individual shrubs of a different type are scattered throughout an area.

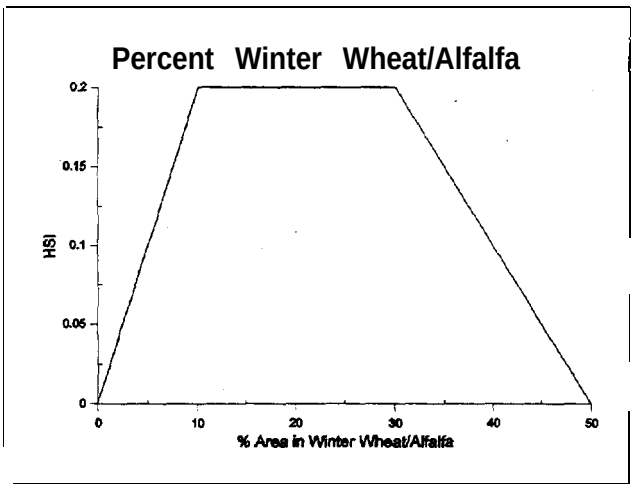
Shrub Diversity Ratings: A = 3 species, B = 2 species, C = 1 species

SIV8: Percent Palatable Herbaceous Cover



This variable is the amount of ground cover. comprised of palatable herbaceous vegetation (grasses and forbs) such as: clover, pasqueflower, arnica, orchard grass, pinegrass, stipa, and wheatgrass.

SIV9: Percent of Area Comprised of Winter Wheat/Alfalfa



SIV9 is used to rate the percent of the project area providing food from winter wheat and alfalfa. This variable is additive and not necessary to achieve optimum conditions (HSI = 1.0). The maximum value is .2. The combined food HSI value should not exceed 1.0 (if exceeded, round down to 1.0).

Food Equation:

$$\frac{(2(V5 + V7) + V6 + V8)}{6} + V9$$

Model HSI Equation:

(Cover HSI x Food HSI)½

Canada Goose Model for Chief Joseph Dam Study

This model was modified from models developed during the Albeni Falls wildlife impact assesment (Martin et al. 1988) and for the Palisades Project (Sather-Blair and Preston 1985). This Chief Joseph model was developed to describe the quality of goose breeding habitat around Rufus Woods Lake. It considered only nesting and brood-rearing areas which are the most important components determining the quality of Canada goose breeding habitat.

Nesting

Islands

Stable islands present; Ground cover on portions of islands 4 inches to 16 inches high; Brood habitat is within 1 mile of area.	0.8 - 1.0
Stable islands present; Cover on islands less than 4 inches or greater than 16 inches; or Brood habitat is 1 to 3 miles from area.	8.5 - 0.7
No stable islands present; or Islands with limited or no cover; or Brood habitat greater than 3 miles away.	0.0 - 0.4

Brood-rearing

Brood pasture easily accessible from main water body; Foraging zones common; Vegetation less than or equal to 4 inches tall (palletable, succulant herbaceous), Greater than 1/2 acre in size; Open water wetlands are present (lack of predator cover).	0.7 - 1.0
Less than above and/or no open water wetlands; or area is 1 to 2 miles from nesting habitat; Vegetation is greater than or equal to 4 inches and less than 8 inches tall; Size is greater than 0.1 acre but less than 0.5 acre.	0.4 - 0.6:

Little or no brooding area; or Area is less than 0.1 acre and is 0.0 - 0.3
greater than 2 miles from nesting habitat; Vegetation is greater
than 8 inches tall.

MODEL

$$HSI = \frac{\text{Nesting Suitability Index} + \text{Brood-rearing Suitability Inddx}}{2}$$

SAGE-SE
(Centrocercus urophasianus)

CHARACTERISTICS

Sage grouse are very distinctive with a black belly, long pointed tail feathers and large size (28 inches in length). Excluding the recently introduced turkey, it is Washington's largest upland game bird, the males attaining a weight of over six pounds. The male is larger and more colorful than the female, with yellow eye combs, black throat and bib, and a large white ruff on its breast. In flight, the dark belly, absence of white outer tail feathers and its much larger size distinguish this bird from the sharp-tailed grouse.

FOOD AND HABITAT REQUIREMENTS

The sage grouse has a specialized digestive system. It possesses a thin-walled stomach adapted to a soft vegetable diet. All other gallinaceous game birds have thick-walled gizzards designed for grinding hard seeds. For this reason the sage grouse is inseparably linked with the sage brush plant for food. About 75% of the diet consists of sag&rush leaves. A minimum of 20% sagebrush cover is optimum. Forbs and insects are also important to the bird's nutritional requirements. Animal foods comprise up to 10% of the diet.

Typical sage grouse habitat consists of lightly-grazed areas of big sagebrush interspersed with grasses and forbs. Wet meadows and wheat fields adjoining such areas are extensively used.

Water is used daily when it is available, although sage grouse can go for long periods without drinking. The best populations are usually found near water.

BREEDING

The sage grouse is promiscuous in its mating habits. Beginning in early spring the males travel up to several miles to a central, open "strutting ground," where each day at dawn and dusk they strut and display before the hens. Courting males fan their tails and rapidly inflate and deflate their air sacs, emitting a loud popping sound. Mating occurs at the strutting ground. These areas, sometimes termed leks, are characterized by bare ground ranging from 0.1 to 100 acres. Leks are usually adjacent to nesting and rearing habitats. The nest is located on the ground, under a sagebrush or in a clump of ryegrass, and usually contains from 7 to 13 eggs. Optimum nesting habitat has a minimum of 20% cover of sagebrush ranging from 7-30 inches in height. Sage grouse use the same leks and nesting sites year after year.

STATUS IN WASHINGTON

The sage grouse was formerly abundant wherever big sagebrush was present in eastern Washington. The large bird and its eggs were an important item in the diet of the early settlers of the area. Destruction of its habitat by plowing and sagebrush control, cattle grazing, over-shooting and perhaps unknown factors have drastically reduced its numbers, and it is now absent from most of its former range.

Sage Grouse

(Centracercus urcohasianus)

Draft 10/90

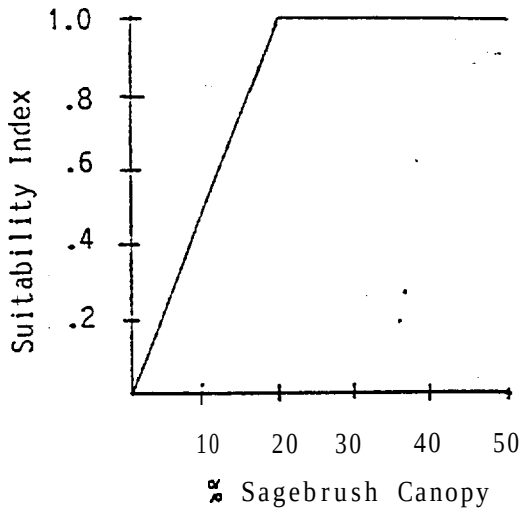
Shrub-Steppe (SS)

Winter Habitat

Variable 1: Percent sagebrush canopy.

V1 Field Values:

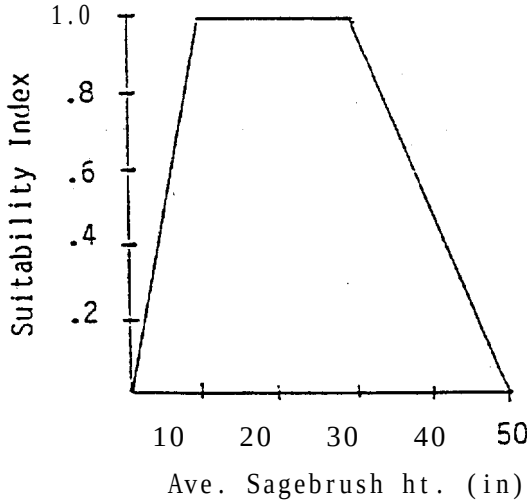
0 x = 0
1 - 10% = .2
10 - 19% = .7
20 - 50% = 1.0



Variable 2: Average sagebrush height (in)

V2 Field values:

0in = 0
1 - 10in.= .5
10 - 30in.= 1.0
31 - 40in.= .7
41 - 50in.= .3
50in = 00



HSI = (V1 x V2) ½

APPENDIX D

COVER TYPE MAPS

HABITAT COVER TYPES

- Shrub/Grass
- Grassland (CRP)
- Grassland (Native-like)
- Shrubland
- Riparian Forest
- Riparian Shrub
- Conifer Forest
- Conifer Woodland
- Dense Conifer Forest
- Deciduous Forest
- Mixed Forest
- Emergent Wetland
- Forested Wetland
- Surface Water
- Exposed
- Agriculture
- Urban

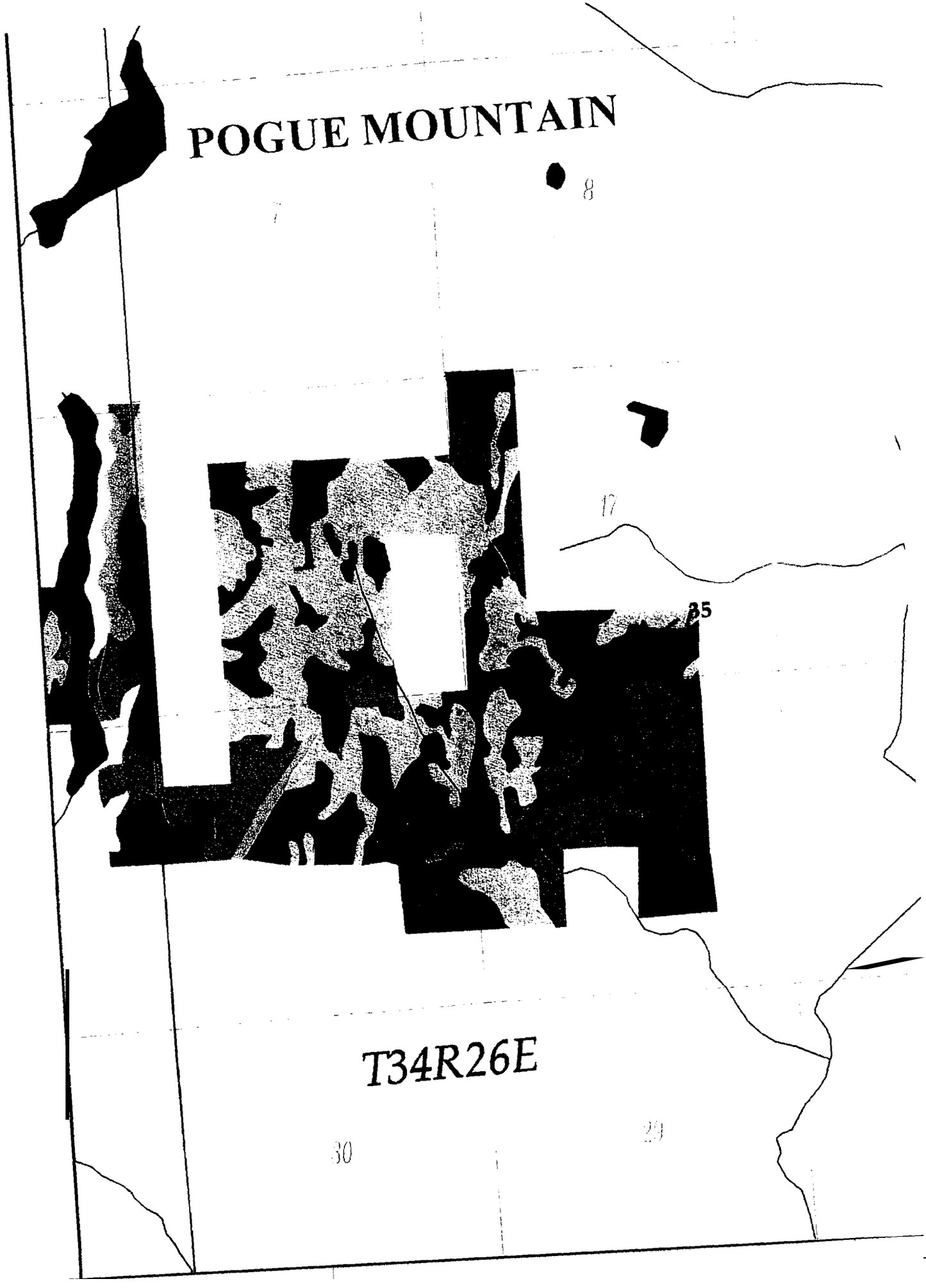
ADMINISTRATIVE BOUNDARIES

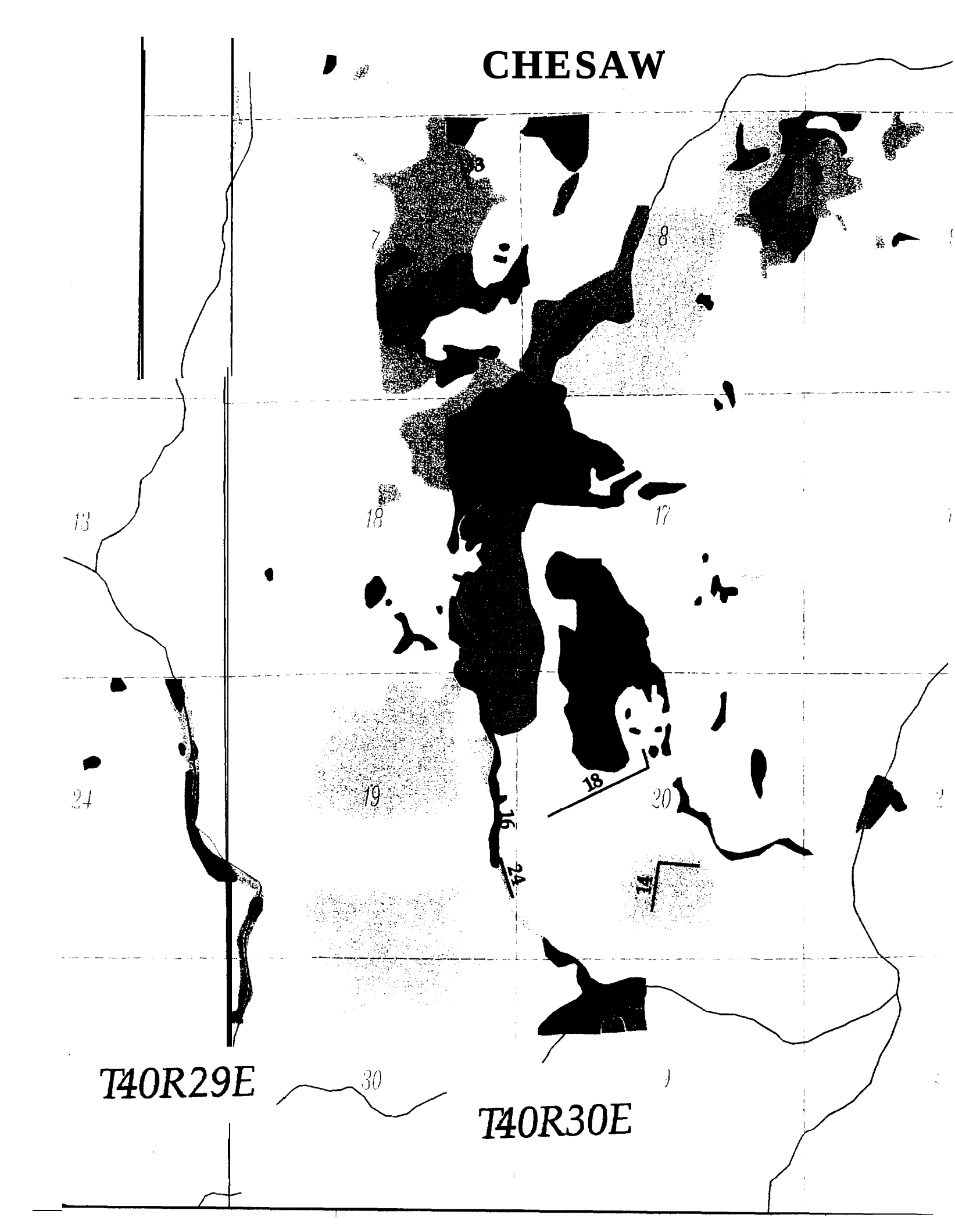
- Township Lines
- Section Lines
- Habitat Transects

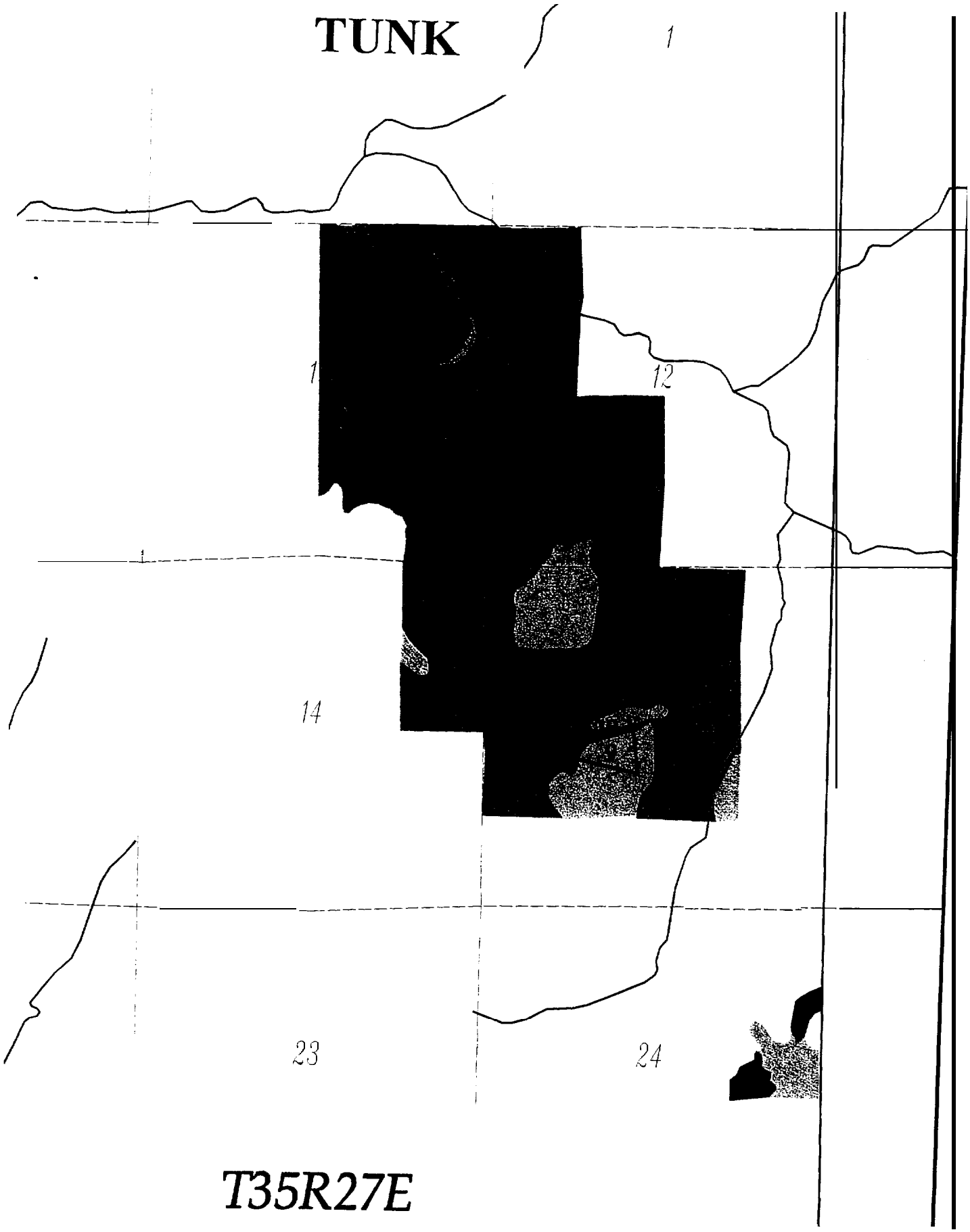
HYDROLOGY TYPES

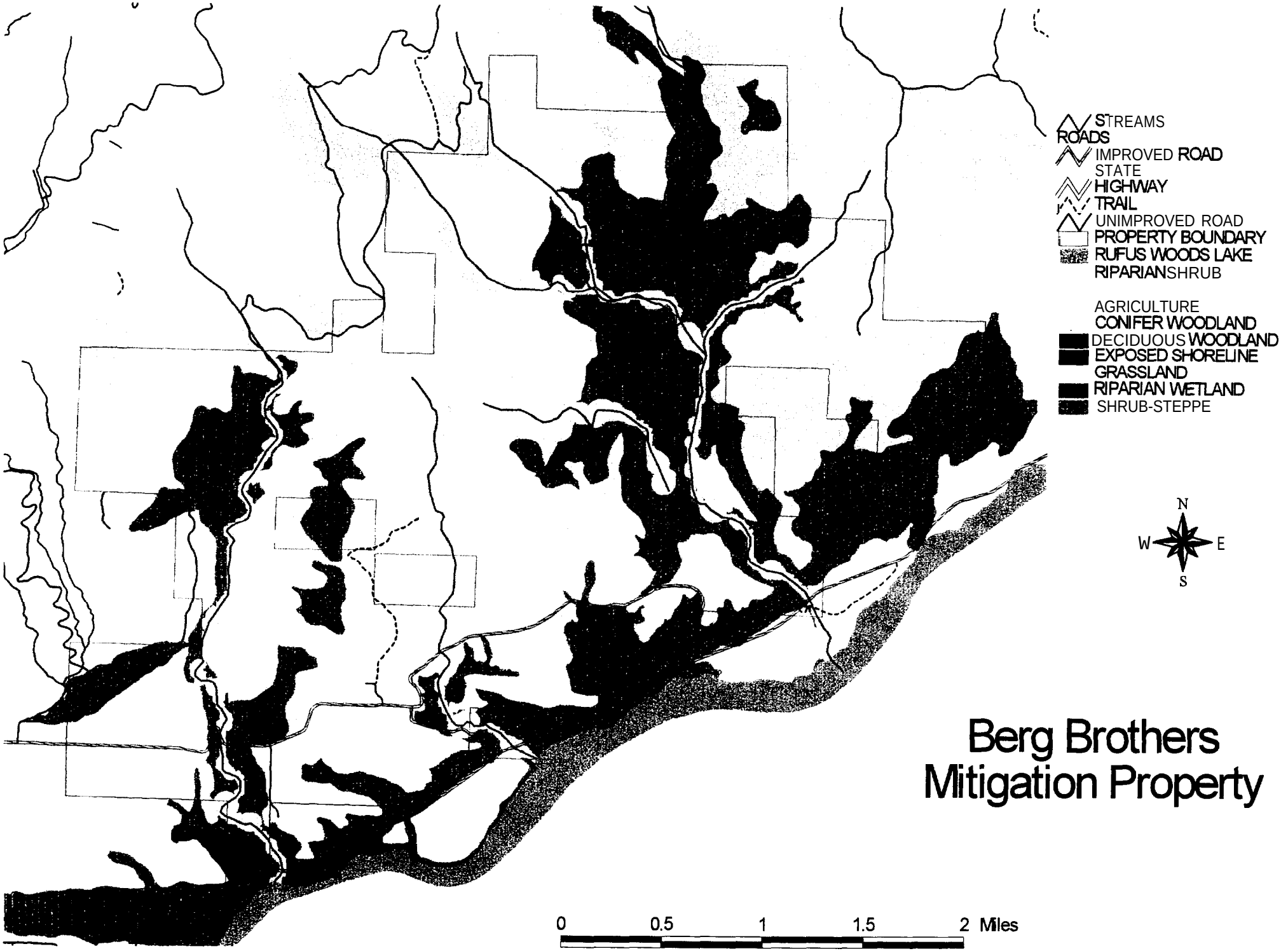
- Water Body
- Stream


SCOTCH CREEK
T35R26E
T35R25E


POGUE MOUNTAIN
8
17
35
T34R26E
30
29


CHESAW
T40R29E
T40R30E
13
18
17
24
19
20
30
18
16
24
14


TUNK
1
1
12
14
23
24
T35R27E


STREAMS
ROADS
IMPROVED ROAD
STATE HIGHWAY
TRAIL
UNIMPROVED ROAD
PROPERTY BOUNDARY
RUFUS WOODS LAKE
RIPARIAN SHRUB
AGRICULTURE
CONIFER WOODLAND
DECIDUOUS WOODLAND
EXPOSED SHORELINE
GRASSLAND
RIPARIAN WETLAND
SHRUB-STEPPE
N
W
E
S
Berg Brothers
Mitigation Property
0
0.5
1
1.5
2 Miles

APPENDIX E

HABITAT MEASUREMENT JNSTRUMENTS and TECHNIQUES

FOREST DENSIOMETERS

Thank you for purchasing a SPHERICAL DENSIOMETER.

This scientific instrument was originally deveioped and published by Dr. Paul E. Lemmon (1956 and 1957). In these papers, he discusses the statistical validity behind the accuracy and repeatability of the data Collected using the SPHERICAL DENSIOMETER. This instrument has been extensively -tested over the past 35 years by numerous foresters and forestry technicians on stands of ponderosa pine, lodgepole pine and Douglas fir. The pioneering work was done mainly in the Pacific northwest; however, subsequently the instrument has been used for measuring overstory density throughout the U.S. and internationally.

The original methodology was developed to characterize and quantify canopy density for representative forest sites where numerous parameters such as tree size (height, girth, age and growth rates), tree spacing, soil type, slope and slope orientation, elevation and others were determined. The early work was done as part of a nationwide, study to develop a series of guidelines to improve the efficiency of forest management. The goals were to maximize yield of these renewable natural resources at maturity and to aid management decisions that would help the forest stands approach a balanced ecological system.

The SPHERICAL DENSIOMETER consists of either a concave (model C) or a convex (model A) mirror with 24 - 1/4" squares engraved on the surface. The design is such that the operator views the same degree of arc overhead regardless if the user is in a low lying canopy area or a mature stand of high canopy timber.

Each square of the grid is then equally subdivided mentally into 4 smaller squares (1/8" x 1/8") and represented by an imaginary dot in the center of each'of the smaller squares. Thus a total of 96 dots representing smaller square areas can then be counted within the grid. Once the representative forest site has been selected for measurement, the' user holds the instrument level and far enough away from his/her body such that the operator's head is just outside the grid. The operator can then count the number of dots, representing the smaller (1/8" x 1/8") square areas of canopy openings, up to a total of' 96. The number determined is then multiplied by 1.04 to obtain the percent of overhead area NOT OCCUPIED by canopy. The difference between this percentage and 100% is the estimated overstory density in percent.

Four readings are taken about a reference tree in each site area and averaged. The operator should be positioned with his/her back toward the reference tree, and moving about the reference tree facing North, East, South and-West. "The reference tree in each site represents a typical dominant or co-dominant species in the stand. The points selected around the reference tree should be far enough away [from the reference tree] so that the crown of the reference tree is just outside the overstory area being estimated" (Lemmon, 1956). The statistical accuracy and repeatability of the instrument is based on taking four readings, using up to 96 dots representing the smaller (1/8" x 1/8") squares

for up to a total of 384 smaller squares per site (96 x 4), and then averaging all four readings at the different orientations about the reference tree. Obviously, in a forest environment, you will be counting considerably less than 96 dots representing the smaller squares, so the exercise is a lot less laborious than it might first appear. The denser the overstory canopy, the fewer dots you will have to count since you are counting the 1/8" x 1/8" areas in which you can see sky in the major portion of each of the smaller squares. With a little practice, you will find that the data can be gathered quickly and with repeatability using the same or different operators-

You can use another trick that will speed your data collection in open forest where greater than half of the canopy area is open to the sky. You can reverse the process and count just the smaller square areas (1/8" x 1/8") that are covered by the canopy. If you then multiply by 1.04 you will obtain the estimated overstory density directly in percent.

The SPHERICAL DENSIOMETER is designed for rugged field use (rain or shine), yet compact and light weight enough to tit into a shirt or coat pocket for ease of transport. When used with respect, this little instrument has given many years of field service. Each instrument box is hand made of walnut and may have some unique "character" as might be expected using a natural wood product. Attempts have been made to keep the knots and blemishes to a minimum; however, they were incorporate where they added beauty to the box and did not compromise the integrity of the instrument.

LIFETIME WARRANTY: If a SPHERICAL DENSIOMETER becomes inoperable, we will repair or replace it at no cost to you, beyond the cost of shipping the instrument to us; provided the instrument has not been severely abused. If the box appears to have been used to drive nails or has been run over by a logging truck, I'm afraid these examples. would fall under the "severely abused" category.

References:

Lemmon, Paul E., 1956, A Spherical Densiometer for Estimating Forest Overstory Density; Forest Science 2(4)314-320.

Lemmon, Paul E., 1957, A New Instrument for Measuring Forest Overstory Density; Jour. Forestry 55(9)667-668.

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Reprinted from *the* JOURNAL OF FORESTRY, Vol. 55, No. 9, September 1957

A New Instrument for Measuring Forest Overstory Density[1]

A new instrument called a "spherical densiometer" has been described for estimating fdrest overstory density.2 This pocket-type instrument employs, a mirror with spherical curvature which makes possible the reflection of a large overhead area. A grid is used to estimate. percentage of this overhead area covered with forest, canopy. Estimation is usually from a point near the forest floor. Adequate sampling gives the average canopy of a forest area.

Two models, A and B (Figs. 1 and 2), have been adopted as standard. Each employs a highly polished chrome mirror 2½ inches in diameter and having the curvature of a 6-inch sphere. The convex side of the mirror is used in Model A and the concave side in Model B. Each has some advantages orer the other.

The mirrors are mounted in small wooden recessed boxes with hinged lids similar to compass boxes. The over-all dimensions are about 3½ x 3½ x 1⅛ inches. A circular spirit level is mounted, (recessed) beside the mirrors. Positive slide fasteners are provided in Model B which allow the lid to open to an angle of about 45 degrees.

Cross-shaped and circular grids with squares and dots are used to estimate overstory coverage by tree crowns. Grids are of two kinds: (1) those scratched upon the surface of the- mirror, Model A, and (2) those superimposed between the mirror and the eye, Model B.

The cross-shaped grid scratched upon the convex surface of the mirror in Model A has 24 quarter-inch squares (Fig. 3A). Instructions for using the densiometer and cumulative values for the squares on the grid are shown on a chart that is attached to the inside of the box lid (Fig. 3B). It is 'easier and faster to estimate the relative amount of overstory coverage with this instrument by assuming the presence of four equi-spaced dots in each square and by counting dots representing openings in the canopy. The percentage of overstory density is then assumed to be the complement of this number. Each assumed dot is assigned a value of one percent in this case. A slight discrepancy exists between estimations using the squares and estimations by counting assumed dots, because there are only 96 dots in the entire grid. area. Cumulative values of the squares shown in the chart add up to 100 percent for the entire area within the grid. If desired, one may calculate the exact percentage values for each assumed dot and thereby make the two methods of use exactly comparable.

Model B has a circular grid. The circle is 1½ inches in diameter 'superimposed over quarter-inch squares. Each square has four equi-spaced dots (Fig. 4A). This grid is made from a positive print of a photographic film mounted between thin sheets of plexiglass and fitted into the window of the box lid. Instructions for operating Model B are given on a chart modnted on the bottom of the instrument box (Fig. 4B). The operator estimates overstory density by counting the dots representing overstory openings and assuming this to represent the percentage of noncovered overstory area. Here again a slight discrepancy exists because there are only 96 dots included within the area of the circular grid. Exact percentage values for each dot may be calculated to estimate the entire circular area as 100 percent. This refinement is not considered necessary for ordinary use of the instrument.

Instruments can be developed with different kinds, sizes, and shapes of grids and with mirrors of different curvatures. However, standardization of these properties is necessary to provide comparable information that can be duplicated. The instruments described have been thoroughly tested and have given satisfactory results with most western conifers. We believe the spherical densiometer described (either Model A or B) will serve

'Editor's **note.-At the request of the author the reader's attention-is called to the comercial availability of this instrument. See page 696.**

[1]**Lemon, Paul E. 1956. A spherical densiometer for estimating: forest overstory density. Forest Sci. 2:314-320.**

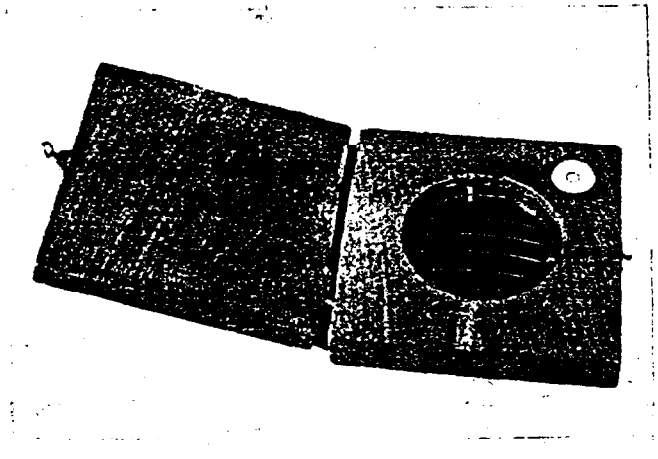


FIG. I.-Spherical densiometer. Model A, mith estimating grid scratched on the surface of the convex **mirror.**

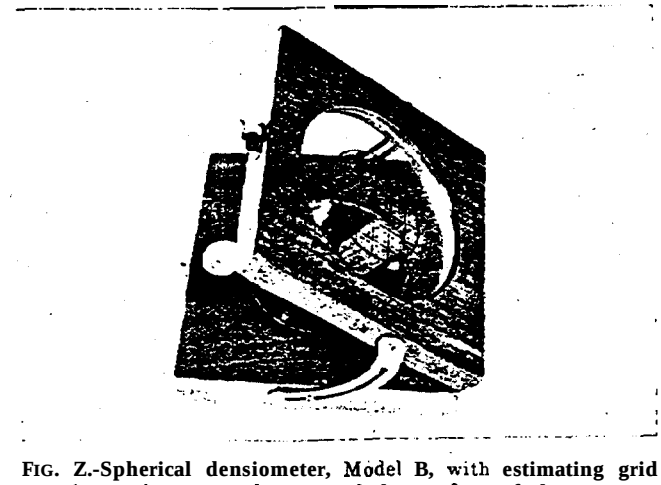


FIG. Z.-Spherical densiometer, Model B, with estimating grid superimposed between the eye and **the** surface **of the concave** mirror.

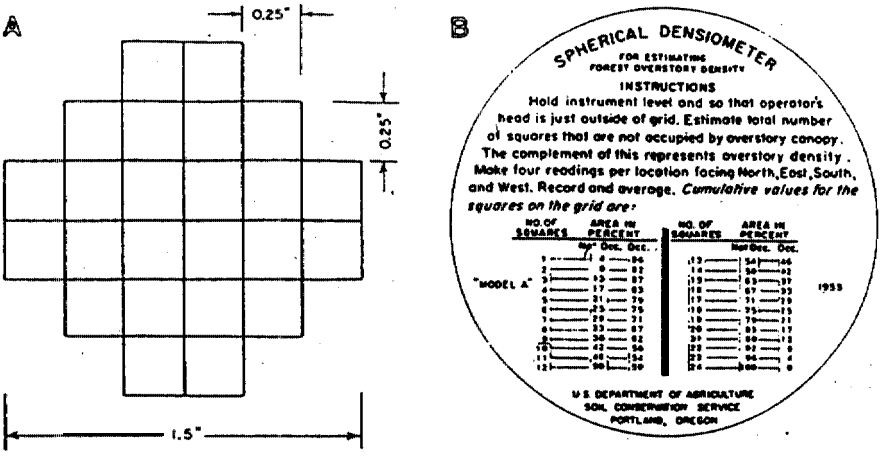
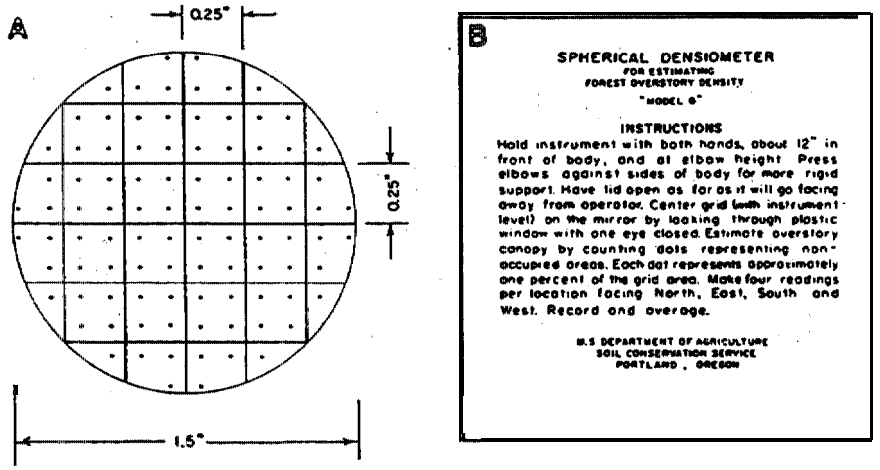


FIG. 3.—(A) Cross-shaped grid scratched on the convex surface of the mirror in Model A. Each square is ¼ inch on a side. (B) Instructions for using Model A. This is fastened to the inside of the lid of the mounting box.



Fro. 4.-(A) Circular grid superimposed between the eye and the concave mirror in Model B. Each square is ¼ inch on a' ride. (B) Instructions for using Model B. This is fastened to the bottom of the mounting box.

tbe needs of practicing forester, range conservationist, and plant ecologist or those of mast scientists doing highly technical work.

Operators need ,a little training to become consistent in the use of the instrument. Judgment and experience is needed to differentiate between overstory areas that are considered completely covered by the overstory and those that have thin but uniformly distributed coverage. In the latter case it may be necessary to estimate the area of many small irregular openings and reduce the percentage overstory density by the sum of these. Training and experience are needed for each different forest species or type because of the differences in overstory characteristics. The season of the year is important when making measurements in forests containing deciduous species.

Experience has shown that sufficient accuracy can be attained with the spherical densiometer by holding it as nearly level as possible in the hand. This is made possible by installing a circular spirit level in the mounting box. No mechanical support, such as a tripod, is needed. This adds to the practicability of the instrument in use.

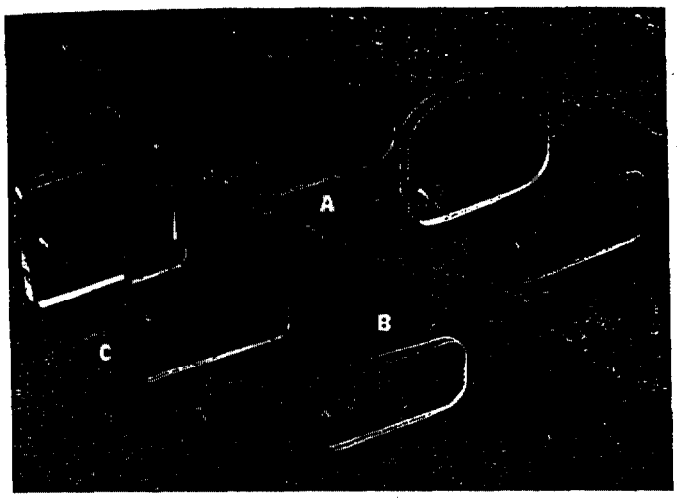
A large number of measurements of overstory density have been made to test the instrument. ' One such study involved the measurement of overstory density at points in 28 different forests. Measure. ments were made at each point by four different operators each using instrument Model A and Model B. The results were subjected to an analysis of variance to determine consistency of measurements. There were no significant differences among measurements made by different operators or with different instruments and none of the interactions were significant. The differences due to forests, however, were highly significant-above the 99 percent level of probability. Under similar conditions one can expect variations in overstory density measurements to be within t1.3 percent, ±2.4 percent, and ±3.1 percent at probability levels of 70, 95, and 99 percent r&peetively. These variations amount to about 2, 3, and 4 percent when the standard deviation is expressed in terms of the overstory at the point of measurement (coefficient of variation).

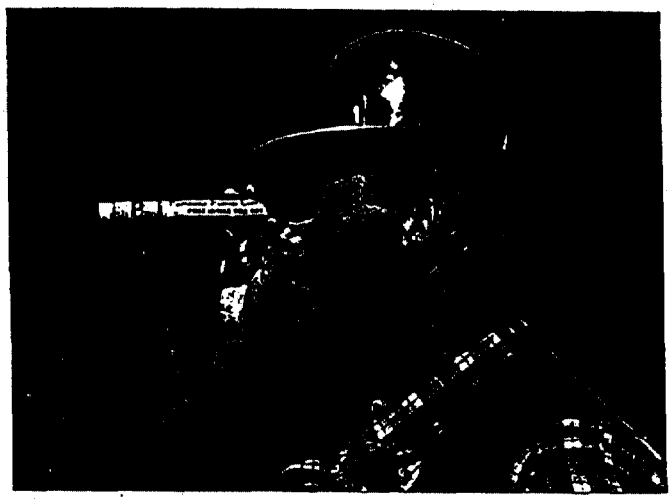
Another study involved placement of 416 different forest overstory measurements into 5 percent overstory density classes. Variation around'the mean within each class was calculated and the standard deviations and coefficients of variation plotted against the overstory density classes. It was found that variation among measurements increased as the overstory being measured decreased— only slightly when overstory density decreased from 100 down to about 60 percent but rapidly thereafter. When placing overstory density into 5 percent classes with the spherical densiometer, reliability in the order of about 5 percent can be expected so long as one is measuring forests that have more than about 50 percent overhead canopy. Since one naturally estimates percentage of overstory area *not* covered in dense forests and overstory area *covered* in open forests, estimations of overstory density when placed in classes will seldom vary more than ±5 percent.

Loss in reliability of overstory density measurements results from placing forests in overstory density classes baaed on measurements with the spherical densiometer as contrasted with 'using the actual measurements. For instance, reliability of about rt1.3 percent can be attained when actual measurements are used whereas. the reliability is reduced to about 5 percent when classes are used.

PAUL E. LEMMON
Soil Conservation Service,
U. S. Department of Agriculture,
Washington, D. C.

Wedge Prisms & Angle Gauge





A. Custom Shape Prisms

English and Metric

Accurate to ±1% of rated BAF. The efficient familiar design (30° ellipse curvature at top) for all generak cruising. Base is parallel to horizontal axis for slope correction reference 40mm x 40mm Leather case (1 oz.)

JIM-GEM® Prisms

English	Clear	Amber
10	59031	59033
20	59032	590.34
	$21.95	$48.50

"Cruise Master" Prisms

English	Clear	Amber
5	59342	59158
10	59170	59168
15	59181	59165
20	59190	59175
25	59183	59215
30	59185	59217
40	59189	5922.1
	$38.25	$48 90

Metric	Clear
1	59105
2	59107
2.5	so154
3	59109
4	59113
	$38.25

B. Rectangular Prisms

Accurate to ±1% of rated BAF. Gives a narrow-sharp image for good results in dense timber. 20mm x 40mm. Supplied in leather case. (1 oz.)

JIM-GEM® Prisms

English	Clear	Amber
10	59026	59021
20	59018	59022
	$17.25	429.95

"Cruise Master" Prisms

English	Ckar	Amber
5	59343	59159
10	59180	59169
15	59182	59153
20	59200	59176
25	59184	59216
30	59186	59218
40	59192	59224
	$38.25	$48.90

C. JIM-GEM® Square Prisms

Accurate to ± 1% of rated BAF. For general cruising in areas having less than 15% slope. 40mm x 40mm. Leather case (1 oz.)

English	Clear	Amber
10	59025	59027
20	59211	59028
	$21.95	$48.50

Panama Angle Gauge

Allows you to measure the basal area of a for& stand using the English BAF 10. It consists of an B-1 / 4" hollow plastic tube with an eyepiece opening in one end.

To use, position yourself so the eyepiece is directly over the sampling point, look through the eyepiece and "count': each tree that appears wider at breast height than the vertical portion of the cross-shaped opening. See examples.

59350 (4 oz.) $24.70

Count this Tree.

Do not count this **Tree**

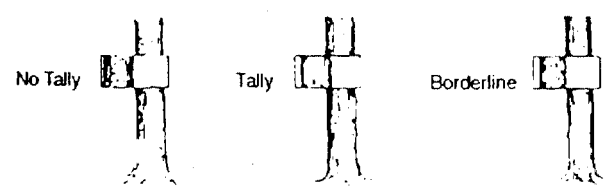
Pointers on using the Wedge Prism

Hold it correctly – hold prism at any convenient distance from the eye, directly over the sampling point. Hold in a vertical position and at a right angle to the line of sight.

Correct it for slope – make corrections in point sampling when slope is 15% or greater (that is a 15-ft. rise or drop in elevation per 100 horizontal feet). (For slope correction using a secant-clinometer, multiply the BAF of the prism/angle gauge times the secant value of the slope in the direction of each tally tree. This reading will be the BA of the tally tree. Trees sampled in this method should be added together to obtain the total BA for the plot.) When the wedge prism is used, an appropriate on-the-ground compensation for slope can be made by tilting the top edge of the prism through the estimated slope angles.

Clear or amber glass – clear glass prisms perform satisfactorily in most cruising conditions. Amber glass prisms prove superior when cruising is done in low light, hazy or misty conditions.

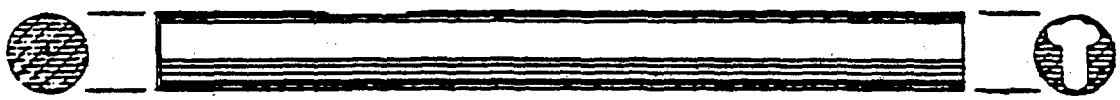
Handling borderline trees – tree stems not completely offset when viewed through the prism are counted; others are not tallied. Measure and check borderline trees with the appropriate plot radius factor before deciding to tally every other borderline stem.



PANAMA
BASAL AREA
ANGLE GAUGE

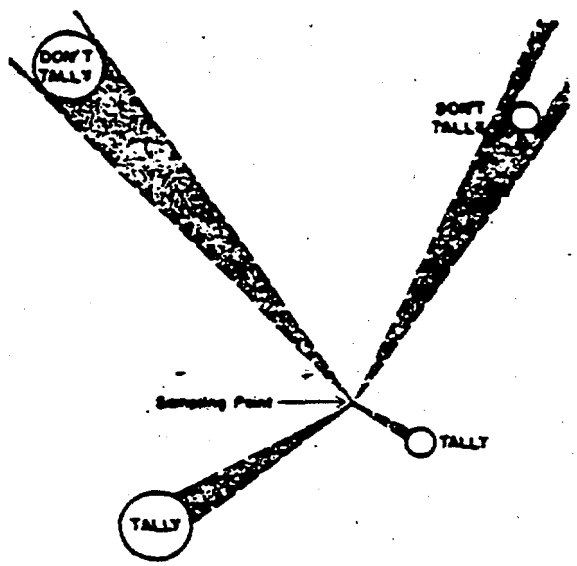
The PANAMA Basal Area Angle Gauge is a modification of the 33" long gauge described in Article by Mr. L. R. Grosenbaugh. Journal of Forestry Vol. 50. No. 1. Jan. 1952. In reducing the length we have tried to mak it more convenient to carry - - - and use.

In the PANAMA Angle gauge the cruiser looks thru the tube instead of over the top In reducing the overal length of the gauge we have maintained the plot radius factor or angle of 104.18 minutes. In the forward enc of the tube we have the two upright lines for paralleling the sides of the tree. We hve opened the parallel line near the top so that the cruiser can more quickly come to a decision oa borderline trees. We have also adde 8 slight arch in the exact top center for "centering" the tree. The widening of the Jot at the top for admittin light oa either side and the arch at the top will greatly help in overcoming the objection to a shorter gauge.



FIXED TYPE (8¼ inches long)

Plotless *timber* cruising. Shaded areas represent 104.10 minute angles optically established by the instrument described above. Circles represent cross-sections (at breast height) of trees viewed from the sampling point. Cruiser merely stands at the sampling point (analagous to a plot center). counts every tree whose d.b.h. appears larger than the angle or aperture, and disregards every tree whose d.b.h. appears smaller. All visible from the sampling point must be counted or rejected. The count of trees, multiplied by 10 gives a m estimate of basal area per acre. In the diagram. only two trees are counted, so the basal area estimate is 20 square feet per acre. Reliable estimates require more than one sample, of course.



Basal Area Estimates

Assured of an instrument. the cruiser should decide oa the pattern of sampling points (analagous to plot centers) that he wishes to employ on the area to he cruised. He must then visit each sampling point (or at least an unbiased point in its vicinity):. look in every direction through his instrument, and count the number *of* trees whose d.b.h. s appear larger than the crosspiece or aperture. The principle is illustrated in figure 1. The eyepiece (or vertex) of the angle-gaug should pivot on the sampling *point* until the *count* is completed, except that it may be temporarily mom sideways perpendicular to the line of right to clear nearby brush or trees likely to mask other qualifying trees After a little practice. the cruiser will find he can gauge all but borderline trees by eye alone.

Suppose that the cruiser has tallied a total of 240 qualifying trees at 30 unbiased sampling points oa the area

$$\text{Estimated basal area per acre} = (10)\left(\frac{\text{Number of tallied trees}}{\text{Number of sampling points}}\right) = (10)\left(\frac{240}{30}\right) = 80 \text{ sq. ft.}$$

Fixed Type, Weight 2 oz.

Panama Pump Company.

P. O. Box 15626 HATTIESBURG, MISSISSIPPI, U. S. ,A 39404-5626 Phone Area Code 601—544-42

3.12 LINE INTERCEPT (OR LINE TRANSECT)

3.12.1 Variables Estimated

Basal or canopy cover of herbs, shrubs, or trees (pp. 5, 7).

3.12.2 Description

In summary, a meter tape is stretched out to form a line in the site. The crew moves along the meter tape and records the measurement at which the line passes over or under the edges of the individual plants.

A randomly located straight line transect is laid out in the site (see Appendix A for a discussion of how to establish a random transect and how to lay it out on the ground). The crew moves along the tape and projects the plant canopies (or basal areas) vertically to the tape and records the length of the line segment and the kind of plant involved (Fig. 10). If individual plants overlap, each is measured separately. When the line passes close to the intercepted parts of the canopy, it is possible to "eyeball" the vertical projection from the plant to the line. If the line passe's farther from the intercepted parts of plants (e.g., tree canopies), it is important to use a precise method of projecting, such as the Lindsey Sighting Level (p. 35) or the Vertical Rod (p. 39). After completing the transect, pulling on the end of the tape should permit one to break or pull out the anchor stick, so the tape can be rewound.

Calculations are generally as follows for each plant type (X) (e-g., plant species) recorded:

$$C = \frac{\Sigma I}{\ell} (100)$$

where C_x = cover of x (%)

ΣI_x = sum of intercepts with x

ℓ = lengths of the line transect

3.12.3 Accuracy

This technique gives quite accurate results. Accuracy is highest if the plants measured have the same growth form and similar crown diameters

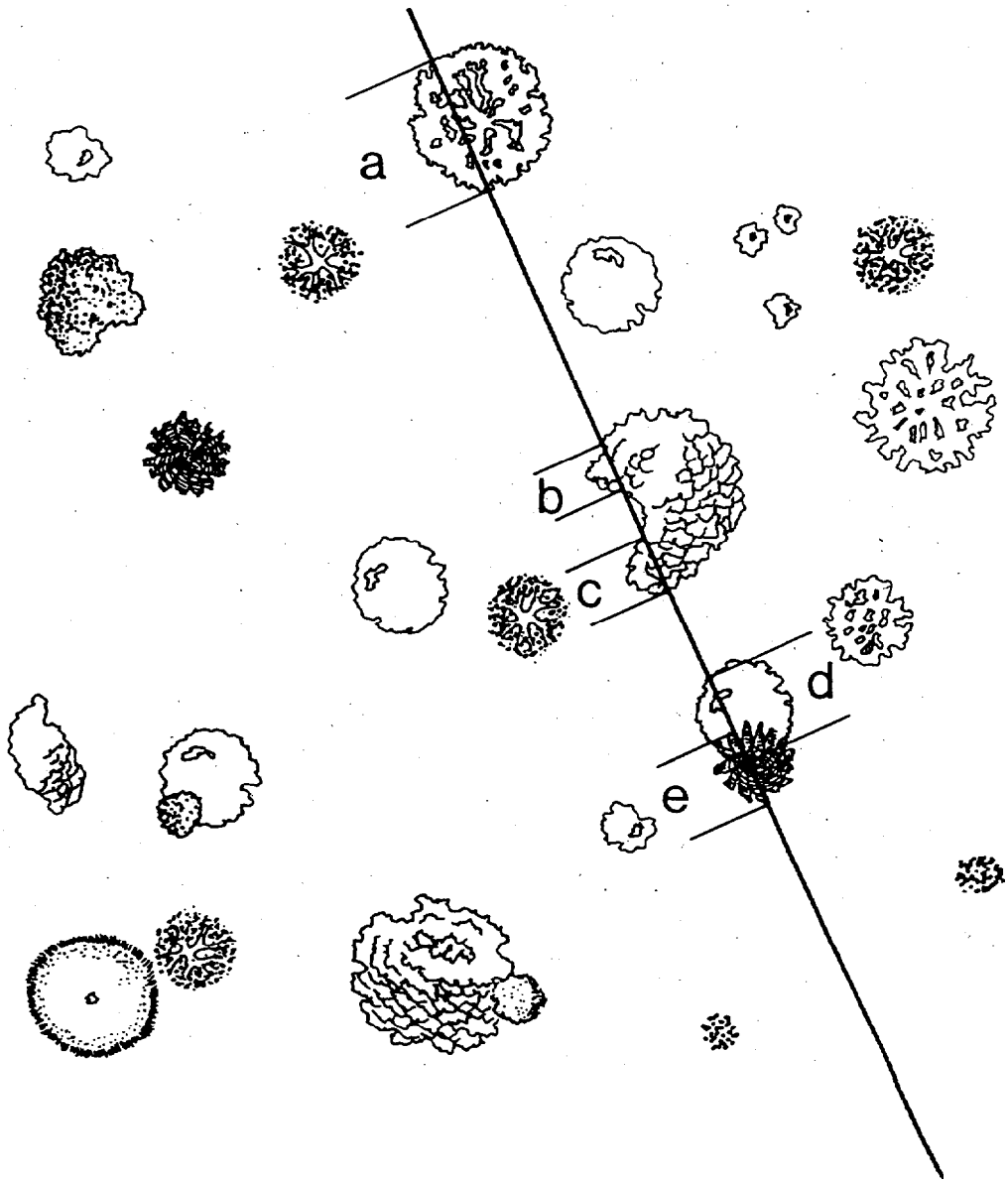
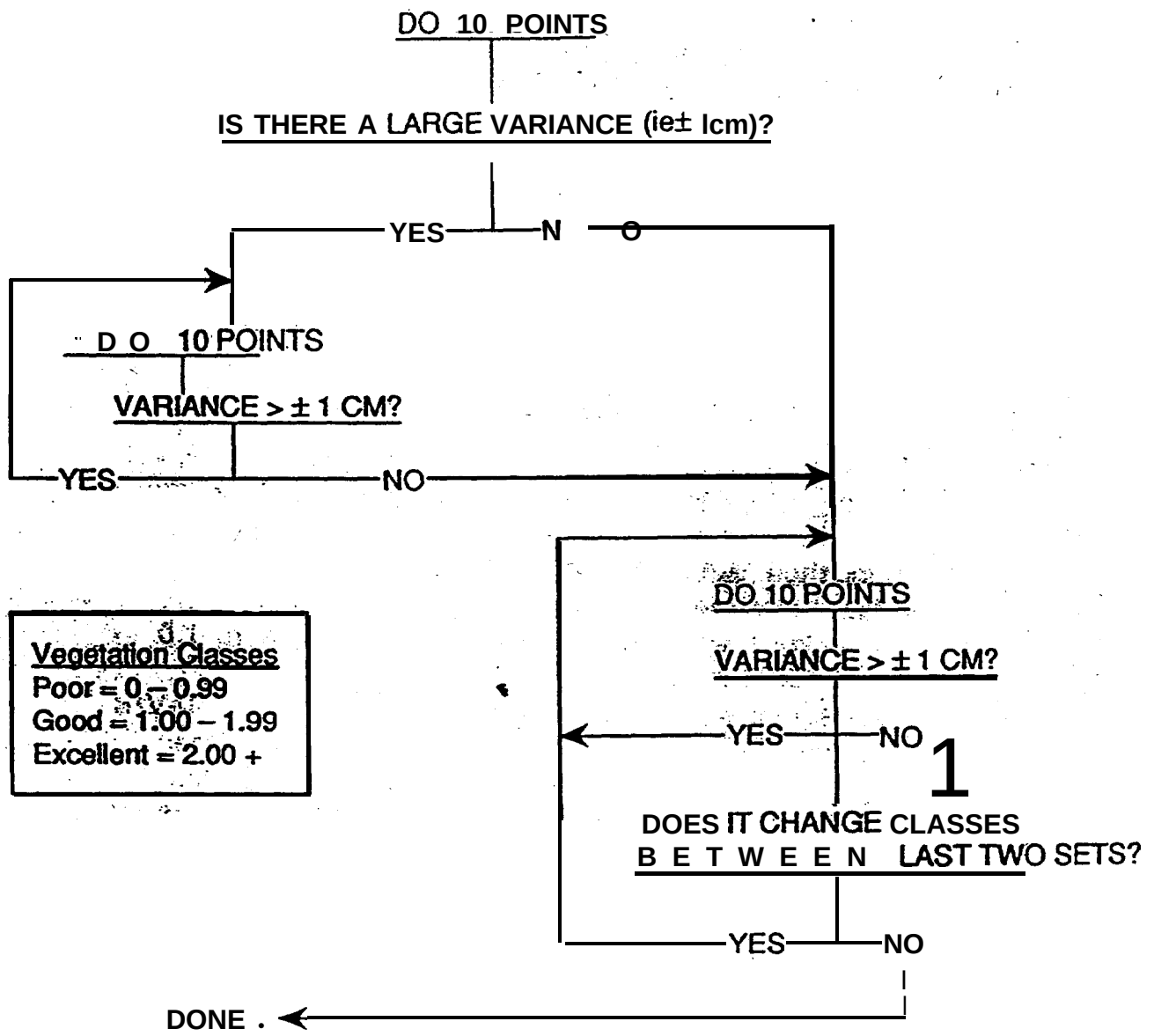


Figure 10. View from above of the Line Intercept technique showing a transect line with intercepts indicated.

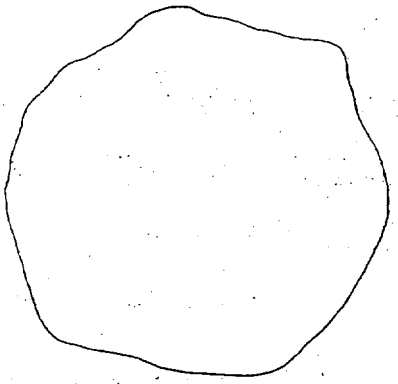
Habitat Sampling method that utilizes a running mean to determine the number of points necessary to adequately describe habitat conditions.



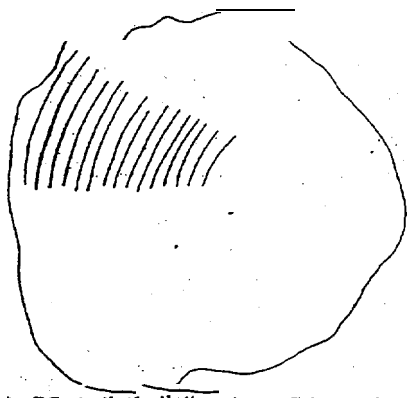
. Report the mean of the last ten running mean values.

SECTION C

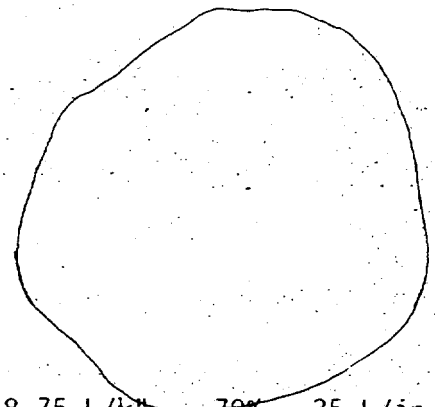
SLOPE COMPARISON CHART
For 7.5' Quadrangle



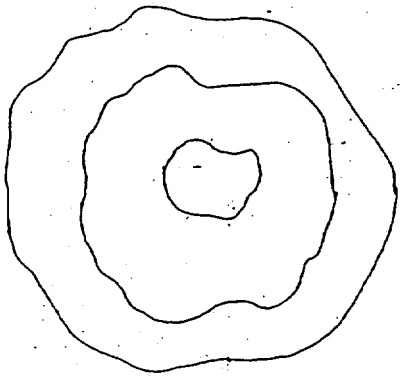
1% .5 L/in.



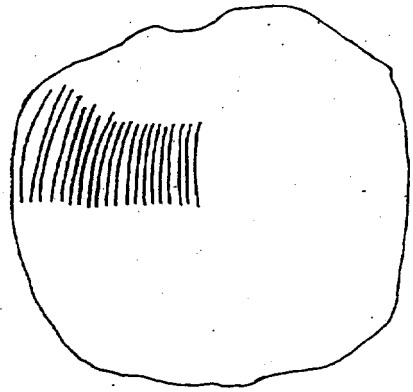
3.75 L/¼" 30% 15 L/in



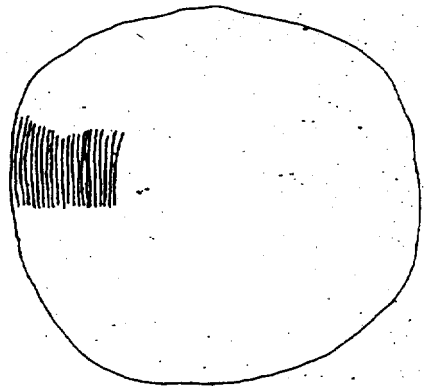
8.75 L/¼" 70% 35 L/in.



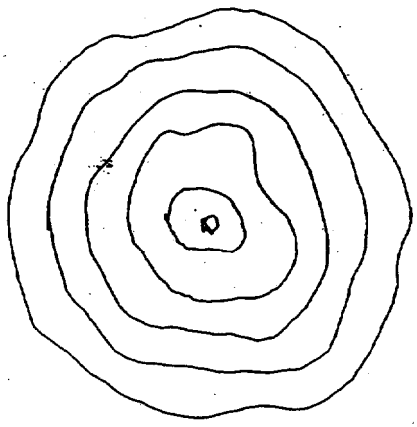
5% 2.5 L/in.



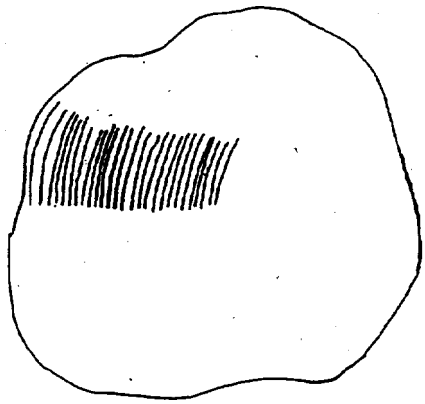
5 L/¼" 40% 20 L/in.



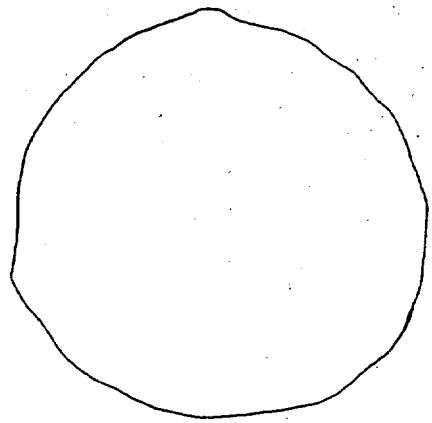
10 L/¼" 80% 40 L/in.



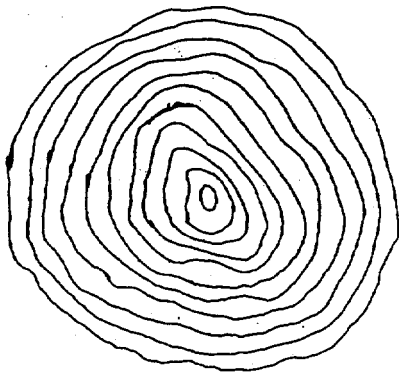
1.25 L/¼" 10% 5 L/in.



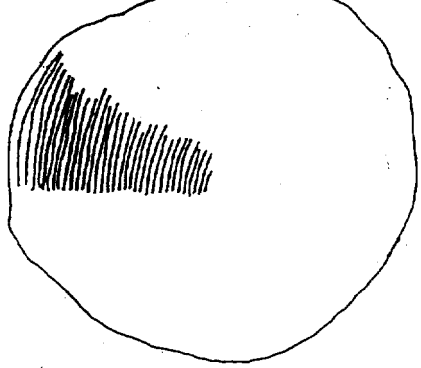
6.25 L/¼" 50% 25 L/in



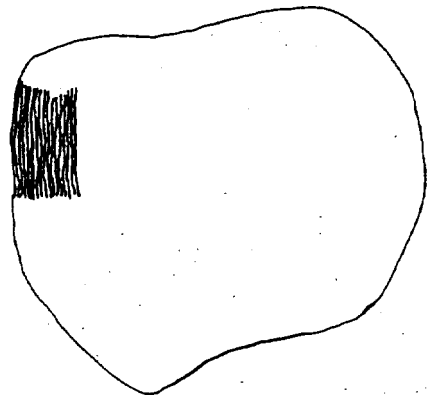
11.25 L/¼" 90% 45 L/in.



2.5 L/¼" 20% 10 L/in.



7.5 L/¼" 60% 30 L/in.



12.5 L/¼" 100% 50 L/in.

APPENDIX F

HABITAT SUITABILITY INDICES/HABITAT UN-IT SUMMARIES

G	A	B	C	0	E	F	G	H	I	J	K	L	M
64	COLUMBIA RIVER WILDLIFE MITIGATION HABITAT UNIT SUMMARY												
65													
66													
67	Project Sub-Area	Ownership	MOA Minimum HUs	TY 20 HUs	Acres								
68													
69	Scotch Creek/Happy Hill	WDFW	2,874	5,608	7,300								
60													
61	Pogue Mountain	WDFW	287	742	1,414								
62													
63	Chesaw	WDFW	1,283	2,656	4,290								
64													
65	Tunk	WDFW	362	839	1,087								
66													
67	TOTAL HUs/ACRES		4,806	9,845	14,091								
68													
69													
70													
71	Baseline (TY 0) / Projected (TY 20) HUs For Scotch Creek Project												
72													
73	Project Sub-Area	Ownership	Cover Type	Acre8	HEP Model	TY 0 HSI (Baseline)	TY 0 HUs (Baseline)	W/O Project HSI	TY 10 HSI (Projected Minimum HSI)	MOA Projected HSI Gains (I - H)	MOA Credited Minimum HUs (D x J)	TY 20 HSI (Potential)	TY 20 HUs (Potential)
74													
75	Scotch Creek/Happy Hill	WDFW	Grassland	111	Sharp-tailed Grouse	0.2	22	0.1	0.3	0.2	22	0.5	56
76					Mule Deer	0.0	0	0.0	0.2	0.2	22	0.2	22
77			Grassland-Native Like	993	Sharp-tailed Grouse	0.3	298	0.2	0.4	0.2	199	0.5	497
78					Mule Deer	0.0	0	0.0	0.1	0.1	99	0.1	99
79			Shrub-Grass	3,237	Sharp-tailed Grouse	0.2	647	0.1	0.3	0.2	647	0.5	1,619
80					Mule Deer	0.2	647	0.1	0.3	0.2	647	0.3	971
81			Shrub-Land	1,209	Sharp-tailed Grouse	0.3	363	0.2	0.4	0.2	242	0.5	606
82					Mule Deer	0.4	494	0.3	0.5	0.2	242	0.5	606
83			Emergent Wetland	198	Sharp-tailed Grouse	0.2	40	0.1	0.3	0.2	40	0.5	99
84					Mule Deer	0.0	0	0.0	0.1	0.1	20	0.1	20
85			Riparian Forest	15	Downy Woodpecker	1.0	15	0.9	1.0	0.1	1	1.0	15
86			Riparian Shrub	46	Yellow Warbler	0.0	0	0.0	0.5	0.5	24	0.5	24
87			Conifer Forest	194	White-tailed Deer	0.7	136	0.6	0.8	0.2	39	0.8	155
88			Conifer Woodland	261	Lewis Woodpecker	0.5	131	0.4	0.6	0.2	52	0.6	157
89			Forested Wetland	88	Downy Woodpecker	1.0	88	0.9	1.0	0.1	9	1.0	88
90			Agriculture	436	Sharp-tailed Grouse	0.0	0	0.0	0.5	0.5	218	0.5	218
91			Deciduous Forest	10	Downy Woodpecker	1.0	10	0.9	1.0	0.1	1	1.0	10
02	Acquisition	SPA	Shrub-Grass	500	Sharp-tailed Grouse	0.2	100	0.0	0.4	0.4	200	0.4	200
93					Mule Deer	0.1	50	0.0	0.3	0.3	150	0.3	150
94	Sub-Total Acres/HUs			7,300			3,030				2,874		5,606

G	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Project Sub-Area	Ownership	Cover Type	Acres	HEP Model	TY 0 HSI (Baseline)	TY 0 HUs (Baseline)	W/O Project HSI	TY 10 HSI (Projected Minimum HSI)	MOA Projected HSI Gains (I-H)	MOA Credited Minimum HUs (D x J)	TY 20 HSI (Potential)	TY 20 HUs (Potential)
2													
3	Chesaw	WDFW	Grassland	562	Sharp-tailed Grouse	0.1	56	0.0	0.3	0.3	169	0.5	281
4					Mule Deer	0.0	0	0.0	0.1	0.1	56	0.1	56
5			Grassland-Native Like	2,729	Sharp-tailed Grouse	0.2	546	0.1	0.3	0.2	546	0.5	1,366
6					Mule Deer	0.0	0	0.0	0.1	0.1	273	0.1	273
7			Shrub-Grass	192	Sharp-tailed Grouse	0.1	19	0.0	0.2	0.2	38	0.5	96
8					Mule Deer	0.2	38	0.1	0.3	0.2	38	0.3	58
9			Shrub-Land	198	Sharp-tailed Grouse	0.2	40	0.1	0.3	0.2	40	0.5	99
10					Mule Deer	0.5	99	0.4	0.5	0.1	20	0.5	99
11			Emergent Wetland	80	Mink	0.2	16	0.1	0.3	0.2	16	0.3	24
12			Riparian Forest	104	Downy Woodpecker	0.8	83	0.7	0.8	0.1	10	0.8	83
13			Riparian Shrub	25	Yellow Warbler	0.4	10	0.3	0.5	0.2	5	0.5	13
14			Forested Wetland	14	Downy Woodpecker	1.0	14	0.9	1.0	0.1	1	1.0	14
15			Conifer Forest	125	White-tailed Deer	0.5	63	0.4	0.6	0.2	25	0.6	75
16			Dense Conifer Forest	49	White-tailed Deer	0.8	39	0.7	0.8	0.1	5	0.8	39
17			Mixed Forest	205	White-tailed Deer	0.3	62	0.2	0.4	0.2	41	0.4	82
18			Surface Water	7	N/A	0.0	0	0.0	0.0	0.0	0	0.0	0
19	Sub-Total Acres/HUs			4,290			1,085				1,283		2,656
20													
21													
22	Tunk	WDFW	Grassland	82	Sharp-tailed Grouse	03	2 0	0.2	0.4	0.2	16	0.6	41
23			Mule		Deer	0.0	26	0.0	0.1	0.1	7	0.5	8
24			Grassland-Native Like	87	Sharp-tailed Grouse	03	02	04	02	1	9	0.1	44
25					Mule Deer								9
26			Shrub-Grass	647	Sharp-tailed Grouse	0.0	0 194	0.0	0.1	0.2	129	0.5	324
27					Mule Deer	0.3	194	0.2	0.4	0.2	129	0.4	259
28			Shrub-Land	159	Sharp-tailed Grouse	0.3	48	0.2	0.3	0.1	16	0.5	80
29					Mule Deer	0.3	48	0.2	0.3	0.1	16	0.3	48
30			Riparian Forest	60	Downy Woodpecker	0.1	6	0.0	0.2	0.2	12	0.2	12
31			Riparian Shrub	14	Yellow Warbler	0.3	4	0.2	0.4	0.2	3	0.4	6
32			Conifer Forest	17	White-tailed Deer	0.4	7	0.3	0.5	0.2	3	0.5	9
33			Conifer Woodland	21	Lewis Woodpecker	0.1	2	0.0	0.1	0.1	21	0.1	2
34	Sub-Total Acres/HUs			1,067			553				3621		839
35													
36													
37	Poque Mountain	WDFW	Grassland-Native Like		Sharp-tailed Grouse	0.3	2	0.2	0.4	0.2	1	0.4	2
38					Mule Deer	0.0	0	0.0	0.0	0.0	0	0.0	0
39			Shrub-Grass	207	Sharp-tailed Grouse	0.2	41	0.1	0.2	0.1	21	0.2	41
40					Mule Deer	0.2	41	0.1	0.3	0.2	41	0.3	62
41			Shrub-Land	499	Sharp-tailed Grouse	0.2	100	0.1	0.3	0.2	100	0.3	150
42					Mule Deer	0.5	250	0.4	0.5	0.1	50	0.5	250
43			Emergent Wetland	21	Mink	0.1	2	0.0	0.1	0.1	2	0.1	2
44			Riparian Shrub	11	Yellow Warbler	0.2	2	0.1	0.3	0.2	2	0.3	3
46			Conifer Forrnt	181	White-tailed Deer	0.9	163	0.8	0.9	0.1	18	0.9	163
46			Conifer Woodland	419	Lewis Woodpecker	0.1	42	0.0	0.1	0.1	42	0.1	42
47			Dense Conifer Forest	14	White-tailed Deer	0.9	13	0.8	0.9	0.1	1	0.9	13
48			Mixed Forest	35	White-tailed Deer	0.2	7	0.1	0.3	0.2	7	0.3	11
49			Agriculture	18	Sharp-tailed Grouse	0.1	2	0.1	0.2	0.1	2	0.2	4
50			Exposed	4	N/A	0.0	0	0.0	0.0	0.0	0	0.0	0
51	Sub-Total Acres/HUs			1,414			664				287		742
52													

A	A	B	C	D	E	F	G	H	I	J	K	L
49	Project	Ownership	Cover Type	Acres	HEP Model	Baseline HSI	Baseline HUs	W/O Project HSI	W/O Project HUs	Projected HSI	Projected HUs	Credited HUs
50												
51	Douglas Co. Pygmy Rabbit	WDFW	Shrubland	140	Pygmy Rabbit	0.6	84	0.5	70	0.6	84	14
52					Mule Deer	0.1	14	0.0	0	0.1	14	14
53					Sage Grouse	0.4	56	0.3	42	0.4	56	14
54			Agriculture	100	Pygmy Rabbit	0.0	0	0.0	0	0.6	60	60
55					Mule Deer	0.0	0	0.0	0	0.1	10	10
56					Sage Grouse	0.0	0	0.0	0	0.5	50	50
57	Total Acres/HUs			240			154		112		274	162
58												
59												
60	Pygmy Rabbit CRMP	WDFW	Shrubland	3,500	Pygmy Rabbit	0.6	2,100	0.5	1,750	0.7	2,450	700
61					Mule Deer	0.2	700	0.1	350	0.2	700	350
62					Sage Grouse	0.5	1,750	0.4	1,400	0.5	1,750	350
63	Total Acres/HUs			3,500			4,550		3,500		4,900	1,400
64												
65												
66	Dormaier Property	BPA	Shrubland	320	Pygmy Rabbit	0.4	12s	0.3	96	0.5	160	166
67					Mule Deer	0.6	160	0.4	12s	0.5	160	160
68					Sage Grouse	0.5	160	0.4	128	0.5	160	160
69	Total Acres/HUs			320	-- [illegible] --	[illegible]	448		352		480	480
70												
71	Berg Brothers	CCT	Grassland	3,108	Sharp-tolled Grouse	0.4	1.243					
72					Mule Deer	0.2	715					
73			Shrub-grass	1,950	Sharp-tailed Grouse	0.3	585					
74					Mule Deer	0.6	585					
75			Riparian Shrub	462	Mule Deer	0.2	271					
77			Agriculture	540	Sharp-tailed Grouse	[illegible]	108					
78			Conifer Woodland	160	Lewis' Woodpecker	0.2	30					
			Deciduous Woodland	32	Yellow Warbler	0.4	13					
							8					
80			Exposed/Shoreline	20	Canada Goose	0.2	4					
81	Total Acres/HUs			6,293			3,562					

APPENDIX G

PLANT AND WILDLIFE SPECIES LIST

APPENDIX G

PLANT AND WILDLIFE SPECIES LIST

Common Name	Scientific Name
PLANTS	
Yarrow	*Achillea millefolium*
Cattail	***Typha latifolia***
Sedges	*Carex* **sp.**
Cheat grass	***Bromus tectorum***
Crested wheatgrass	***Agropyron cristatum***
Bluebunch wheatgrass	***A. spicatum***
Great Basin wild rye	*Elymus condensatus*
Needle and thread grass	*Stipa* **comata**
Sandberg bluegrass	***Poa sandbergii***
Sherman big bluegrass	***P. ampla***
Idaho fescue	*Festuca idahoensis*
Diffuse knapweed	*Centaurea diffusa*
Russian knapweed	***C. repens***
Buckwheat	*Eriogonum* **sp.**
Balsamroot	***Balsamorhiza sp .***
Wheat	*Triticum* **sp.**
Rye	*Secale* **sp.**
Currant	***Ribes sp.***
Wild rose	***Rosa woodsii***
Rabbit brush	*Chrysothamnus* **sp.**
Bitterbrush	***Purshia tridentata***
Big sagebrush	***Artemisia tridentata***
Stiff sagebrush	***A. rigida***
Three-tipped sagebrush	***A. tripartita***
Chokecherry	***Prunus virginiana***
Serviceberry	***Amelanchier alnifolia***
Dogwood	*Cornus* **sp.**
Black cottonwood	***Populus trichocarpa***
willow	*Salix* **sp.**
Water birch	***Betula occidentalis***
Alder	*Alnus* **sp.**
Aspen	***Populus tremuloides***
Ponderosa pine	*Pinus* **ponderosa**
Douglas fit	*Pseudotsuga* **menziesii**
Grand fir	***Abies grandis***

PLANT and **WILDLIFE SPECIES LIST** (cont.)

Common Name	Scientific Name
MAMMALS	
Mink	*Mustela vison*
Mule deer	*Odocoileus hemionus*
White-tailed deer	*O. virginianus*
Pygmy rabbit	*Brachylagus idahoensis*
Elk	*Cervus canadensis*
BIRDS	
Canada Goose	*Branta canadensis*
Ruffed grouse	*Bonasa umbellus*
Downy woodpecker	*Picoides pubescens*
Lewis' woodpecker	*Melanerpes lewis*
Yellow warbler	*Dendroica petechia*
Sharp-tailed grouse	*Tympanuchus phasianellus*
Sage grouse	*Centrocercus urophasianus*