BONNEVILLE POWER ADMINISTRATION

Habitat Evaluation Procedures (HEP) Report

Grand Coulee Dam Mitigation

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GRAND COULEE DAM WILDLIFE MITIGATION HABITAT EVALUATION PROCEDURES REPORT

Spokane Tribe of Indians Wildlife Mitigation Projects

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES II

ABSTRACT III

INTRODUCTION 1

HABITAT EVALUATION PROCEDURES (HEP) CONCEPTS 2

PROJECT AREA 3
- McCoy Lake Watershed Management Area 3
  - A 401-A 3
  - Etue 3
  - Harris 4
  - Kenworthy 4
  - People of the Living God 5
- Fox Creek Management Area 6
  - Kieffer 6
  - Smith 6
- Blue Creek Wildlife Management Area 7
  - A 322 7
  - Blue Creek Wildlife Management Area 7
- Turtle Lake/Wellpinit Mtn. Wildlife Area 8
  - A 67-B 8

DESCRIPTION OF COVER TYPES 11

METHODS 13
- Hiding Cover Pole 15
- Robel Pole 15
- Vegetation Ring 15
- Shrub Intercept 15
- Densitometer 16
- Occular Estimation 16
- Model Design and Assumptions 16

EVALUATION SPECIES MODEL RESULTS 17
- White-tailed Deer 17
- Yellow Warbler 18
- Mule Deer 19
- Sharp-tailed Grouse 20
- Western Meadowlark 21
- Ruffed Grouse 22

SUMMARY 23

GLOSSARY 24

LITERATURE CITED 27

APPENDIX A: HEP TEAM MEMBERS 29

APPENDIX B: HEP EVALUATION RATING SCALE 30

APPENDIX C: PLANT AND WILDLIFE SPECIES LIST 31

APPENDIX D: HABITAT UNITS FOR CREDITING PURPOSES 32

APPENDIX E: HSI MODELS 33

LIST OF TABLES AND FIGURES

TABLE 1: STOI HEP VERSUS LOSS ASSESSMENTS 2

TABLE 2: PROJECT AREA COVER TYPES AND ACREAGES 12

TABLE 3: HEP SURVEY SAMPLING TECHNIQUES 14

TABLE 4: WHITE-TAILED DEER BASELINE HEP SURVEY RESULTS 17

TABLE 5: YELLOW WARBLER BASELINE HEP SURVEY RESULTS 18

TABLE 6: MULE DEER BASELINE HEP SURVEY RESULTS 19

TABLE 7: SHARP-TAILED GROUSE BASELINE HEP SURVEY RESULTS 20

TABLE 8: WESTERN MEADOWLARK BASELINE HEP SURVEY RESULTS 21

TABLE 9: RUFFED GROUSE BASELINE HEP SURVEY RESULTS 22

FIGURE 1: STOI HEP SURVEY STUDY SITES 9

FIGURE 2: STOI WINTER RANGE ZONES 10

ABSTRACT

The purpose of this Habitat Evaluation Procedures (HEP) study was to determine baseline habitat units and to estimate future habitat units for Bonneville Power Administration (BPA) mitigation projects on the Spokane Indian Reservation. The mitigation between BPA and the Spokane Tribe of Indians (STOI) is for wildlife habitat losses on account of the construction of Grand Coulee Dam. Analysis of the HEP survey data will assist in mitigation crediting and appropriate management of the mitigation lands.

The HEP team included members of the STOI's Wildlife Program. Surveys were conducted on 6 evaluation species consisting of White-tailed deer (*Odocoileus virginiana*), Mule deer (*Odocoileus hemionus*), Sharp-tailed grouse (*Tympanuchus phasianellus*), Western meadowlark (*Sturnella neglecta*), Ruffed grouse (*Bonasa umbellus*), and Yellow Warbler (*Dendroica petechia*).

HEP Results Overview:

White-tailed deer habitat was fair with most areas lacking large conifer (>35' tall) canopy closure resulting from timber harvest prior to Spokane Tribe acquisition.

Mule deer habitat was marginal to good and was lacking evergreen canopy closure for cover.

Sharp-tailed grouse habitat was rated as fair to good, but lacks adequate winter cover and food.

Western meadowlark habitat was good to excellent, only 2 units were rated lower due to hay harvest prior to acquisition and no grass components present.

Ruffed grouse habitat was assigned an HSI value of 1.0 (no adequate model exists),which could occur with proper management.

Yellow warbler habitat was fair, lacking hydrophytic shrubs within riparian areas.

Management of the units will focus on the habitat variables that are lacking for the evaluation species.

INTRODUCTION

The Spokane Tribe of Indians (STOI) has a long history of occupation in Northeast Washington, possibly for as long as 6,000 or more years (Scholz et. al. 1985). During that time, and until just 59 years ago, they depended heavily on the Columbia River for their livelihood. For example, they collected as much as 60% of their food resources in just 60 days in the form of anadromous fish (Scholz et. al. 1985). They supplemented much of the remainder of their diet with the hunting of big game animals that were reported as abundant along the river during the winter (Douglas 1914).

All of this changed the year Grand Coulee Dam spanned the Columbia River and flooded over 80,000 acres of rich riparian floodplain. Both fish and wildlife suffered greatly. Anadromous fish quickly became extinct above the dam, with the loss of up to 2 million adults annually. All of the riparian river bottom (approximately 4,000 acres) along the reservation boundaries on both the Columbia and Spokane Rivers were lost. This greatly impacted wildlife, especially the wintering herds of deer upon which the tribal members depended as a winter food source. With the total loss of fish, and the great loss of big game along the river, tribal hunters now focus their attention to the interior forests of the Spokane Indian Reservation. This is something that was probably not common in the pre-dam years. Grand Coulee Dam has had an impact to not just fish and wildlife, but also to the culture of the Spokane Tribe.

The purpose of this report is to detail the state of the interim wildlife habitat mitigation for Grand Coulee Dam construction/inundation losses implemented to date. This process began in 1980 with the passage of the Pacific Northwest Electric Power Planning and Conservation Act (PL96-501). This act recognized the importance of fish and wildlife to the Pacific Northwest, and also the impact of the construction of the federal hydropower system upon them. Individual Habitat Evaluation Procedures (HEP) assessments were then conducted for each federal facility (Grand Coulee see Creveling and Renfrow 1986). The impacts of the dams to wildlife were then amended into the Fish & Wildlife Program in 1989 (NPPC 1989). Criteria were then developed to prioritize habitats, and to begin mitigation projects for habitat losses. In 1993, the STOI entered into an agreement with Bonneville Power Administration (BPA), in which BPA would begin funding wildlife mitigation projects (Interim Agreement WWC/BPA 1993). Protection and gains of habitats would be credited against the inundation losses of Habitat Units (HUs) to BPA for target species. In May 1996, the STOI and BPA signed a contract providing the Tribe with 4% of the 1993 Agreement funding.

Currently the Tribe has acquired 10 parcels (ranging in size from 35 to 701 acres and totaling 1863.5 acres) that have been approved as wildlife mitigation projects. Most of the parcels are located on the west end of the reservation where a large portion of the losses occurred. The purchasing criteria for the parcels focused on critical habitat, such as big game winter range and riparian areas.

HABITAT EVALUATION PROCEDURES (HEP) CONCEPTS

The U.S. Fish & Wildlife Service (USFWS) developed HEP as a method in an attempt for quantifying the value of wildlife habitat. HEP is based on the use of a Habitat Suitability Index (HSI) Model for an evaluation species. A model is composed of different habitat variables that a species needs to satisfy all its life requisites. The model allows you to calculate a HSI value for the evaluation species. The HSI value (from 0.0 to 1.0) is a ratio of the study area habitat conditions and the optimum habitat conditions for the species model. A HSI value of 1.0 indicates excellent habitat conditions for the species, while a 0.0 value is poor habitat. In comparing habitat losses and gains for a project, HEP obtains Habitat Units (HUs) for the species by multiplying the HSI value by the amount of habitat (usually acres).

The HSI models that were used for this evaluation consisted of one USFWS "Blue Book Species Model" and four modified species models. The USFWS model was for Yellow Warbler (Richard L. Schroeder, 1982), while the modified models included Western Meadowlark (mod. from Schroeder and Sousa, 1982), Sharp-tailed Grouse (Paul R. Ashley, 1996), White-tailed Deer (P. Ashley, M. Berger, and M. Whalen, 1998), and Mule Deer (Paul R. Ashley, 1996). These models were selected for evaluation based on the cover types present within the project area and the Grand Coulee Dam loss assessment (Table 1). Mitigation for Ruffed Grouse is being conducted even though an adequate HSI Model does not exist for this area. Proper management of riparian areas will have a valuable benefit to Ruffed Grouse in the future, which could result in a high HSI value.

Table 1: STOI HEP VERSUS LOSS ASSESSMENT

Dam	Loss Assessment Species (HU's)	HEP Evaluation Model	Cover Types
Grand Coulee	Sharp-tailed Grouse (2445)	Sharp-tailed Grouse Western Meadowlark	Grassland Shrub-steppe
	White-tailed Deer (1106)	White-tailed Deer	Conifer Woodland Grassland Riparian Agricultural Scrub-shrub Shrub-steppe
	Mule Deer (1019)	Mule Deer	Conifer Woodland Shrub-steppe
	Ruffed Grouse (913)	Ruffed Grouse	Riparian Scrub-shrub
	Mourning Dove (612)	Western Meadowlark	Agriculture
	Riparian Forest (165)	Yellow Warbler	Riparian

PROJECT AREA

All of the parcels were purchased with funding from BPA (Interim Washington Wildlife Mitigation Agreement).

- Refer to Figure 1 for map of Project Areas (p. 9).
- Refer to Figure 2 for map of Winter Range Zones (p. 10).

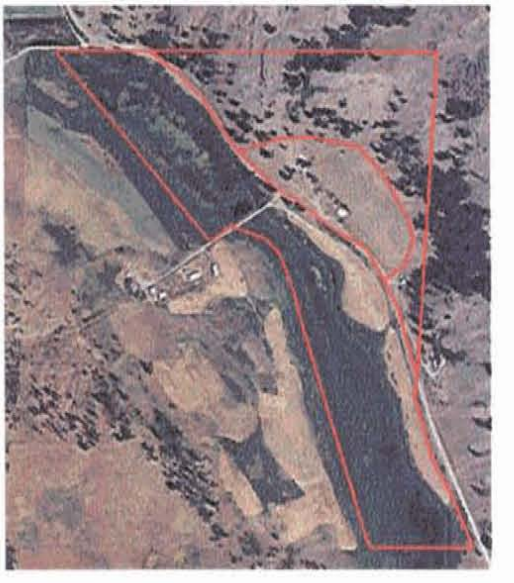
MCCOY LAKE WATERSHED MANAGEMENT AREA

A401-A

A401-A is located about 1.5 miles east of West End and lies within the McCoy Lake watershed. It is 35 acres in size and has 17 acres of heavily harvested conifer woodland, 10 acres of grassland, and 8 acres of riparian (McCoy Creek). This parcel was acquired for the protection and enhancement of important riparian habitat.

Etue

The Etue tract is located 2 miles northeast of West End and lies in the McCoy Lake watershed. It is a 74 acre parcel that includes 40 acres riparian, 27 acres conifer woodland, and 7 acres agricultural. The area was purchased for the protection and enhancement of the riparian habitat.



Harris

The Harris parcel is located 1.5 miles northeast of West End and is within the McCoy Lake watershed. It is the most diverse area at 180 acres and having 5 cover types. The cover types consist of 106 acres of conifer woodland (recently harvested), 53 acres of shrub-steppe, 22 acres of grassland, 5.5 acres of agriculture (extensive amounts of knapweed), and 3.5 acres of riparian habitat. The tract was acquired for the protection and improvement of the emergent wetland and riparian areas.

Kenworthy

The Kenworthy tract is located about 1.5 miles east-northeast of West End and is within the McCoy Lake watershed. The 40-acre parcel was purchased with a focus on management of the 8 acres of riparian habitat that includes 2 water sources (a spring to the east and McCoy Creek flowing through the property). The rest of the area is comprised of 30 acres of grassland and 2 acres of shrub-steppe.

People of the Living God

The People of Living God parcel is located 2.5 miles northeast of West End on the north boundary of the reservation. The area, including 123 acres that the Spokane Tribe of Indians contributed, totals 440 acres and lies within the McCoy Lake watershed. The cover types consist of 325 acres conifer woodland, 75 agricultural (currently active), 30 riparian (heavily grazed), and 10 grassland. The unit was purchased for the enhancement of the riparian area.

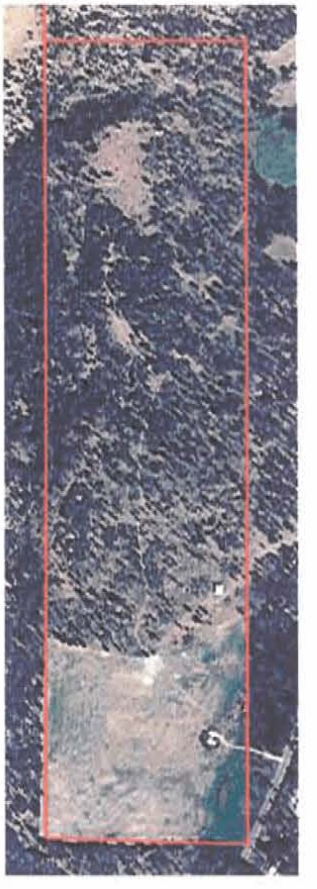
FOX CREEK MANAGEMENT AREA

Kieffer

The Kieffer tract is located approximately 4 miles northwest of West End and about 1 mile west of Highway 25. The unit is within the Castle Creek Winter Range Zone. The area is 40 acres in size and is composed of 28 acres of conifer woodland, 8 acres of riparian habitat which includes a 1 to 2 acre pond, and 4 acres of agriculture land. It was acquired primarily for the protection and enhancement of big game winter range and the riparian area.

Smith

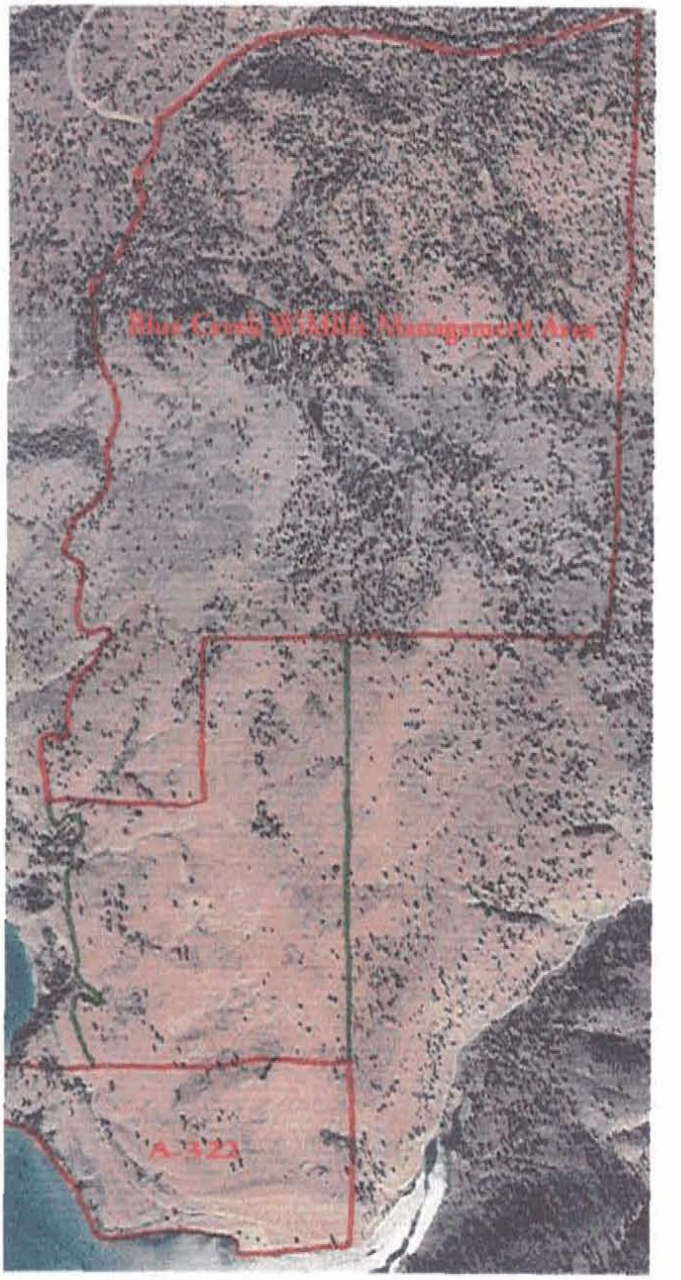
The Smith parcel is located about 3 miles west-northwest of West End along Highway 25 and within the Castle Creek Winter Range Area. The unit totals 160 acres and is composed of 115 acres of conifer woodland (harvested), 35 acres of agricultural land (harvested prior to acquisition), and 10 acres of riparian habitat. The parcel was purchased primarily for big game habitat and protection of the riparian area.



BLUE CREEK WILDLIFE MANAGEMENT AREA

A322

Parcel A322 is 77.5 acres located seven miles west of Wellpinit along the banks of the Spokane River and lies within the Blue/Sand Creek Winter Range Zone. Approximately 68.5 acres consists of shrub-steppe, while the other 9 is scrub-shrub habitat that is dominated by Douglas hawthorn and rose. The area was purchased because it is an important big game wintering area. In August 1996, approximately 580 acres within and adjacent to the parcel were burned by a wildfire. The fire killed a large portion of the bitterbrush that was utilized by big game during the winter months. Management is focused on protection and enhancement of the area for big game winter range.



Blue Creek Wildlife Management Area:

The Blue Creek Wildlife Management Area is located seven miles west of Wellpinit. The 701-acre area lies within the Blue/Sand Creek Winter Range Zone. The area is comprised of 572 acres of conifer woodland, 16 acres of riparian with a 1-acre pond, and 113 acres of shrub steppe. Management is focused on protection and enhancement of the area for big game winter range.

TURTLE LAKE/WELLPINIT MOUNTAIN WILDLIFE AREA

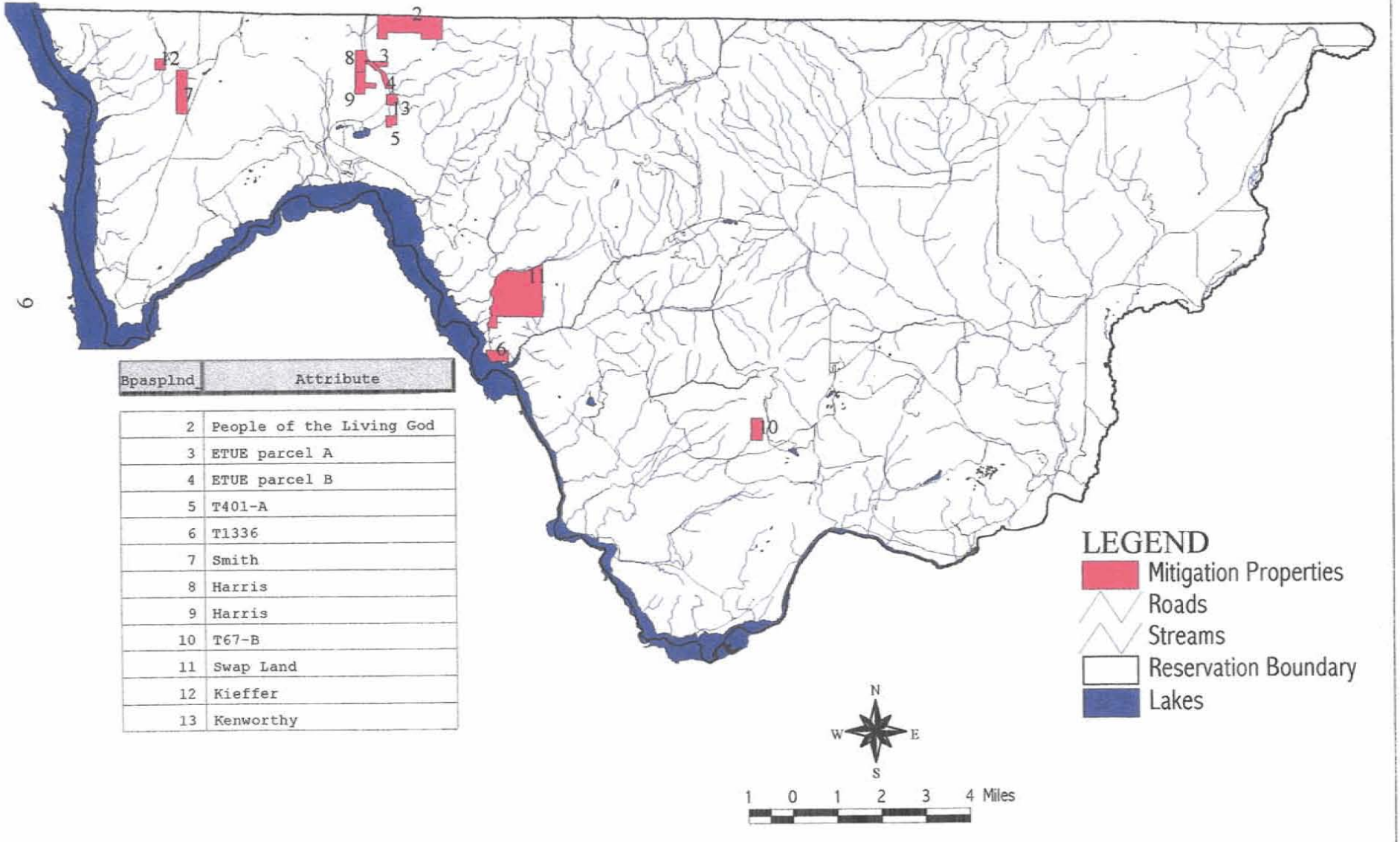
A67-B

A67-B is located two miles southwest of Wellpinit. The 80-acre unit is broken up into 50 acres of conifer woodland (extensive amounts of redstem ceanothus) and 30 acres of agricultural land. The area was purchased for the protection and enhancement of big game winter range.

Figure 1

SPOKANE INDIAN RESERVATION

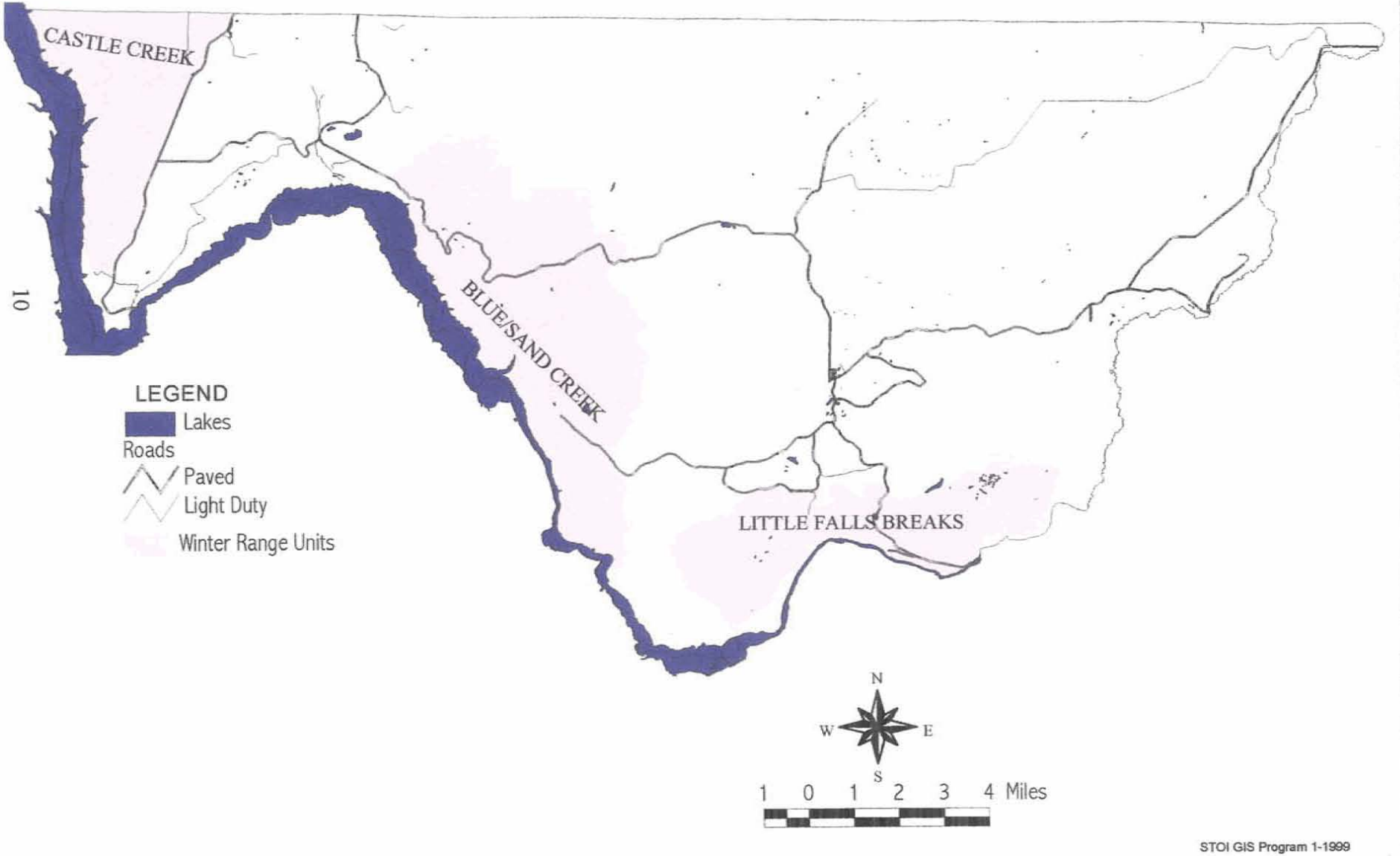
Wildlife Mitigation Properties - BPA Funded



Bpasplnd	Attribute
2	People of the Living God
3	ETUE parcel A
4	ETUE parcel B
5	T401-A
6	T1336
7	Smith
8	Harris
9	Harris
10	T67-B
11	Swap Land
12	Kieffer
13	Kenworthy

STOI GIS Program 4-1999

Figure 2
SPOKANE INDIAN RESERVATION
Big Game Winter Range Zones



DESCRIPTION OF COVER TYPES

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). Reasons for determining cover types are to select suitable evaluation (HSI) species models for a given habitat and to interpret the HEP data collected for that habitat.

The cover types that were identified and used include the following: Agriculture, Conifer Woodland, Grassland, Riparian, Scrub-shrub, and Shrub-steppe.

Agriculture: Areas that are/were in crop production; includes grain and/or hay crops.

Conifer Woodland: Habitat that is characterized by open stands of pine/fir species comprised of >70 percent conifers with greater than 20% canopy closure.

Grassland: Habitat comprised of grasses/forbs and less than 5 percent shrub canopy cover.

Riparian: Habitat that is immediately adjacent to surface water, vegetation consists of species that require moister environments.

Scrub-shrub: Habitat that has mesic vegetation due to the presence of ground water (seep, etc.) but lacks surface water. Example includes Douglas hawthorn, rose, and/or chokecherry thickets within a drier cover type.

Shrub-steppe: Xeric sites that are occupied by shrubs and herbaceous vegetation interspersed with bare ground, litter, and rock outcrops. Trees can be present (<20 percent canopy cover).

Table 2: PROJECT COVER TYPES AND ACREAGES

Wildlife Management Area	Project	Cover Type	Acres
McCoy Lake Watershed Management Area	A 401A	Conifer Woodland	17
		Grassland	10
		Riparian	8
		Total Acres	**35**
	Etue	Riparian	40
		Conifer Woodland	27
		Agriculture	7
		Total Acres	**74**
	Harris	Conifer Woodland	106
		Shrub-steppe	43
		Grassland	22
		Agriculture	5.5
		Riparian	3.5
		Total Acres	**180**
	Kenworthy	Grassland	30
		Riparian	8
		Shrub-steppe	2
		Total Acres	**40**
	People of the Living God (Includes Tribal Contribution	Conifer Woodland	325
		Agricultural	85
		Riparian	30
		Total Acres	**440**
Fox Creek Management Area	Kieffer	Conifer Woodland	29
		Riparian	8
		Agriculture	3
		Total Acres	**40**
	Smith	Conifer Woodland	115
		Agriculture	35
		Riparian	10
		Total Acres	**160**
Blue Creek Management Area	A 322	Shrub-steppe	68.5
		Scrub-shrub	9
		Total Acres	**77.5**
	Blue Creek Wildlife Management Area	Conifer Woodland	572
		Shrub-steppe	113
		Riparian	16
		Total Acres	**701**
	Blue Creek (Tribal Contribution)	Conifer Woodland	27
		Shrub-steppe	9
		Total Acres	**36**
Turtle Lake/Wellpinit Mountain Wildlife Area	A 67B	Conifer Woodland	57
		Agriculture	23
		Total Acres	**80**

Cover Type	Acres
Conifer Woodland	1275
Agriculture	148.5
Riparian	123.5
Shrub-steppe	235.5
Scrub-shrub	9
Grassland	72
TOTAL	**1863.5**

METHODS

The HEP team was comprised of members of the STOI "Wildlife Program" with assistance from Paul Ashley (Washington Dept. of Fish & Wildlife) and Matt Berger (Colville Confederated Tribes). The objective of the surveys was to determine baseline habitat units and to estimate future habitat units on wildlife mitigation lands. The project area consisted of 10 separate units that had been purchased through BPA mitigation funding. Information on land use and wildlife was collected for the units, along with maps and aerial photographs of the study areas. The next step in the study was to delineate the six different cover types that occurred in the areas. Five evaluation (HSI) species models were selected due to cover type delineation and STOI loss assessments. The objective of data collection was to attain all information needed to calculate the HSI value for the appropriate model. The HSI variable data was collected through the use of different surveying techniques (Table 3). Random transects consisting of 100' plots were run through the different cover types. Within each 100' plot there was a random point at which specific information was collected (% herbaceous cover, % hiding cover, etc.). Statistical analysis was conducted on an important habitat variable to determine the number of plots (feet) that needed to be run. Field data analysis was achieved through the calculation of the baseline HSI value and Habitat Units for the appropriate evaluation species. The final step of analysis included the estimation of future HUs for crediting purposes. The future HUs were based on sound habitat management practices.

Table 3: HEP SURVEY SAMPLING TECHNIQUES

Species Model	Technique	SI Variables
White-tailed Deer	Line Intercept	% Preferred Shrub Canopy < 5' Tall; Preferred Shrub/Tree Composition; Shrub Browse Diversity
	Hiding Cover Pole	% Horizontal Concealment
	Densitometer	% Conifer Canopy Cover ≥ 35' Tall; % Canopy Cover Trees/Shrubs ≥ 5' Tall
	Vegetation Ring	% Palatable Herbaceous Cover
	Remote Sensing/ Topography Maps	Width of Cover; Density of Roads per Square Mile; % of Area in Winter Wheat/Alfalfa; Distance Between Cover/Forage Areas
Mule Deer	Line Intercept	% Crown Cover of Preferred Shrubs < 5' Tall; % Crown Cover of All Shrubs < 5' Tall; # of Preferred Shrub Species Present
	Pocket-Rod	Mean Height of All Shrub Species
	Densitometer	% Evergreen Canopy Cover > 5' Tall
	Vegetation Ring	% Cover of Preferred Grass Species
	Remote Sensing/ Topography Maps	% of Area in Winter Wheat/Alfalfa; Density of Roads per Square Mile; Topographic Diversity; Solar Radiation Index
Western Meadowlark	Vegetation Ring	% Canopy Cover of Herb. Plants; % Herb. Canopy Cover Composed of Grass; % Shrub Canopy Cover
	Robel Pole (VOR)	Average Height of Herbaceous Canopy
	Line Tape	Distance to Perch Site
Sharp-tailed Grouse	Robel Pole (VOR)	VOR of Residual Veg.; % VOR Preferred Winter Forage Species
	Remote Sensing/ Topography Maps	% Slope; Distance Between Nesting/Winter Cover; Presence/Absence of Grain Crops; Distance to Cover; Suitability Index (Grain); % Area Providing Winter Food/Cover
Yellow Warbler	Line Intercept	% Deciduous Shrub Canopy Cover; % Decid. Shrub Canopy Comprised of Hydrophytic Shrubs
	Pocket-Rod	Avg. Height of Decid. Shrub Canopy

HIDING COVER POLE

The purpose of the hiding cover pole is to measure any concealment that is provided by vegetation and landscape obstructions for white-tailed deer. The hiding cover pole consists of a 1.5 m x 2.54 cm pole, which is divided into 3 equal segments (Griffith and Youtie, 1988). Sampling is done at a random point within each 100' plot along the transect, and at each random point 4 readings (2 along and 2 perpendicular to the transect) are taken 45 feet from the pole. For each of the four readings, there are three measurements (each increment of the cover pole) taken. Each of the increments is equal to 1/3 of the total hiding cover measurement (100%). The increment measurement is considered 100% then averaged to calculate the hiding cover percentage. This is then averaged over all the plots along the transect.

ROBEL POLE

The purpose of the Robel pole is to determine the Visual Obstruction Reading (VOR) for sharp-tailed grouse and western meadowlark. The pole consists of one 1.5 m x 2.54 cm pole (measuring) and a 1 m pole (sighting) that are connected by a 4 m rope (Robel et. al. 1970). The rope is connected to the top of the sighting pole and is attached 1 m up on the measuring pole. The measuring pole is broken up into 4 decimeter (dm) increments and the readings measure the number of increments that are completely obstructed to the nearest ½ increment. Four readings are taken at a random point along the 100' plot (2 along and 2 perpendicular to the transect). These readings are averaged for the plot and in turn averaged for the entire transect.

VEGETATION RING (Micro Plot)

The purpose of the vegetation ring is to determine the amount of canopy cover of herbaceous and shrub vegetation. The vegetation ring consists of an 11 ft cable that is connected end-to-end. A paired plot sample is taken at a random point within the 100' plot of a transect. The paired plot sample is conducted by sampling on both sides of the transect line. The ring is placed 5' from the transect line. The percent canopy cover of plant species located within the ring are then determined. The total of all species can exceed 100% due to different vegetation heights. The average is calculated for all the species present over the entire transect.

SHRUB INTERCEPT

The purpose of the shrub intercept is to calculate the percent canopy cover of shrubs and small trees (< 5' tall). A 200' line tape is laid out in a random direction to form a straight line. Trees and shrubs that vertically intercept the tape are measured for length of intercept and height. These measurements are then averaged for the entire transect.

DENSITOMETER

The purpose of the densitometer is to determine tree canopy closure. The densitometer is constructed of a 1 5/8" T-shaped hollow tube with an angled sighting mirror and offset leveling vials (vertical and horizontal). There is an engraved circle on the sight end and a solid dot on the vertical view end. When the instrument is leveled the solid dot will fall within the circle and if the dot covers a tree it is a "hit". An observation is taken every 10' along the entire transect. The number of hits is then divided by the total number of observations to determine the percent canopy closure.

OCULAR ESTIMATION

The estimation of a habitat variable by qualified wildlife personnel.

MODEL DESIGN & ASSUMPTIONS

The **white-tailed deer model** is designed to evaluate year round habitat and it is assumed that water is not a limiting factor.

The **mule deer model** is for the evaluation of only winter habitat. This model assumes that water is not a limiting factor and that herbaceous vegetation is not an important variable in a mule deer's winter diet.

The **sharp-tailed grouse model** is designed to evaluate potential habitat. The model does not focus on lek sites and assumes grain cover types are additive (optimum habitat can occur without grain crops being present).

The **western meadowlark model** is designed to evaluate habitat conditions in cover types such as grassland, agriculture (pasture), shrubgrass, shrubland, and shrub-steppe.

The **yellow warbler model** is designed to evaluate just the breeding habitat, since breeding habitat will include all of the life requisites.

No adequate **ruffed grouse model** was available; the HSI value (set at 1.0) was based on future potential with proper management.

EVALUATION SPECIES MODEL RESULTS

WHITE-TAILED DEER

White-tailed deer habitat throughout most of the project areas is rated as good to excellent. The reason for low HSI value in most areas is due to the lack of conifer cover (>35 feet). Many of the project sites were harvested prior to acquisition by the STOI. These parcels have adequate conifer regeneration to improve hiding cover and thermal cover over time. Planting preferred shrub species would increase the food HSI on these sites.

Table 4: WHITE-TAILED DEER BASELINE HEP SURVEY RESULTS

Management Area	Project Area	Acres	Baseline HSI	Baseline HUs
McCoy Lake Watershed Management Area	A401-A	35	1.0	35
	Etue	74	1.0	74
	Harris	180	1.0	180
	Kenworthy	40	1.0	40
	People LG*	440	1.0	440
Fox Creek Management Area	Kieffer	40	.68	27
	Smith	160	.79	126
Blue Creek Wildlife Management Area	A322	77.5	.19	15
	Blue Creek	701	.96	673
	Blue Creek (Tribal Contribution)	36	.96	35
Turtle Lake/Wellpinit Mtn. Wildlife Area	A67-B	80	.65	52

*Includes Tribal Contribution

YELLOW WARBLER

Yellow Warbler ratings range from marginal to excellent with most sites being considered fair. The limiting factor for high quality warbler habitat is the lack of hydrophytic shrubs. Planting hydrophytic shrubs within riparian areas would dramatically improve yellow warbler habitat.

Table 5: YELLOW WARBLER BASELINE HEP SURVEY RESULTS

Management Area	Project Area	Cover Type	Acres	Baseline HSI	Baseline HUs
McCoy Lake Watershed Management Area	A401-A	Riparian	8	.8	6
	Etue	Riparian	40	.12	5
	Harris	Riparian	3.5	.45	1
	Kenworthy	Riparian	8	.28	2
	People LG*	Riparian	30	.75	23
Fox Creek Management Area	Kieffer	Riparian	8	.36	3
	Smith	Riparian	10	.5	5
Blue Creek Wildlife Management Area	Blue Creek	Riparian	16	.38	6

*Includes Tribal Contribution

MULE DEER

Mule deer habitat within the conifer woodland and shrub-steppe cover types is rated as marginal to good. The low HSI is a result of low percentages of evergreen trees greater than 5 feet tall, which provides thermal cover. Excessive timber harvests is the primary reason for reduced cover within the conifer woodlands. There is adequate conifer regeneration to improve the cover HSI in the future. Allotment 322 and the Blue Creek WMA (shrub-steppe) also lack adequate cover and food, which was caused by the removal of bitterbrush in a wildfire. Seeding or planting bitterbrush would improve both cover and forage relatively quickly.

Table 6: MULE DEER BASELINE HEP SURVEY RESULTS

Management Area	Project Area	Cover Type	Acres	Baseline HSI	Baseline HUs
McCoy Lake Watershed Management Area	Harris	Conifer Woodland	106	.3	31
	People LG*	Conifer Woodland	325	.6	195
Blue Creek Wildlife Management Area	A322	Shrub-steppe	68.5	.24	17
		Scrub-shrub	9	.24	2
	Blue Creek	Conifer Woodland	572	.4	229
		Shrub-steppe	113	.4	45
	Blue Creek (Tribal Contribution)	Conifer Woodland	27	.4	11
		Shrub-steppe	9	.4	3
Turtle Lake/ Wellpinit Mtn. Wildlife Area	A67-B	Conifer Woodland	57	.25	14

*Includes Tribal Contribution

SHARP-TAILED GROUSE

Sharp-tailed grouse habitat was rated as fair to good on the project areas in which a survey was conducted. The Blue Creek WMA and parcel A322 had a HSI value of .58, with the major lacking factor being no grain crop present in the area.

Table 7: SHARP-TAILED GROUSE BASELINE HEP SURVEY RESULTS

Management Area	Project Area	Cover Type	Acres	Baseline HSI	Baseline HUs
Blue Creek Wildlife Management Area	A322	Shrub-steppe	77.5	.58	45
	Blue Creek	Shrub-steppe	113	.58	66
		Riparian	16	.58	9
	Blue Creek (Tribal Contribution)	Shrub-steppe	9	.58	5

WESTERN MEADOWLARK

Meadowlark habitat was rated as excellent on 8 out of 11 project areas in which surveys were conducted. Two other areas were rated good and 1 was considered poor. The low rated site was hayed prior to being acquired by the STOI. The Smith parcel had a HSI value of 0.0 due to no grass components being present (100% forbs). With the exclusion of haying, the herbaceous vegetation heights will be enhanced immediately. Seeding native grasses on the Smith parcel would improve the HSI value for meadowlark.

Table 8: WESTERN MEADOWLARK BASELINE HEP SURVEY RESULTS

Management Area	Project Area	Cover Type	Acres	Baseline HSI	Baseline HUs
McCoy Lake Wildlife Management Area	A 401A	Grassland	10	.8	8
	Etue	Agriculture	7	.55	4
	Harris	Shrub-steppe	43	.76	33
		Grassland	22	.76	17
		Agriculture	5.5	.76	4
	Kenworthy	Grassland	30	.95	28
	People LG*	Agriculture	85	.51	43
Fox Creek Management Area	Smith	Agriculture	35	0	0
Blue Creek Wildlife Management Area	A322	Shrub-steppe	68.5	.89	61
	Blue Creek	Shrub-steppe	113	.68	77
	Blue Creek (Tribal Contribution)	Shrub-steppe	9	.68	6
Turtle Lake/ Wellpinit Mtn. Wildlife Area	A67-B	Agriculture	23	1.0	23

*Includes Tribal Contribution

RUFFED GROUSE

Ruffed Grouse was given an HSI value of 1.0 for all riparian and moist scrub-shrub cover types. The reason of giving such a high baseline HSI is that an adequate HEP model does not exist for this area and that proper protection and management of the sites would provide valuable habitat in the future.

Table 9: RUFFED GROUSE BASELINE HEP SURVEY RESULTS

Management Area	Project Area	Cover Type	Acres	Baseline HSI	Baseline HUs
McCoy Lake Watershed Management Area	A401-A	Riparian	8	1.0	8
	Etue	Riparian	40	1.0	40
	Harris	Grassland (Moist)	22	1.0	22
		Riparian	3.5	1.0	3
	Kenworthy	Riparian	8	1.0	8
	People LG	Riparian	30	1.0	30
Fox Creek Management Area	Kieffer	Riparian	8	1.0	8
	Smith	Riparian	10	1.0	10
Blue Creek Wildlife Management Area	Blue Creek	Riparian	16	1.0	16

SUMMARY

Conifer woodland habitat currently is in fair condition, but is lacking adequate overstory cover for wildlife, especially white-tailed deer. Timber harvest prior to STOI land acquisition is the number one factor causing insufficient cover. The natural regeneration that is taking place on the areas is ample to take care of the problem over time, but this will take many years.

Areas that are lacking adequate amounts of high quality forage can be improved by planting more shrubs. Prescribed burning can also benefit forage amounts by causing existing shrubs to sprout and to promote the growth of new shrubs. For instance with redstem ceanothus, germination of the seed requires heat scarification (Tirmenstein, 1990).

The riparian habitat on most of the areas was in moderate condition. Most of these areas have been heavily grazed for many years. Noxious weeds (thistle) are a significant problem in most of the riparian areas. The riparian sites could easily be improved by planting deciduous trees and shrubs (black cottonwood, quaking aspen, and red-osier dogwood) and controlling noxious weeds. These enhancements would dramatically improve the habitat for white-tailed deer, ruffed grouse, and yellow warbler.

White-tailed and mule deer benefit from the presence of agricultural crops like alfalfa and winter wheat. Agricultural lands that were purchased which have quality stands of alfalfa will remain in that crop to benefit wildlife.

Mule deer habitat within the shrub-steppe cover type (Blue Creek WMA and A322) is rated as moderate. The low rating was caused by a wildfire that eliminated large amounts of bitterbrush that was utilized for cover and forage. The site would benefit from seeding bitterbrush if the area does not have sufficient natural regeneration within the next few years.

Much of the grassland habitat is in moderate to fair condition due to overgrazing by livestock. The grazing allowed noxious weeds such as knapweed and dalmatian toadflax to establish on some of the drier sites. Enhancing these sites will be an arduous task, but the removal of livestock will be beneficial in noxious weed control. Seeding areas with a dense mixture of native grasses (bluebunch wheatgrass and Idaho fescue) will help suppress the noxious weed infestations. The amount of available cover and forage will also benefit wildlife species that are dependent on grassland habitats.

GLOSSARY

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

Anadromous: Migrating up rivers from the sea to breed in fresh water. Used for fish.

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%.

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.

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.

Habitat: The natural environment of a plant or animal.

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 1.0 whereas 0 is the lowest habitat quality measurement and 1.0 is optimum habitat.

Habitat Units: 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).

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

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

Mesic: Habitat having a moderate water supply.

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.

Noxious Weeds: Undesirable plant species.

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 0.5m tall with individuals or clumps not touching or interlocking. Shrub canopy cover is generally greater than 5% while tree cover is less than 20%.

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 Typing: Delineation of plant communities on aerial photographs.

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

Winter Range: An area that is used by wildlife species during the winter months to provide shelter and food; usually refers to big game.

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

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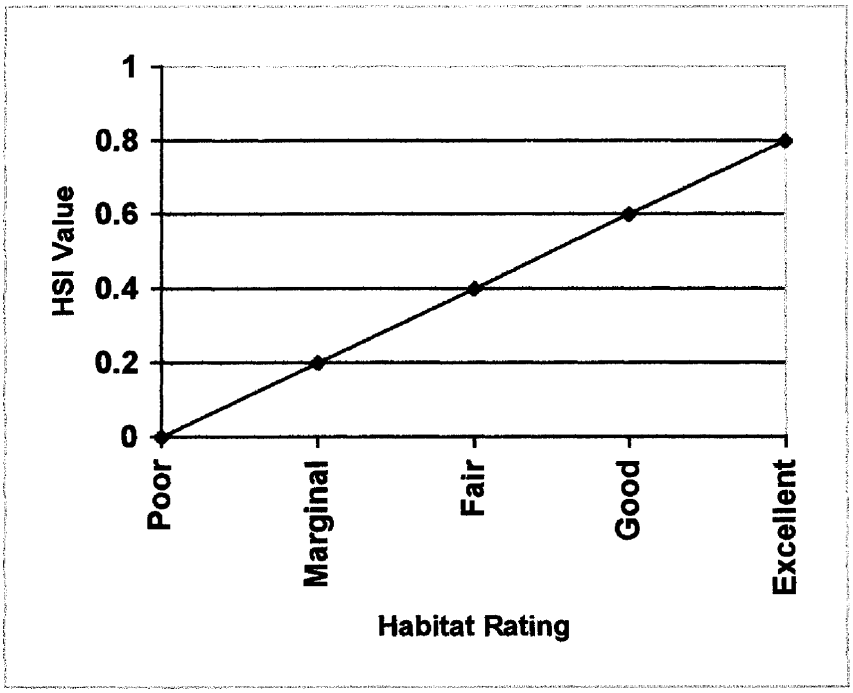
APPENDIX A

HEP TEAM MEMBERS

B. J. Kieffer	Wildlife Program Manager	Spokane Tribe of Indians
Kelly Singer	Wildlife Habitat Biologist	Spokane Tribe of Indians
Twa-le Abrahamson	Wildlife Technician III	Spokane Tribe of Indians
Paul R. Ashley	Fish Biologist IV	Washington Dept. of Fish & Wildlife
Matthew Berger	Wildlife Biologist I	Colville Confederated Tribes

APPENDIX B

HEP EVALUATION RATING



APPENDIX C

PLANT & WILDLIFE SPECIES LIST

Common Name	Scientific Name
PLANTS	
Yarrow	*Achillea millefolium*
Sedges	*Carex sp.*
Cheat grass	*Bromus tectorum*
Bluebunch wheatgrass	*Agropyron spicatum*
Needleandthread grass	*Stipa comata*
Sandberg bluegrass	*Poa sandberii*
Idaho fescue	*Festuca idahoensis*
Knapweed	*Centaurea sp.*
Buckwheat	*Eriogonum sp.*
Balsamroot	*Balsamorhiza sp.*
Wheat	*Triticum sp.*
Currant	*Ribes sp.*
Wild rose	*Rosa woodsii*
Bitterbrush	*Purshia tridentata*
Chokecherry	*Prunus virginiana*
Serviceberry	*Amelanchier alnifolia*
Red-osier dogwood	*Cornus stolonifera*
Black cottonwood	*Populus trichocarpa*
Willow	*Salix sp.*
Water birch	*Betula occidentalis*
Alder	*Alnus sp.*
Aspen	*Populus tremuloides*
Ponderosa pine	*Pinus ponderosa*
Douglas fir	*Pseudotsuga menziseii*
MAMMALS	
Mule deer	*Odocoileus hemionus*
White-tailed deer	*O. virginianus*
BIRDS	
Ruffed grouse	*Bonasa umbellus*
Yellow warbler	*Dendroica petechia*
Sharp-tailed grouse	*Tympanuchus phasianellus*
Western meadowlark	*Sturnella neglecta*
Mourning Dove	*Zenaida macroura*

APPENDIX D

HABITAT UNITS FOR CREDITING PURPOSE

LANDS	ACRES	Western Meadowlark	Sharp-tail Grouse	Yellow Warbler	Ruffed Grouse	White-tail Deer	Mule Deer	TOTAL
McCoy Lake Watershed Management Area								
A 401A	35	8	0	6	8	35	0	57
Etue	74	4	0	5	40	74	0	123
Harris	180	54	0	1	25	180	31	291
Kenworthy	40	28	0	2	8	40	0	78
People LG	317	31	0	17	22	317	141	528
People LG **	123	13	0	6	8	123	54	204
SUBTOTAL	**769**	**138**	**0**	**37**	**111**	**769**	**226**	**1281**
Fox Creek Area								
Kieffer	40	0	0	3	8	27	0	38
Smith	160	0	0	5	10	126	0	141
SUBTOTAL	**200**	**0**	**0**	**8**	**18**	**153**	**0**	**179**
Blue Creek Wildlife Management Area								
A 322	77.5	61	45	0	0	15	19	140
BCWMA	701	77	75	6	16	673	274	1121
BCWMA **	36	6	5	0	0	35	14	60
SUBTOTAL	**814.5**	**144**	**125**	**6**	**16**	**723**	**307**	**1321**
Turtle Lake/Wellpinit Mountain Wildlife Area								
A 67B	80	23	0	0	0	52	14	89
SUBTOTAL	**80**	**23**	**0**	**0**	**0**	**52**	**14**	**89**
TOTALS	**1863.5**	**305**	**125**	**51**	**145**	**1697**	**533**	**2870**

****Tribal Contribution Areas**

APPENDIX E

HABITAT SUITABILITY INDEX MODELS

WHITE-TAILED DEER

MULE DEER

SHARP-TAILED GROUSE

WESTERN MEADOWLARK

YELLOW WARBLER

WHITE-TAILED DEER HEP MODEL (DRAFT) 05/96
(Revised 15 Jun 98)

COVER TYPES: Conifer Forest, Dense Conifer Forest, Riparian Forest, Mixed 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" (6dm)) 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 (10.5 m) Tall
SIV3:	Percent Canopy Cover of Trees and Shrubs ≥ 5 Feet (1.5 m) Tall
SIV4:	Width of Cover
SIV5:	Density of Roads Open to the Public per Square Mile (1.6 km^2)
SIV6:	Percent Preferred Shrub Canopy Cover < 5 Feet Tall (1.5m)
SIV7:	Preferred Shrub/Tree Composition
SIV8:	Shrub Browse Diversity
SIV9:	Percent Palatable Herbaceous Cover
SIV10:	Percent of Area Comprised of Winter Wheat/Alfalfa
SIV11:	Distance Between Cover and Forage Areas

EQUATIONS:

Cover: $$[V1 \times \frac{2(V2 + V3}{3} \times V4 \times V5]^{1/4}$$

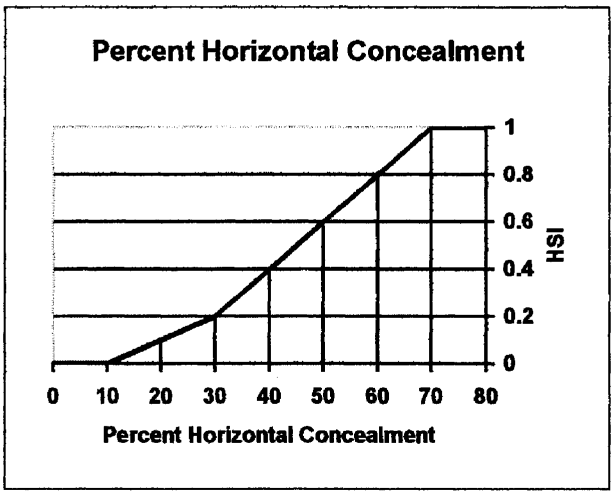
Food: $$[V6 \frac{(V7 + V8 + V9 + V10 + V11)}{4}]^{1/2}$$

HSI = Lower value between cover and food

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 (WDFW0, M. Berger (CCT), and M. Whalen (WDFW), May 1996, June 1998.

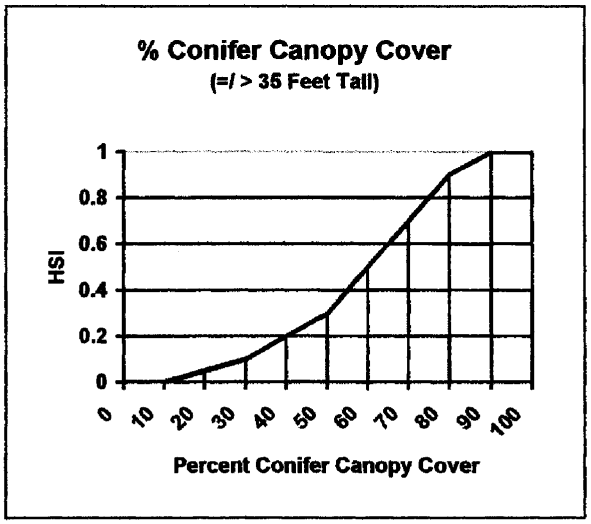
COVER

SIV1: Percent Horizontal Concealment



Jageman, 1984, considered hiding cover to be optimum when 90% of an adult standing deer (1m 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 3 x 0.5 meter increments representing 33+% horizontal foliage and concealment of an adult standing deer as viewed from a distance of 15 m (45 ft) from four cardinal points (Griffith and Youtie 1988).

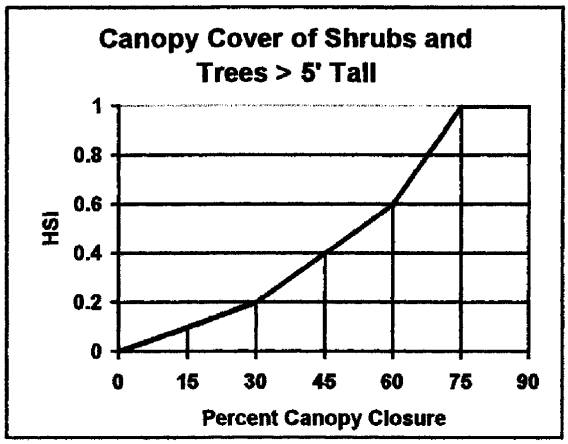
SIV2: Percent Conifer Canopy Cover ≥ 35 Feet (10.5 m) in Height



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%. Thomas (1979) suggested that thermal canopy closure conditions for deer and elk were sub-marginal at ≤ 40% canopy closure, marginal between 41% and 70% canopy closure and satisfactory above 70% canopy closure.

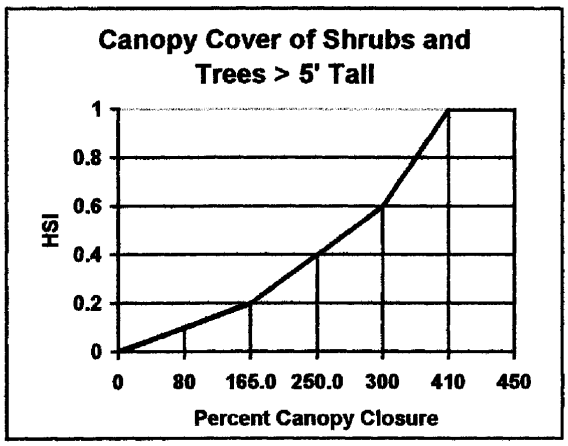
Thermal cover requirements on winter range are the same as those on summer and spring-fall range, except that all thermal cover must be evergreen and developed at least to the pole-sapling stage (Thomas 1979). Thermal cover provided by conifers is weighted twice as valuable as deciduous cover in this model because, unlike deciduous vegetation, evergreen tree species provide winter thermal protection to white-tailed deer throughout most of Eastern Washington, North Idaho, and Western Montana during severe winters (Singer 1979).

SIV3: Percent canopy Cover of Shrubs and Trees ≥ 1.5 m (5ft) in Height (includes deciduous and evergreen shrubs, trees, and saplings).



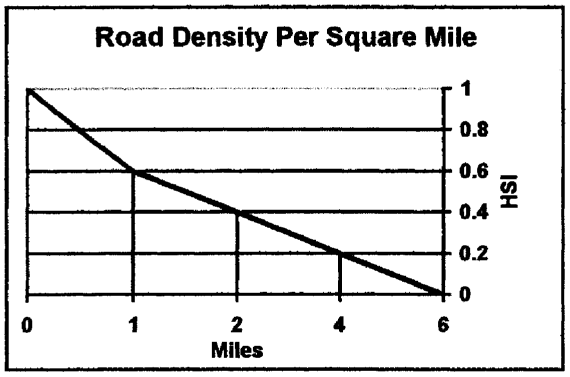
Small evergreen trees and shrubs are used by deer for thermal cover on winter range. Likewise, Loveless (1964) reported that on spring and summer ranges deciduous trees and shrubs are used. The thermal cover requirements of deer on summer and spring-fall ranges include evergreen/deciduous saplings or shrubs at least 1.5 meters (5 ft) tall with ≥ 75% canopy closure.

SIV4: 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). Thomas (1979) estimated optimum size of deer thermal cover areas is 2 to 5 acres (0.8 to 2 hectares) in size with a minimum width of 300 feet (91.5 meters).

SIV5: Density of Roads Open to the Public per Square Mile (1.6km^2)



The effectiveness of deer habitat in obtaining optimum use of the maximum area is adversely influenced by the presence of roads that are open to the vehicular traffic (Leege 1976, Thiessen 1976, Perry and Overly 1977). Dense cover adjacent to roads, however, may reduce road density impacts by screening deer from view.

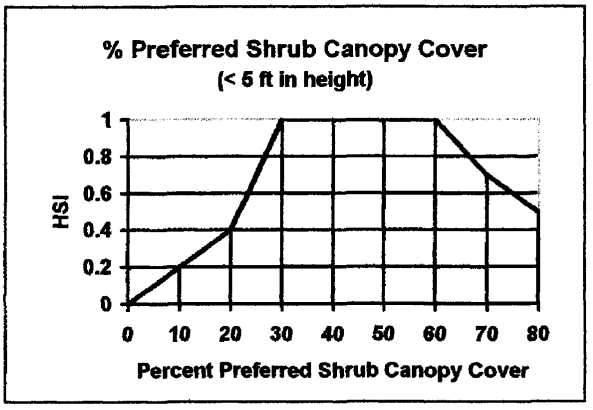
It is assumed that not all roads are open/maintained throughout the year and that road densities on winter range may have a greater impact than described in SIV5. On the other hand, roads that traverse section lines may have less of an impact than an equal length of road winding through a section of habitat. Managers should evaluate road density impacts on winter ranges with greater care than on summer ranges and adjust graph values accordingly. HSI values presented in SIV5 reflect values primarily associated with spring and summer ranges.

COVER HSI EQUATION:

$$[V1 \times \frac{2(V2 + V3}{3} \times V4 \times V5]^{1/4}$$

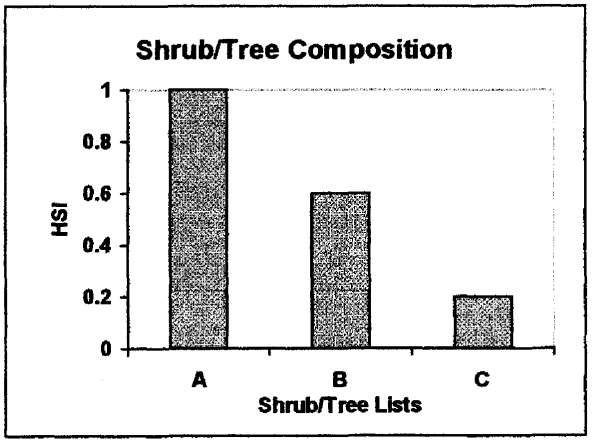
FOOD

SIV6: Percent Preferred Shrub Canopy Cover < 5 Feet Tall (1.5m)



Preferred shrubs[1] include: ceanothus, willow sp., serviceberry, chokecherry, red-osier dogwood, maple, kinnikinnick, pachistima, Oregon grape, snowberry, hawthorn, spirea, ninebark, oceanspray, alder, mock orange, elderberry, thimbleberry, and Menziesia.

SIV7: 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:

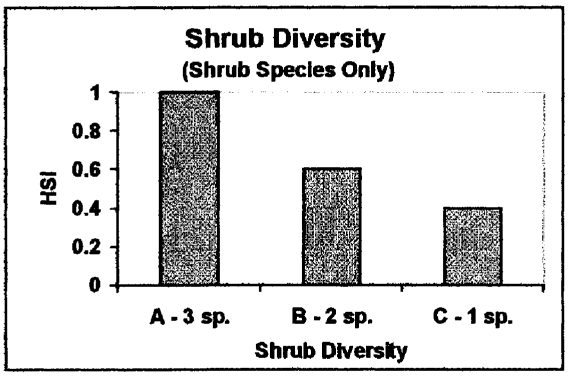
Group A: Western red cedar, ceanothus, willow, serviceberry, chokecherry, red-osier dogwood, maple, kinnikinnick, pachistima, and Oregon grape.

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

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

[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.

SIV8: Shrub Browse Diversity

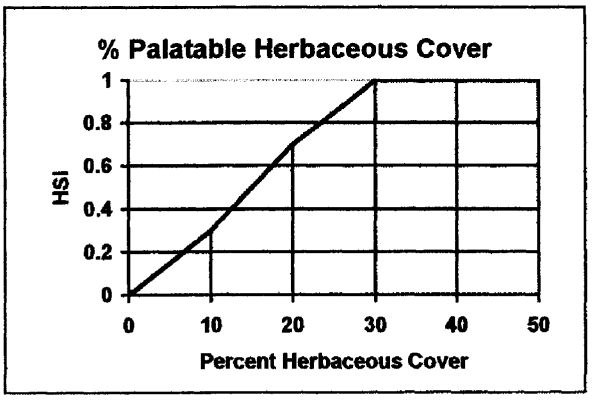


This variable describes shrub browse diversity. Consider only shrub species when determining the HSI for this variable. To be counted within a grouping, a single shrub species must be a minimum of 10% of the preferred shrub canopy closure (SIV6). For example, if the preferred shrub canopy closure is 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 the inflated HSIs for this variable in situations where browse is predominantly a single shrub species and only a few individual shrubs of a different type are scattered throughout an area. Managers should, however, consider the relative importance of each shrub species prior to exclusion. Trace amounts of some shrub species may be extremely important to local deer populations.

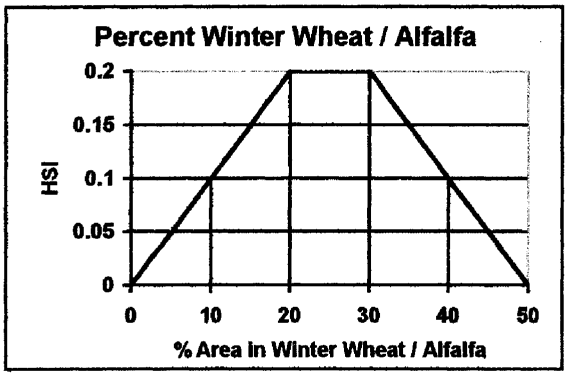
Shrub Diversity Ratings: A = 3 species, B = 2 species, C = 1 species

SIV9: 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 sp., and wheatgrass.

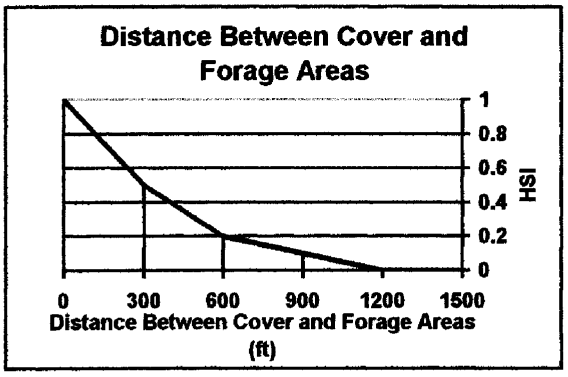
SIV10: Percent of Area Comprised of Winter Wheat/Alfalfa



SIV10 is used to rate the percent of the project area providing food from winter wheat and alfalfa. Keay and Peek (1980) reported that alfalfa, clover, and spreading pasqueflower are preferred forbs and that winter wheat is highly palatable. During late winter and early spring periods when green growth is initiated, white-tails feed on forbs and grasses. Agricultural crops are important to white-tailed deer throughout the year and contribute to high deer populations along the forest/cropland ecotone (Singer 1979). Autumn is a transition period when deer shift from grasses, forbs, and agricultural crops to winter browse species. This variable is additive and not necessary to achieve optimum conditions (HSI = 1.0). The maximum value is 0.2. The combined food HSI value should not exceed 1.0 (if exceeded, round down to 1.0).

If winter wheat/alfalfa is adjacent to the project site and available/locally important to white-tailed deer, the additive value (0.2) should be given <u>in place of</u> SIV10. Note: the additive value should not exceed 0.2 even if agricultural crops are both within and adjacent to the project site.

SIV11: Distance Between Cover and Forage Areas (feet)



For maximum use by deer, forage areas should have no point further than 600 feet (183 meters) from the edge of cover; use becomes insignificant beyond that point (Reynolds 1962, 1966; Harper 1969; Kirsch 1962; Hershley and Leege 1976). This allows for circular forage areas to be up to 1,200 feet (366 meters) wide (600 ft radius).

Food Equation:

$$[V6 \frac{(V7 + V8 + V9 + V10 + V11)}{4}]^{\frac{1}{2}}$$

HSI = Lower value between food and cover

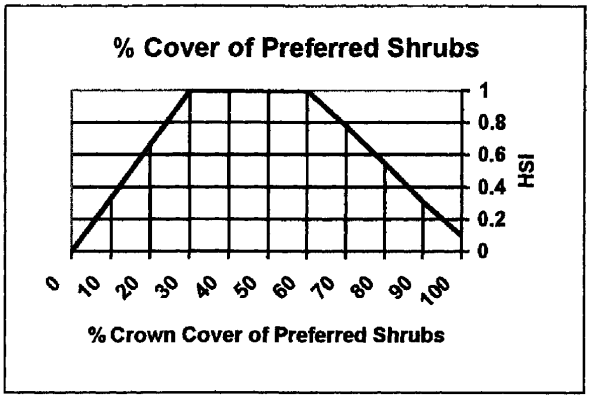
MULE DEER WINTER HABITAT HEP MODEL (DRAFT) 18 JUN 96

Paul R. Ashley, WDFW, Columbia River Wildlife Mitigation Team

COVER TYPES:	Grassland, Shrub-grass, Shrubland (Shrub-steppe)
GEOGRAPHIC AREA:	Columbia River Plateau, Washington State
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 and that snow conditions may influence the HSI calculated for winter food (WFI). It is further assumed that the food value can be estimated by measuring the standing crop of vegetation and 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: Graduated Rod SIV4: Direct Count SIV5: Micro Plot, Nested Plots SIV6: Aerial Photo, Maps SIV7: Line Intercept (graduated rod, tape measure) SIV8: Topo Maps, Clinometer, Direct Observation SIV9: Road Density SIV10: Aerial Photo, Topo Map, Direct Observation

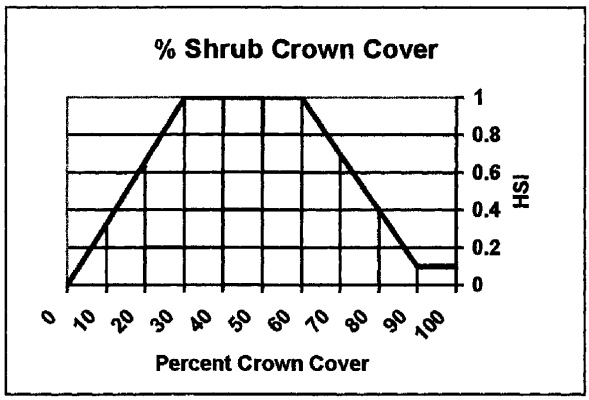
WINTER FOOD INDEX

SIV1: Percent Crown Cover of Preferred Shrubs Equal ≤ 1.5 m (5') in Height (not including small conifers)

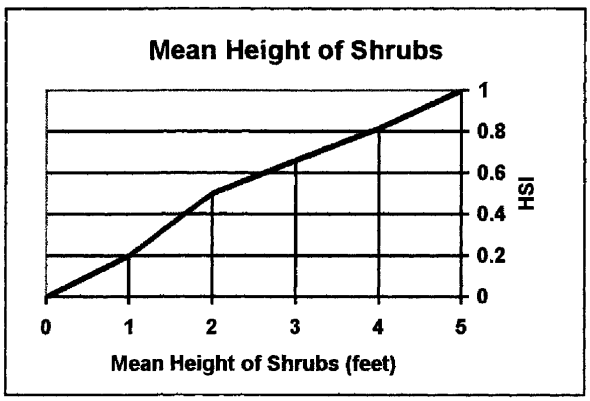


Preferred Shrubs include but are not limited to: Big Sagebrush, Willow, Serviceberry, Snowberry, Chokecherry, Rose spp., Water Birch, Red-osier dogwood, Ninebark, Aspen, Alder, Squaw currant, Bitterbrush, Ceanothus.

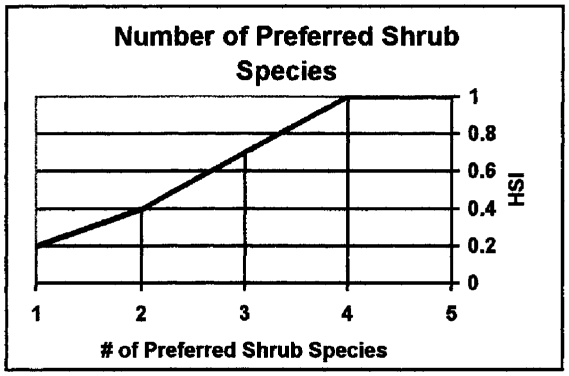
SIV2: Percent Crown Cover ≤ 1.5 m (5') in Height



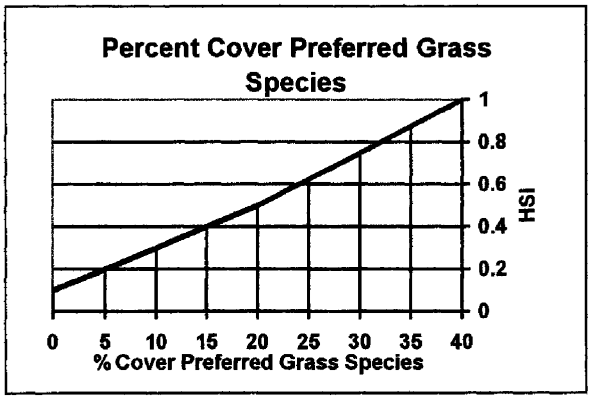
SIV3: Mean Height of Shrub Species (all shrubs)



SIV4: Number of Preferred Shrub Species

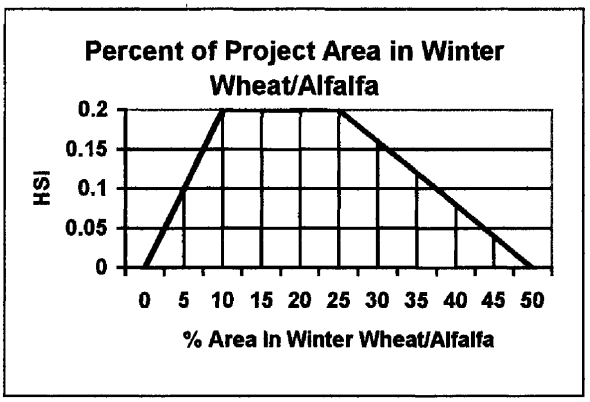


SIV5: Percent Cover Preferred Grass Species



Preferred grass species include bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, bottlebrush squirreltail, Crested wheatgrass, and cheatgrass. (It is assumed that forbs are not available to mule deer during winter.)

SIV6: Percent of Project Area in Winter Wheat / Alfalfa



WINTER FOOD INDEX (WFI) EQUATION:
If grass is an available/important winter food source:
WFI = (VI x V2 x V3 x V4 x V5) $^{1/5}$ + V6*

If grass is not an important winter food component:
WFI = (V1 x V2 x V3 x V4) ¼ + V6*

* The percent of 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. **If winter wheat/alfalfa is within ¼ mile of project and accessible to mule deer, add 0.2. maximum value for V6 is 0.2.**

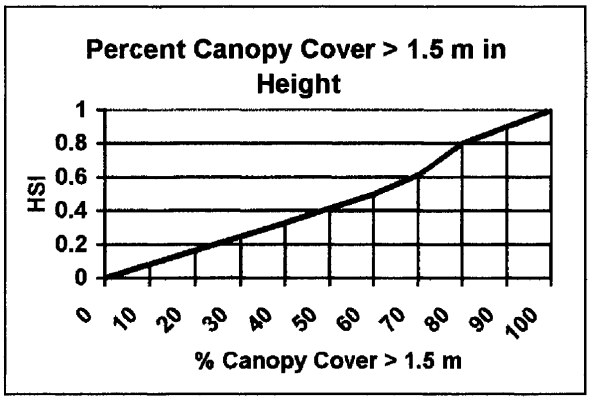
The SIs calculated for percent cover of preferred shrubs (SIV1), percent shrub crown cover (SIV2), number of shrub species of preferred shrubs present (SIV3), and percent native grass cover (SIV4) are assumed to carry equal weight.

It is assumed that preferred shrubs can provide adequate winter forage in the absence of native grass species. Therefore, the lowest SI value for SIV5 is 0.1 in order to not "zero" the WFI equation.

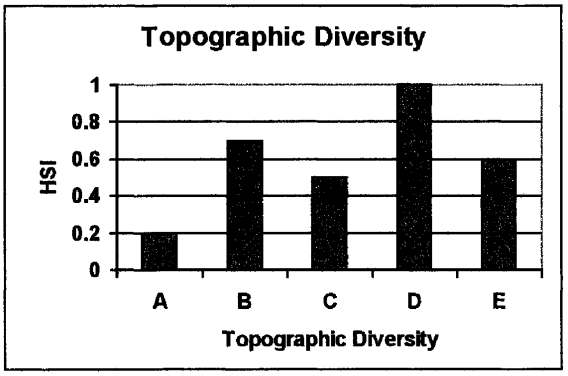
If the average snow depth exceeds 60.9 cm (24 inches) for extended periods of time, the life requisite value for food should equal zero. If persistent snow cover ranges from 30.4 cm (12 inches) to 60.9 cm (24 inches), the life requisite value should be adjusted downward.

WINTER COVER INDEX

SIV7: Percent Canopy Cover of Evergreen Woody Vegetation greater than 1.5 m (5') in height



SIV8: Topograhic Diversity (Consider General Area)



A) Level Terrain (0-5% slope), flat or nearly so – little to no physical diversity (0.2)

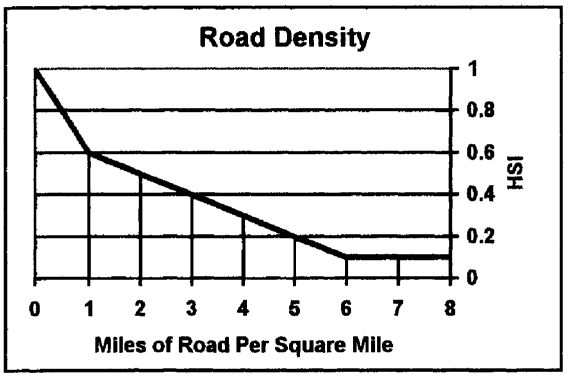
B) Level Terrain (0-5% slope), area broken by drainages (0.7)

C) Rolling Terrain (5-25% slope) (0.5)

D) Broken Terrain (5-25% slope), ridges, rims and/or drainages present (1)

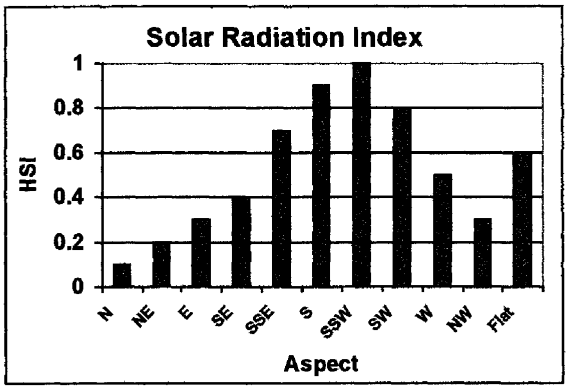
E) Mountainous (>25% slope) (0.6)

SIV9: Road Density (Roads open for public use)



WINTER COVER INDEX (WCI) EQUATION:
WCI = (V7 + V8)/2 x V9; or (V8 x V9) if evergreen canopy cover is not present – use extreme caution if considering eliminating V7.

V10: Solar Radiation Index



MULE DEER WINTER MODEL HSI EQUATION:
HSI = The lower value of (WFI x SIV10) ^{½}; or (WCI x SIV10) ^{½}

SHARP-TAILED GROUSE HEP MODEL DRAFT 3/31/97
Modified 1/97

Paul R. Ashley, WDFW

COVER TYPES: Grassland, Shrub-grass, Shrubland (Shrub-steppe)

GEOGRAPHIC AREA: Eastern Washington

DEFINITIONS:

SHGR:	Sharp-tailed Grouse
NBI:	Nesting/Brood Rearing Index
WFI:	Winter Food Index
Ni:	Percent of Area in Cover Type "i" expressed in decimal form
HC:	Habitat Category
LHSI:	Lower Height Suitability Index
MHSI:	Mid Height Suitability Index
UHSI:	Upper Height Suitability 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 habitat

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
SIV8: Percent equivalent area providing winter food/ cover

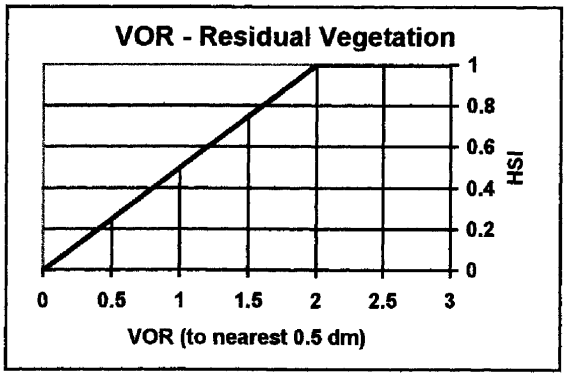
MODEL EQUATIONS:

$NBI = [V1\ (V2 \times Ni \times V3)^{1/3}]^{\frac{1}{2}}$
$WFI = [(V2 \times V8)^{\frac{1}{2}} \times V4]^{\frac{1}{2}} + V7$ (Not to exceed 1.0)
$HSI = (NBI \times WFI)^{\frac{1}{2}}$

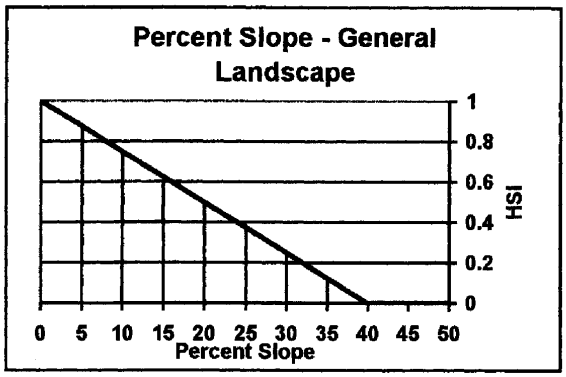
Unlike previous models, this model does not focus on Lek sites and is meant to be used to evaluate potential SHGR habitat. It is assumed that proposed sites are of significant size to support a sharp-tailed grouse population. Application of this model should occur prior to spring "green-up" to evaluate residual vegetation. In addition, a modified Robel pole was used to measure WFHI categories. 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 additive and not necessary to achieve optimum winter habitat conditions within the context of this model.

NESTING/BROOD REARING HABITAT SUITABILITY INDEX

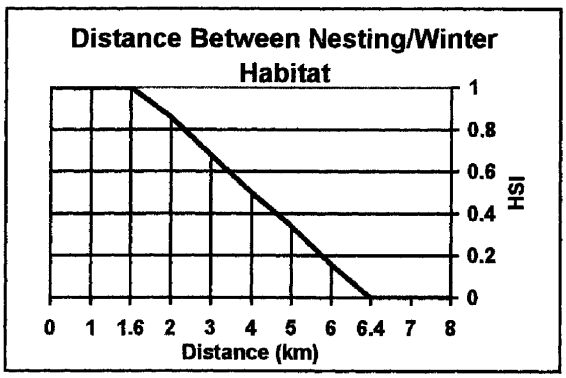
SIV1: Mean VOR of Residual Vegetation (dm)



SIV2: Percent Slope – General Landscape



SIV3: Distance Between Nesting/Winter Habitat

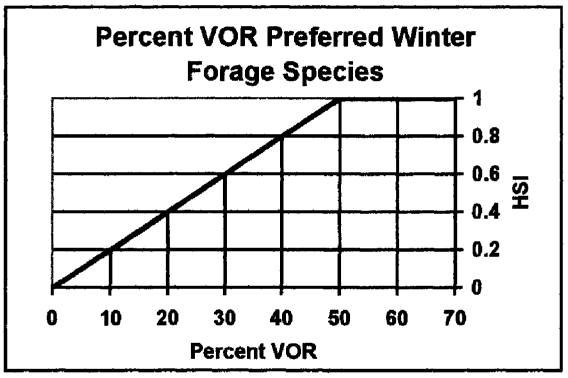


Ni: Percent of Area in Cover Type "i" expressed in decimal form.

Suggested Equation for NBI: $NBI = [V1\ (V2 \times Ni \times V3)^{1/3}]^{\frac{1}{2}}$

WINTER FOOD/COVER INDEX (WFI)

SIV4: Percent VOR Preferred Winter Forage Species



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

DEFINITIONS

HC:	Height Category (Pole Increments = 60 cm 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 Suitability 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 category; 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 5 and 6, estimate % VOR for each height category; determine HSI; calculate mean MHSI (HC5 + HC6)/2 and multiply mean by .5 to obtain a weighted MHSI.

HCs equal to or greater than 7 (UHSI) are assigned a value of 0.1 regardless of VOR. UHSI is additive (see equation below).

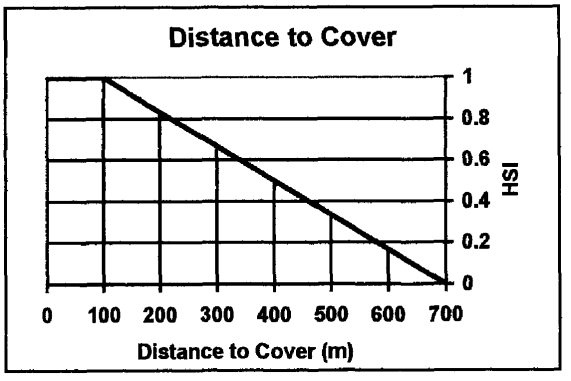
WFHI Equation: (LHSI + MHSI)/2 + UHSI

WINTER FOOD INDEX – GRAIN (WFG)

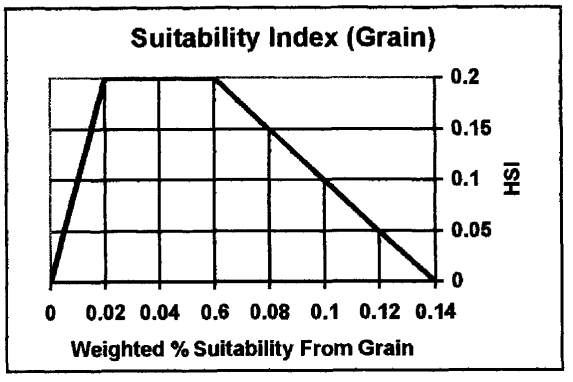
SIV5: Presence/Absence of Grain Crops

GRAIN CROP	HSI
PRESENT	0.2
ABSENT	0.0

SIV6: Distance to Roosting, Loafing, and Hiding Cover (m)



SIV7: Suitability Index for Winter Food Value From Grain



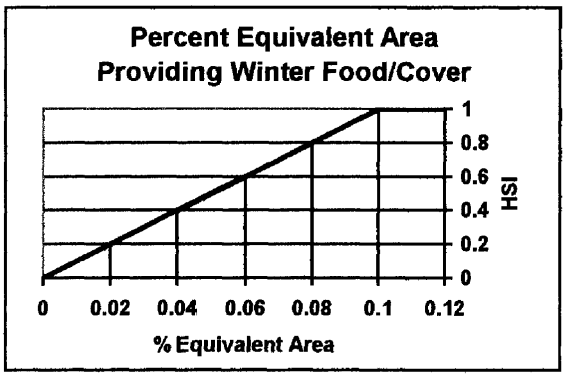
Instructions for Determining HSI for WFG

1. If grain is present (standing or stubble), SIV5 value is 0.2. 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 SIV5 x SIV6 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 0.2.
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



WFI = [(V2 x V8) ^{½} x V4] ^{½} + V7*

*Not to exceed 1.0

MODEL EQUATION: (NBI X WFI) ^{½}

SUGGESTED MEASUREMENT TECHNIQUES

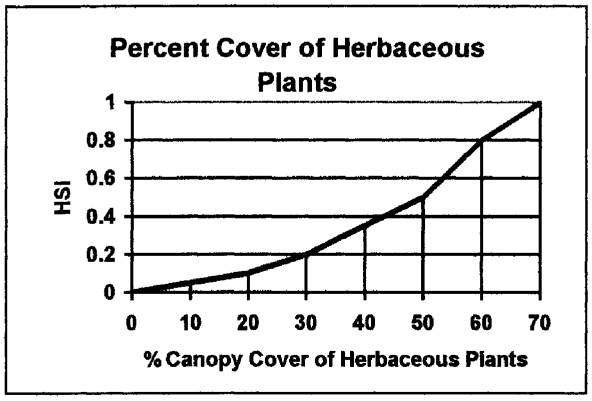
SIV1: Mean VOR of residual vegetation – Robel Pole
SIV2: Percent slope-general landscape – Clinometer, Topo Map
SIV3: Distance between nesting/winter habitat – Aerial Photo/GIS, Topo Map
SIV4: Percent VOR preferred winter forage species – Modified Robel Pole
SIV5: Presence/absence of grain crops – Aerial Photo/GIS, Topo Map
SIV6: Distance to roosting, loafing, and hiding cover – Aerial Photo/GIS, Topo Map
SIV7: Suitability Index for winter food value from grain
SIV8: Percent equivalent area providing winter food/cover

WESTERN MEADOWLARK

Modified from Schroeder and Sousa, 1982.

Cover Types: Grassland, Shrubgrass, Shrubland, Pasture, Shrub-steppe

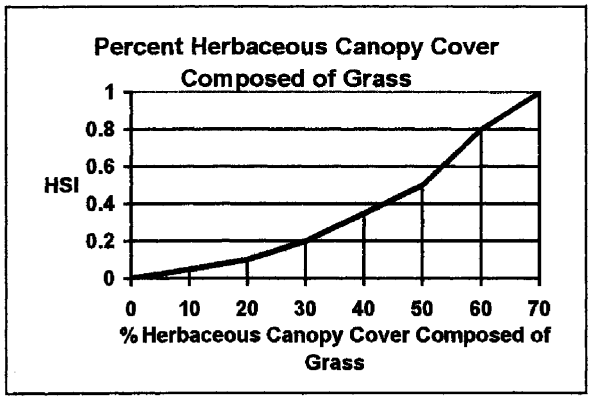
V1: Percent canopy cover of herbaceous plants



Cover Requirements

Western meadowlarks are adapted to short grass and mixed grass prairies, preferring large fields with short vegetation and good drainage. Western meadowlarks exhibit tolerance for a wide variety of plant associations and are widely distributed in Washington – commonly occurring in meadows, orchards, thickets, and cultivated areas. Conservation of woodlands to agricultural fields has favored western meadowlark populations in Washington.

V2: Percent of herbaceous canopy cover composed of grass



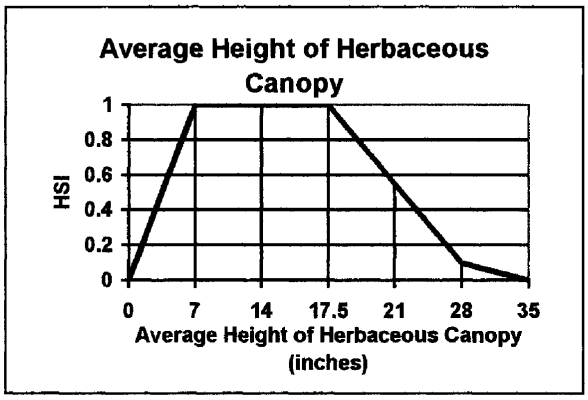
Food Requirements

Bryant (1914), Weins (1973) et.al. suggest that animal material, primarily insects, comprise approximately 63% of the meadowlark's diet while 37% is made up of vegetative matter. Vegetative matter consisted of one-third grain and two-thirds weed seeds. Spring and summer diet was primarily insects with a shift to seeds in fall and winter. Hubbard and Hubbard (1969) reported meadowlarks eating carrion including their own species. It is doubtful that food supply is ever a limiting factor for this species (Lanyon, 1956).

Water Requirements

No specific water requirements were listed in the literature.

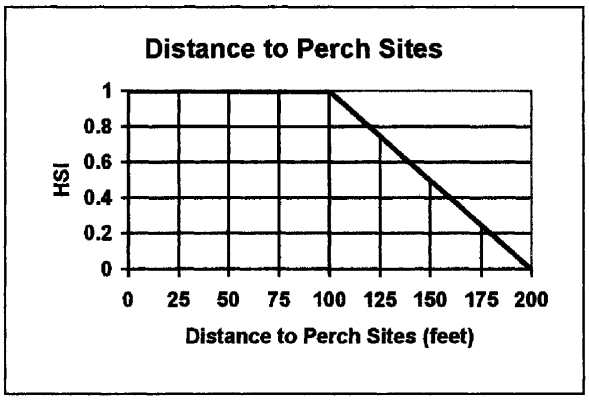
V3: Average height of herbaceous canopy (inches)



Because of its habitat preferences, western meadowlarks are affected by agricultural activities. Increased clearing and cultivation results in an increase of habitat for this species (Bryant 1914; Jewett et.al. 1953).

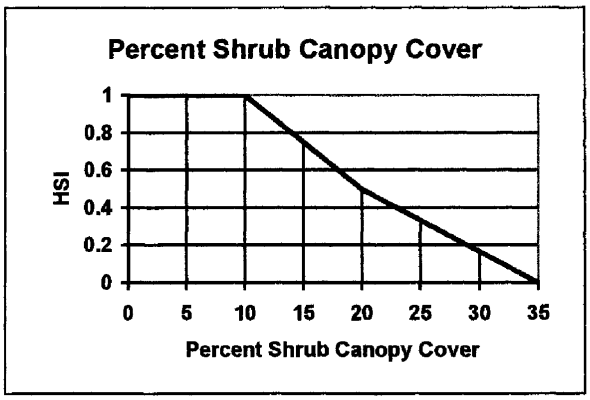
Overgrazing results in destruction of habitat (Rohwer 1972; Weins 1973). Light grazing or winter grazing does not affect meadowlark habitat as much as heavy or summer grazing (Weins 1973).

V4: Distance to Perch Sites (feet)



Reproductive Requirements
Males require elevated perches, such as shrubs, fence posts, or telephone poles as singing sites. Nests are located on the ground, often in depressions or under shrub cover or tussocks of grass (Bent 1958).

V5: Percent Shrub Canopy Cover



Model Equation:
$HSI = [V1 \times V2 \times V3 \times V4]^{1/4} \times V5$

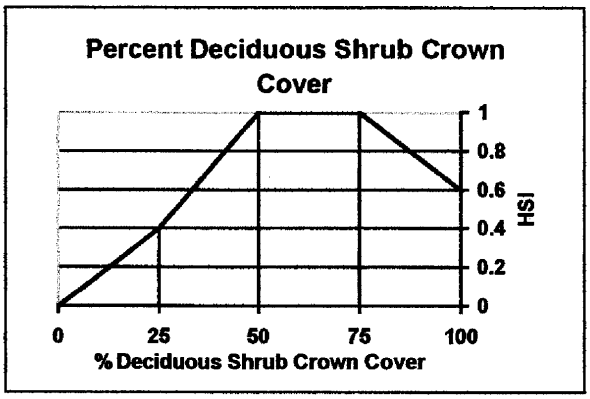
YELLOW WARBLER (*Dendroica petechia*) HEP MODEL

COVER TYPES:	This model was developed to evaluate habitat in the dominant cover types used by the yellow warbler: Deciduous Shrubland (DS) and Deciduous Scrub-shrub Wetland (DSW) (terminology follows that of U.S. Fish and Wildlife Service 1981). Yellow warblers only occasionally utilize forested habitats and reported population densities in forests are low. The habitat requirements in forested habitats are not well documented in the literature. For those reasons, this model does not consider forested cover types.
GEOGRAPHIC AREA:	This model has been developed for application within the breeding range of the yellow warbler.
SEASON:	This model was developed to evaluate the breeding season habitat needs of the yellow warbler.
MINIMUM HABITAT AREA:	Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Information on the minimum habitat area for the yellow warbler was not located in the literature. Based on reported territory sizes, it is assumed that at least 0.15 ha (0.37 acre) of suitable habitat must be available for the yellow warbler to occupy an area. If less than this amount is present, the HSI is assumed to be zero.
APPLICATION:	This model considers the quality of the reproduction (nesting) habitat needs of the yellow warbler to determine overall habitat suitability. Food, cover, and water requirements are assumed to be met by nesting needs.
VARIABLES:	SIV1: Percent deciduous shrub crown cover SIV2: Average height of deciduous shrub canopy SIV3: Percent of deciduous shrub canopy comprised of hydrophytic shrubs.
SUGGESTED TECHNIQUE:	SIV1: Line Intercept SIV2: Graduated Rod SIV3: Line Intercept
EQUATIONS:	Reproduction: $(V1 \times V2 \times V3)^{1/2}$ HSI = Equal to the reproduction value

YELLOW WARBLER HEP MODEL

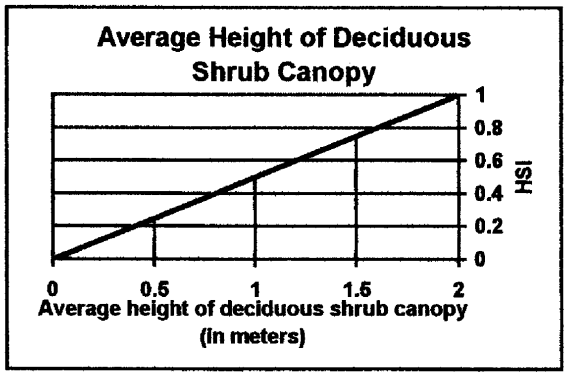
REPRODUCTION

SIV1: Percent deciduous shrub crown cover.



Percent deciduous shrub crown cover is the percent of the ground that is shaded by a vertical projection of the canopies of woody deciduous vegetation which are less than 5m (16.5 ft) in height. Shrub densities between 60 and 80% crown cover are assumed to be optimal. As shrub densities approach zero cover, suitability also approaches zero. Totally closed shrub canopies are assumed to be of only moderate suitability, due to the probable restrictions on movement of the warblers in those conditions.

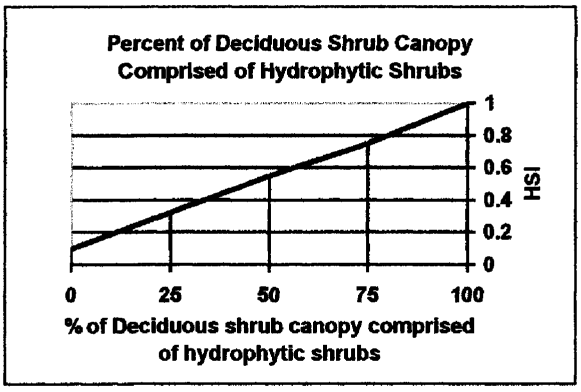
SIV2: Average height of deciduous shrub canopy.



Average height of deciduous shrub canopy is the average height from the ground surface to the top of those shrubs which comprise the uppermost shrub canopy. Shrub heights of 2 m (6.6 ft) or greater are assumed to be optimal, and suitability will decrease as heights decrease to zero. Preferred foraging and nesting habitats in the Northeast are wet areas, partially covered by willows and alders (*Alnus spp.*), ranging in height from 1.5 to 4 meters (5 to 13.3 ft) (Morse 1966). Nests are generally placed 0.9 to 2.4 meters (3 to 8 ft) above the ground, and nest heights rarely exceed 9.1 to 12.2 meters (30 to 40 ft) (Bent 1953). In Iowa, dense thickets were frequently occupied by yellow warblers while open thickets with widely spaced shrubs rarely contained nests (Morse 1966).

YELLOW WARBLER HEP MODEL

SIV3: Percent of deciduous shrub canopy comprised of hydrophytic shrubs.



Percent of deciduous shrub canopy comprised of hydrophytic shrubs is the relative percent of the amount of hydrophytic shrubs compared to all shrubs, based on canopy cover. It is assumed that optimal habitats contain 100% hydrophytic deciduous shrubs and that habitats with no hydrophytic shrubs will provide marginal suitability. Plants used for nesting include willows, alders, and other hydrophytic shrubs and trees (Bent 1953), including box-elders (*Acer negundo*) and cottonwoods (*Populus spp.*) (Schrantz 1943).

Reproduction Equation:

$(V1 \times V2 \times V3)^{1/2}$

HSI = Equal to the reproduction value