

An Ecosystem Diversity Planning Process for Forest Management

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ECOSYSTEM
MANAGEMENT
RESEARCH
INSTITUTE

Forest Management Objectives

- **Ecological**
 - **Biodiversity**
- **Economic**
 - **Forest Products**
 - **Other Resources**
- **Social**
 - **Aesthetic**
 - **Other Uses and Values**

Forest Management Planning

- **Needs an approach that can integrate the different objectives in an effective, efficient, and comprehensive manner**
- **An ecosystem-based approach is the best option**

Biodiversity

- **Biodiversity is the landscape, ecosystems, species, and genetics that are native to an area**
- **Humans have interacted with biodiversity- but major recent human alterations of landscapes are considered impacts to biodiversity**

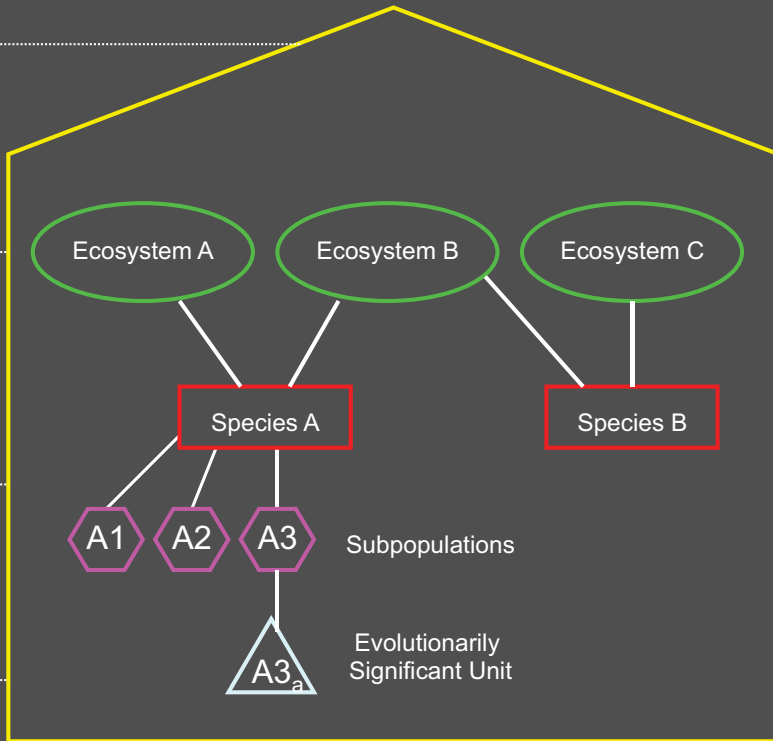
Hierarchical Organization

Landscape Level.....

Ecosystem Level.....

Species Level.....

Genetic Level.....



Premise

- **Biodiversity depends upon the array of native ecosystems that have comprised the landscape**
- **Strategy: maintain an appropriate level of representation of all of the native ecosystems of the area**

Goals

- **Provide for appropriate ecosystem amounts and distributions across landscape (landscape level)**
- **Provide appropriate composition, structure, and processes for each identified ecosystem (ecosystem level)**
- **Provide for resource utilization consistent with these first two goals**

Species Management

- Species will continue to require management, however, a focus on ecosystem diversity will address the biggest concern- providing for the habitat needs of all species.



Identifying Native Ecosystem Diversity

- **Establishes baseline**
 - **Cumulative effects**
- **Identifies ecosystems, their characteristics, and processes**
 - **Reference for setting representation objectives**

Challenges of Ecosystem Diversity



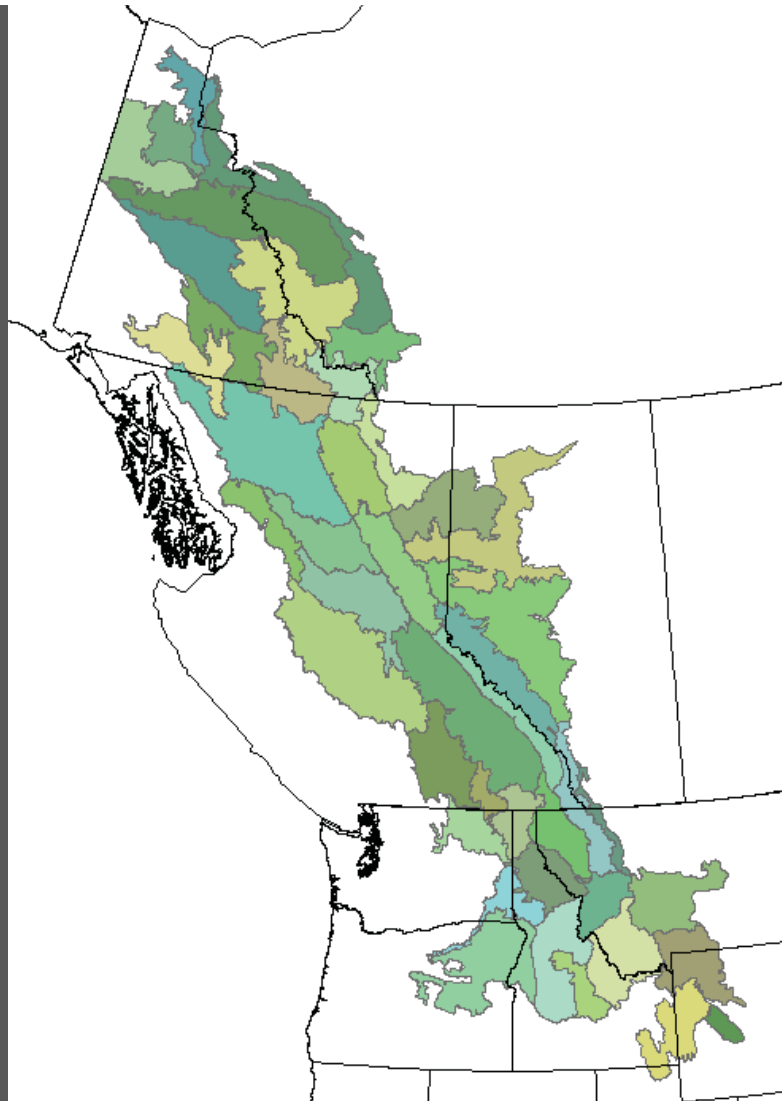
- Ecosystems are not as easily recognized as species
- Scale issues are critical
- Appropriate attention to detail must be balanced with practical limits to application

Ecosystem Diversity Process Steps

- **Step 1. Delineate planning landscape**
- **Step 2. Characterize ecosystem diversity**
- **Step 3. Quantify reference conditions**
- **Step 4. Quantify existing conditions**
- **Step 5. Set management goals**
- **Step 6. Check representation goals**

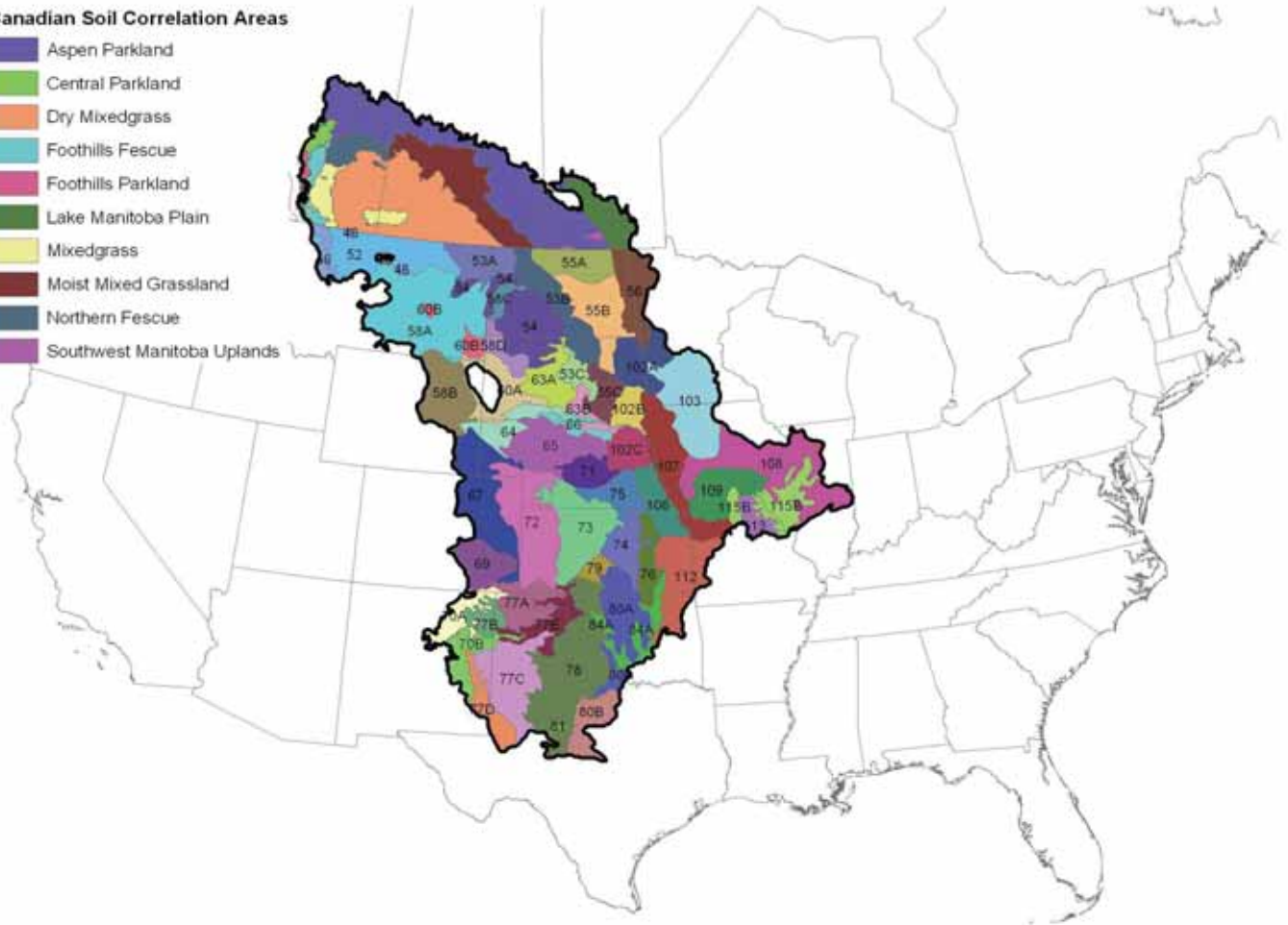
1. Delineate Landscape

- **Landscape should be large**
- **But not too large**
- **Use geo-climatic boundaries where possible to reduce variability in ecosystem diversity**

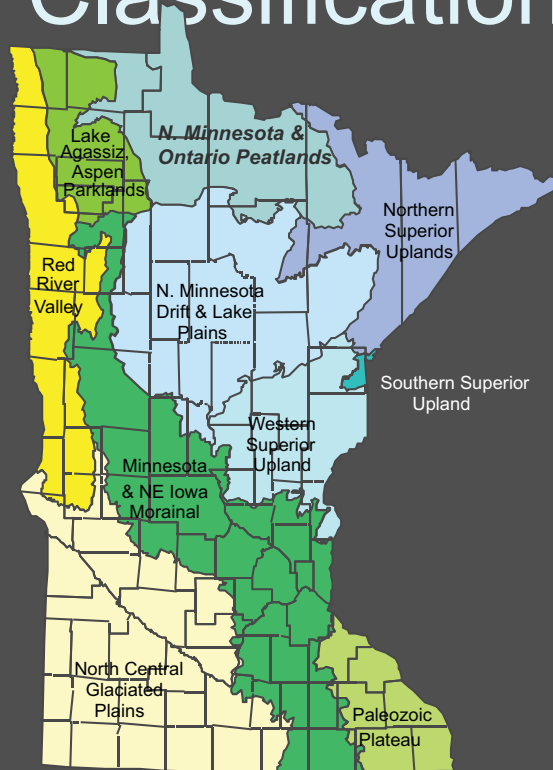


Canadian Soil Correlation Areas

- Aspen Parkland
- Central Parkland
- Dry Mixedgrass
- Foothills Fescue
- Foothills Parkland
- Lake Manitoba Plain
- Mixedgrass
- Moist Mixed Grassland
- Northern Fescue
- Southwest Manitoba Uplands



Ecological Classification System



Section

2. Characterize ecosystem diversity

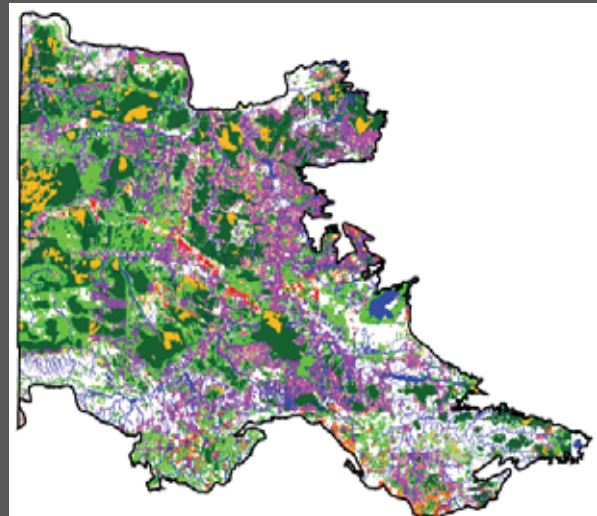
- **Ecosystem diversity has 2 primary drivers:**
 - **Ecological sites- abiotic features**
 - **Disturbance regimes**
- **The combination of ecological sites and responses to disturbance produced the native ecosystem diversity within each landscape**

Ecological Site Classification

- **Many possible classifications**
- **Scale considerations- the right number of units**
- **Examples in terrestrial systems:**
 - **Manitoba Ecosite Descriptions**
 - **Habitat types for North Central Minnesota**

Mapping Ecological Sites

- Data layers used to map habitat type classes:
 - landform
 - soil associations
 - slope
 - topography
 - surficial geology
 - vegetation



Forest Ecosystem Disturbances



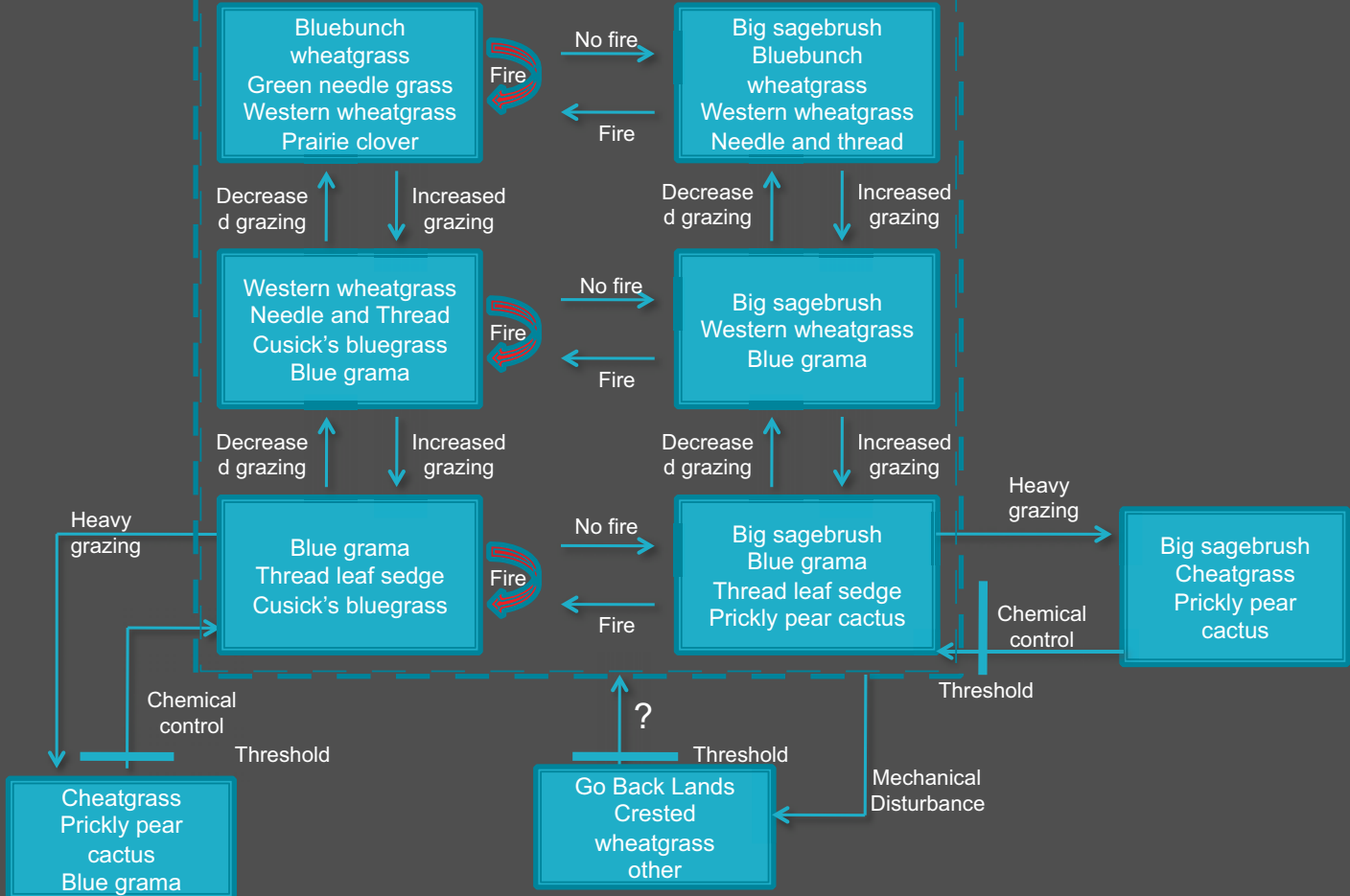
- Diseases/insects
- Shade Tolerance
- Windthrow
- Fire

Describing Disturbance Responses

- **Understanding natural disturbance responses to define reference conditions**
- **Anthropogenic disturbances can be added to understand current and future conditions**
- **Provides a basis for predicting future conditions including possible effects of climate change**

Northern Rolling High Plains MLRA 58B, 10-14" Precipitation Zone
Loamy Ecological Site State and Transition Model

Historically-Occurring States



Ecosystem Diversity Matrix (EDM)

- **Conservation planning tool that classifies ecosystems according to ecological site and response to natural disturbances.**
- **Allows for display of cumulative changes to ecosystem diversity**

Ecosystem Diversity Matrix (simplified)

Habitat Type Class				
VEGETATION GROWTH STAGE	Dry Fir	Rich, Moist Fir	Wet Fir/ Cedar	Wet Spruce
<p>Seedling/Sapling</p> <p><i>Shade Intolerant</i> } Small Tree</p> <p>Medium Tree</p> <p>Large Tree</p> <p>Small Tree</p> <p>Medium Tree</p> <p>Large Tree</p> <p>Old Growth</p> <p><i>Shade Tolerant</i> }</p>	<p>Ecosystem</p>			

SELECTED FIRE SEVERITY RANGES - PLANNED STAND ESTABLISHMENT
 Stand Replace/ Mix-Severity of the Forest Unit, Stand Name, Stand Area (Ha)

Stand Name: *Western Red Pine*

Stand Replace/ Mix-Severity
100-300 yr return interval

<i>Pseudotsuga mensiesii</i>	0
<i>Larix occidentalis</i>	
<i>Picea engelmannii</i>	
<i>Pinus contorta</i>	

Stand Replace/ Mix-Severity
110-340 yr return interval

<i>Pseudotsuga mensiesii</i>	248
<i>Larix occidentalis</i>	
<i>Pinus contorta</i>	
<i>Tsuga heterophylla</i>	

Stand Replace/ Mix-Severity
120-300 yr return interval

<i>Pseudotsuga mensiesii</i>	1302
<i>Larix occidentalis</i>	
<i>Pinus contorta</i>	
<i>Picea engelmannii</i>	

<i>Pseudotsuga mensiesii</i>	38
<i>Larix occidentalis</i>	
<i>Picea engelmannii</i>	
<i>Pinus contorta</i>	

<i>Pseudotsuga mensiesii</i>	0
<i>Larix occidentalis</i>	
<i>Thuja plicata</i>	
<i>Tsuga heterophylla</i>	

<i>Pseudotsuga mensiesii</i>	1140
<i>Larix occidentalis</i>	
<i>Pinus contorta</i>	
<i>Picea engelmannii</i>	

<i>Abies grandis</i>	47
<i>Pseudotsuga mensiesii</i>	
<i>Picea engelmannii</i>	
<i>Larix occidentalis</i>	

<i>Tsuga heterophylla</i>	818
<i>Abies grandis</i>	
<i>Thuja plicata</i>	
<i>Abies lasiocarpa</i>	

<i>Pseudotsuga mensiesii</i>	5643
<i>Abies lasiocarpa</i>	
<i>Picea engelmannii</i>	
<i>Tsuga mertensiana</i>	

3. Reference Conditions

- **Quantify the variation in amounts of each ecosystem within an ecological site for the landscape over a defined past timeframe**

SIMPPLLE Model

- Developed by the USFS
- Spatially explicit landscape-scale model
- Simulates vegetation change caused by disturbance
- Uses include simulations of historical & future conditions

SIMulating
Patterns and
Processes at
Landscape
scaLES



ECONOMIC DIVERSITY INDEX - FLATHEAD VALLEY ECONOMIC
2014-2015 Economic Report - Flathead Valley Economic Development Authority

Economic Sector	Year											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Manufacturing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Construction	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Retail	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Healthcare	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Education	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Government	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Professional Services	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Finance	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Information	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Arts & Entertainment	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Real Estate	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Transportation	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Other	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0

Historical Range of Variability

1-8 (6.51)	2-44 (20.55)	10-45 (22.83)
2-19 (7.87)	12-26 (21.69)	12-26 (24.09)
9-31 (17.45)	5-23 (19.2)	7-21 (14.52)
14%	31%	28%

4. Quantify Existing Conditions

- **Landscape-**
 - **Mapping of existing ecosystems**
- **Ecosystem-**
 - **Determining current composition and structure**

Compare Reference to Existing Conditions

- **Landscape level-**
 - **Changes in amounts of ecosystems**
- **Ecosystem level**
 - **Changes in compositions, structures, process**
 - **Occurrence of exotic species**



- $\leq 10\%$ Historical
- $> 10\%$ but $\leq 30\%$ Historical
- $> 30\%$ but $\leq 100\%$ Historical
- $> 100\%$ Historical

Stand Replace/ Mix-Severity 100-300 yr return interval	Stand Replace/ Mix-Severity 110-340 yr return interval	Stand Replace/ Mix-Severity 120-300 yr return interval
<i>Pseudotsuga mensiesii</i> 0 <i>Larix occidentalis</i> <i>Picea engelmannii</i> <i>Pinus contorta</i>	<i>Pseudotsuga mensiesii</i> 248 <i>Larix occidentalis</i> <i>Pinus contorta</i> <i>Tsuga heterophylla</i>	<i>Pseudotsuga mensiesii</i> 1302 <i>Larix occidentalis</i> <i>Pinus contorta</i> <i>Picea engelmannii</i>
<i>Pseudotsuga mensiesii</i> 38 <i>Larix occidentalis</i> <i>Picea engelmannii</i> <i>Pinus contorta</i>	<i>Pseudotsuga mensiesii</i> 0 <i>Larix occidentalis</i> <i>Thuja plicata</i> <i>Tsuga heterophylla</i>	<i>Pseudotsuga mensiesii</i> 1140 <i>Larix occidentalis</i> <i>Pinus contorta</i> <i>Picea engelmannii</i>
<i>Abies grandis</i> 47 <i>Pseudotsuga mensiesii</i> <i>Picea engelmannii</i> <i>Larix occidentalis</i>	<i>Tsuga heterophylla</i> 818 <i>Abies grandis</i> <i>Thuja plicata</i> <i>Abies lasiocarpa</i>	<i>Pseudotsuga mensiesii</i> 5643 <i>Abies lasiocarpa</i> <i>Picea engelmannii</i> <i>Tsuga mertensiana</i>

ECOSYSTEM DIVERSITY MATRIX - FLATHEAD VALLEY ECOREGION
Upland Forested Systems of the Fortine Unit, Fortine District, Kootenai National Forest

VEGETATION STRUCTURAL STAGES	ENVIRONMENTAL GRADIENT OF ECOLOGICAL SITES (POTENTIAL NATURAL COMMUNITIES)																			
	VEU 1 Moist, Dry Pachyrrhiza Subserotina Douglas Fir	VEU 2 Moist, Dry Douglas Fir/White Fir	VEU 3 Cool, Moist Douglas Fir	VEU 4 Moist, Dry Douglas Fir/White Fir	VEU 5 Cool, Moist Grand Fir	VEU 6 Moist M. heterophylla, Red Cedar	VEU 7 Moist, Moist Subserotina Fir	VEU 8 Moist, Dry Subserotina Fir	VEU 9 Cool, Dry Subserotina Fir	VEU 10 Cool, Dry Subserotina Fir	VEU 11 Cool, Sub-alpine Fir Methuella Pine									
GRASS/SHRUB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
SEEDLING/SAPLING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
POLE	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10									
MEDIUM TREES	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20									
LARGE TREES	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30									
VERY LARGE TREES	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40									
% VEU by Historical Disturbance Regime	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
MEDIUM TREES	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50									
LARGE TREES	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60									
VERY LARGE TREES	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70									
OTHER	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10									
TOTAL ACRES:	30361	57	416262	1423	74196	1178	27631	587	27133	113	794667	1219	633486	12227	294811	3422	60623	0	10614	0

LEGEND

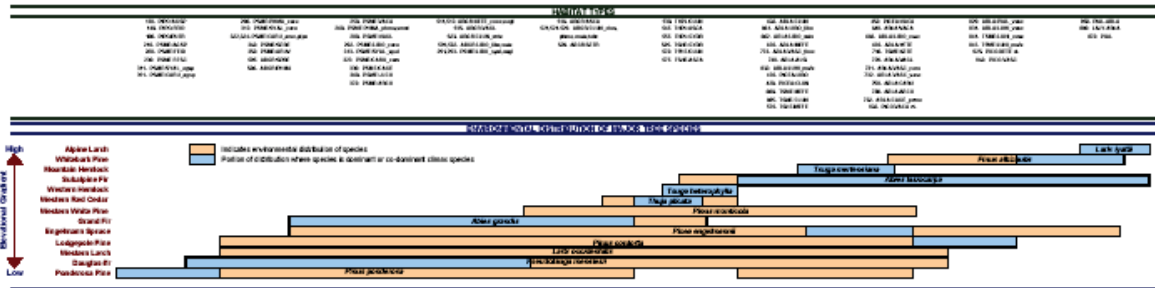
- 0.00 - 0.10: An expanding disturbance regime
- 0.10 - 0.20: An expanding disturbance regime
- 0.20 - 0.30: An expanding disturbance regime
- 0.30 - 0.40: An expanding disturbance regime
- 0.40 - 0.50: An expanding disturbance regime
- 0.50 - 0.60: An expanding disturbance regime
- 0.60 - 0.70: An expanding disturbance regime
- 0.70 - 0.80: An expanding disturbance regime
- 0.80 - 0.90: An expanding disturbance regime
- 0.90 - 1.00: An expanding disturbance regime

Disturbance Regime

- GRASS/SHRUB: 0' - 20'
- Seedling/Sapling: 0.1 - 5.0' dbh
- Pole: 5.1 - 9.0' dbh
- Medium Tree: 9.1 - 15.0' dbh
- Large Tree: 15.1 - 18.0' dbh
- Very Large Tree: 18.1 - 24' dbh

Tree Species

- MBR - Moist growth
- MBL - Moist lowland
- LDC - Low to mid elevation
- LAL - Low to high
- PLS - Picea canadensis
- PLM - Picea mariana
- PLN - Picea canadensis
- PLS - Picea canadensis
- PLM - Picea mariana
- PLN - Picea canadensis



Prepared by: Ecological Diversity Index - Ecological Diversity Index

1) Hauer, J.D. et al. 2002. Performance measures for ecosystem management and ecological sustainability. The Western Forestry Technical Report 02-1, 2002.

2) Hauer, J.D. et al. 1999. Using a consistent approach with response assessment for ecological management. WFS Technical Report 99-1, 1999.

3) Hauer, J.D. et al. 2000. An ecological framework for planning for forest health. J. Sustainable Forestry, 19(2): 207-219.

4) Vegetation response unit (VRU) data for the Fortine Unit, Kootenai National Forest, 1989. Kootenai National Forest, U.S. Dept. of Agric., U.S. Forest Service, Neches Project.

5) Hauer, J.D. et al. 1991. Forest health assessment for the Fortine Unit, Kootenai National Forest, U.S. Dept. of Agric., U.S. Forest Service, Neches Project.

6) Furbush and Bingham. 1987. Fire ecology of Montana and western Idaho. U.S. Dept. Agric., U.S. Forest Service, Neches Project.

7) Hauer, J.D. et al. 2002. Performance measures for ecosystem management and ecological sustainability. The Western Forestry Technical Report 02-1, 2002.

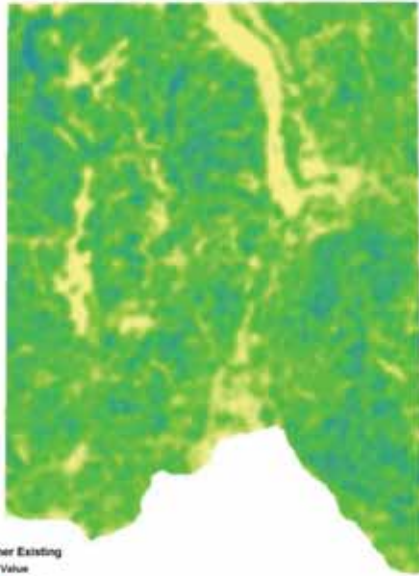


5. Management Recommendations

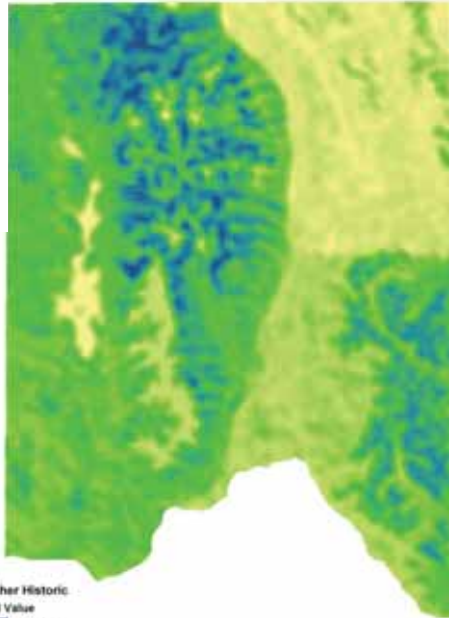
- **Landscape level**
 - **Identify desired amounts and distributions of native ecosystems**
- **Ecosystem level**
 - **Identify desired compositions and structures for representative areas**
- **Guide management prescriptions**

6. Check Representation Goals

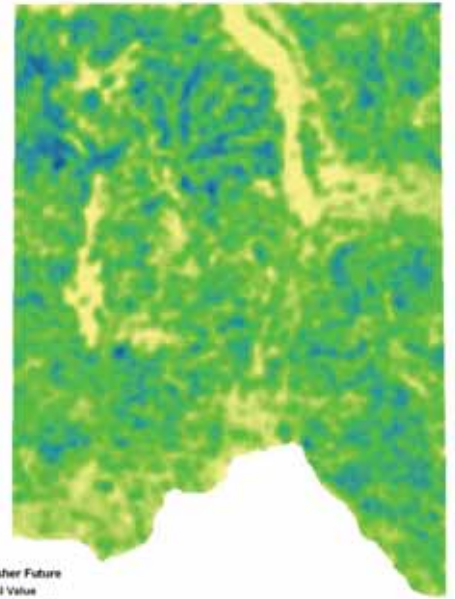
- **Species can be used to check on adequacy of representation**



Fisher Existing
HSI Value
High - 100
Low - 0

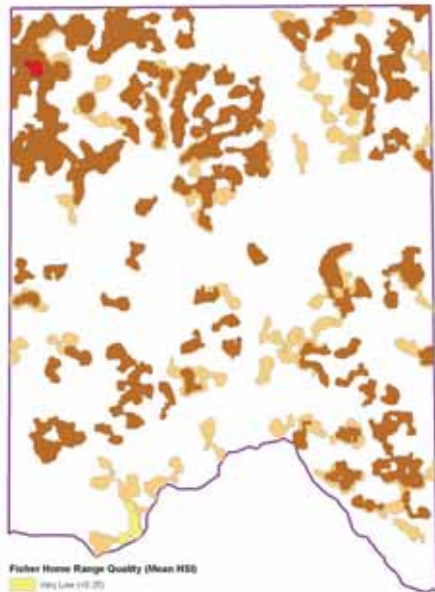


Fisher Historic
HSI Value
High - 100
Low - 0

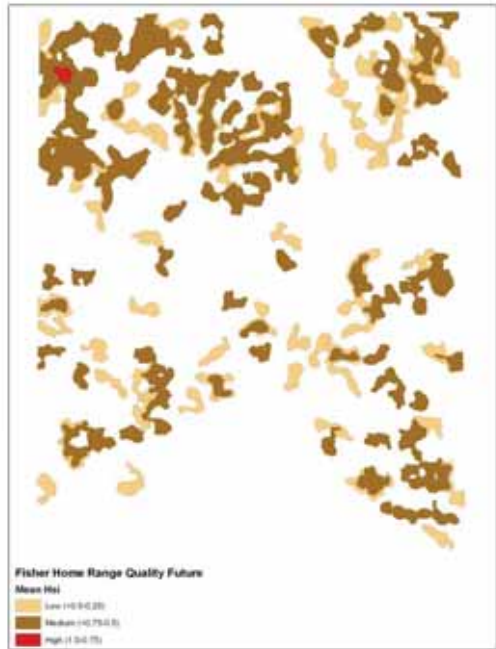


Fisher Future
HSI Value
High - 100
Low - 0

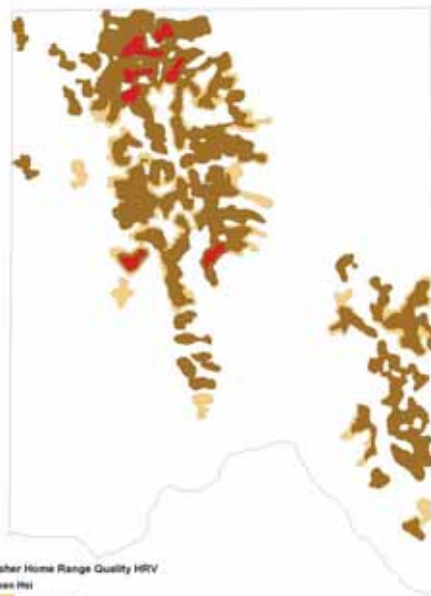




Fisher Home Range Quality (Mean HSB)
 Mean HSB
 Low (1.0-2.0)
 Medium (2.0-3.0)
 High (3.0-7.0)

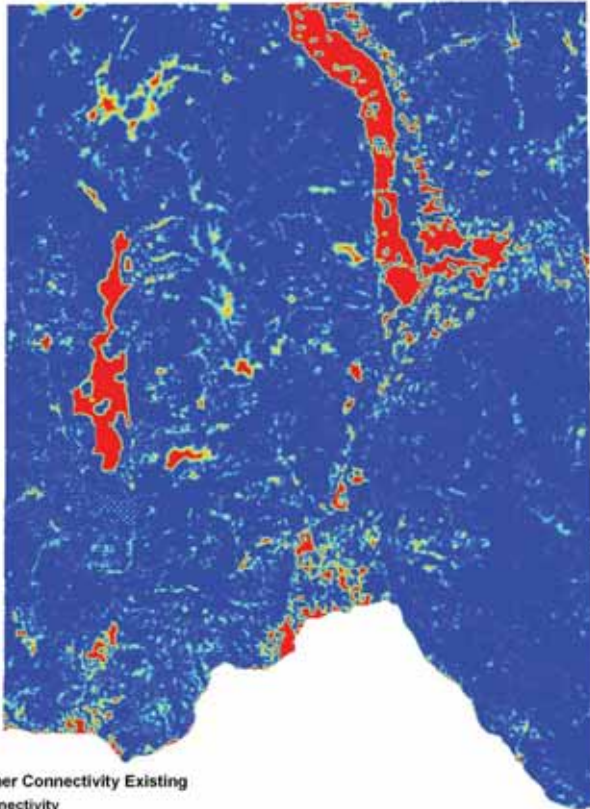


Fisher Home Range Quality Future
 Mean HSI
 Low (1.0-2.0)
 Medium (2.0-3.0)
 High (3.0-7.0)



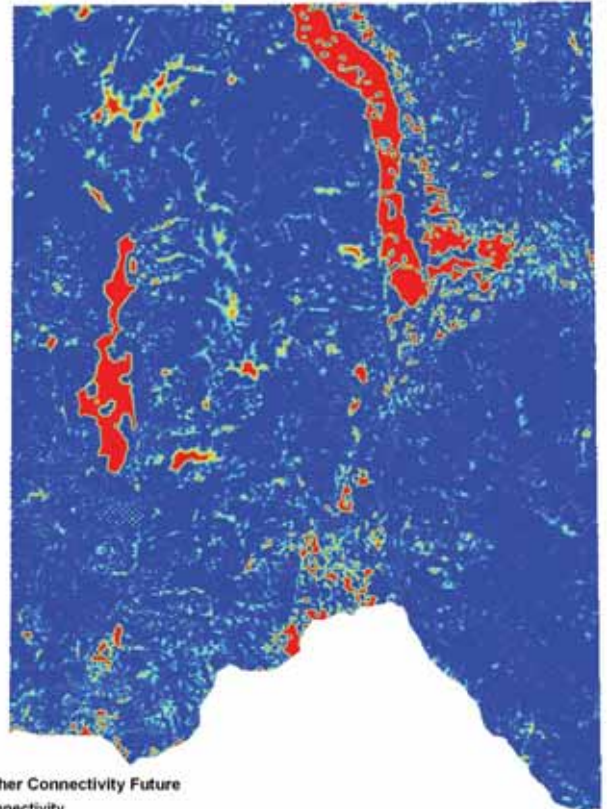
Fisher Home Range Quality HSI
 Mean HSI
 Low (1.0-2.0)
 Medium (2.0-3.0)
 High (3.0-7.0)





Fisher Connectivity Existing

Connectivity



Fisher Connectivity Future

Connectivity



Summary

- **Ecosystem diversity is a cornerstone for conservation of biodiversity**
- **It can be effectively and efficiently characterized, mapped, and used to set management objectives**
- **An ecosystem-based process has been used to develop management plans for numerous areas and for all types of ecosystems**
- **It allows for the integration of ecological, social, and economic objectives**