

Habitat Mapping of Lynx Analysis Units on Bureau of Land Management Lands and Surrounding Areas in Wyoming

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EXECUTIVE SUMMARY

Lynx analysis units (LAUs) are management areas that contain suitable lynx habitat and approximate the size of a female home range. General guidelines for creation of lynx analysis units are outlined in the Canada Lynx Conservation Assessment and Strategy, written by an interagency team of representatives from the USDA Forest Service, the USDI Bureau of Land Management, and the USDA Fish and Wildlife Service (Ruediger et al. 2000).

A GIS coverage of Lynx analysis units on lands administered by the Bureau of Land Management was created following the guidelines in the Canada Lynx Conservation Assessment and Strategy. Over 153,000 ha of land administered by the Bureau of Land Management in Wyoming contains suitable lynx habitat. However, this land is highly fragmented and dispersed throughout the state. Only three areas are large enough (> 6,500 ha) to qualify as lynx analysis units. Two of these areas are at the southern end of, and adjacent to, the Bridger-Teton National Forest. The third lynx analysis unit is in the Green Mountain area in south-central Wyoming. The Green Mountain LAU is about 40 miles from the nearest Forest Service LAU, on the Shoshone National Forest, and 130 miles from the next nearest BLM LAU.

A state-wide coverage of lynx habitat on managed lands was also created to gain a broader-scale view of lynx habitat in Wyoming. The majority of lynx habitat is in the northwestern corner of the state. Suitable habitat in the rest of the state is more fragmented and generally separated by large tracts of shrublands. Due to high mobility of lynx, such separation is likely not an absolute barrier to dispersal through these areas of suitable habitat, but large distances may reduce the likelihood of successful dispersal and colonization by lynx.

INTRODUCTION

Canada lynx (*Lynx canadensis*) was listed as a federally threatened species, effective April 24, 2000 (Federal Register Volume 65, No. 58). To facilitate consistent management of federal lands that contain lynx habitat, an interagency Lynx Biology Team was created to prepare a conservation strategy (Ruediger et al. 2000). The team

contained representatives of the USDA Forest Service, the USDI Fish and Wildlife Service, and the USDI Bureau of Land Management. The conservation strategy was published as the Canada Lynx Conservation Assessment and Strategy (LCAS; Ruediger et al. 2000). In the LCAS, general guidelines for the creation of lynx analysis units (LAUs) were outlined, so that areas with lynx habitat in different parts of the country would be defined in a relatively consistent way among federal agencies.

Guidelines for LAUs include suitable habitat delineation, minimum habitat area, and habitat connectivity (Ruediger et al. 2000). LAUs approximate the size of a female lynx home range. Suitable habitat includes lodgepole pine, subalpine fir, and Engelmann spruce, as well as cool, moist Douglas-fir, grand fir, aspen, and western larch (Aubry et al. 2000). Female lynx homeranges in relatively contiguous, high-quality habitat are about 6,500-10,000 ha (25-39 square miles; Ruediger et al. 2000). In the southern portion of the lynx range in North America, or in more fragmented or lower-quality habitat, LAUs should be larger. It is recommended that 5th or 6th order hydrologic unit codes (HUCs) be used to delineate LAUs in the western U.S. LAUs with little lynx habitat may be combined with adjacent LAUs when possible, or these areas may be eliminated as possible LAUs (Ruediger et al. 2000).

METHODS

Wyoming Lynx Analysis Unit Map

We created a state-wide map of LAUs on Bureau of Land Management and Forest Service lands in Wyoming. LAUs on land administered by the Bureau of Land Management in Wyoming were created in ArcView (version 3.2; Environmental Systems Research Institute, Redlands, California) using: 1) the GAP landcover for Wyoming (Merrill et al. 1996), and 2) a BLM land ownership coverage. Polygons with the primary vegetation types of aspen, Douglas-fir, lodgepole pine, and spruce-fir forests were extracted from the GAP landcover coverage. This landcover coverage was clipped using the BLM land ownership coverage to obtain a coverage that contained suitable habitat on lands administered by the BLM in Wyoming. The sizes of suitable habitat polygons were then analyzed to determine the number and location of polygons that were 6,500 ha or larger.

Lynx analysis units on the national forests in Wyoming were obtained from the forests and added to the map containing the BLM LAUs. The LAUs for many of the National Forests in Wyoming are considered to be either provisional or draft, as methods to create LAUs on these forests are currently undergoing revision.

As requested by the BLM, a 10-mile buffer was placed around the BLM LAUs to gauge the impact of potential BLM actions regarding lynx on land administered by the Forest Service.

Analysis of suitable lynx habitat on federally managed lands in Wyoming

A map of suitable lynx habitat on managed lands in Wyoming was created to gain a broader-scale perspective of lynx habitat on federally managed lands in Wyoming than afforded by considering LAUs alone. Unlike the map of BLM and Forest Service LAUs (above), the map of state-wide lynx habitat on managed lands was created using consistent criteria; the LCAS sets general guidelines for LAU creation, but there remains some leeway in the final product.

The map of lynx habitat on managed lands was created in ArcView (version 3.2; Environmental Systems Research Institute, Redlands, California) using: 1) a state-wide map coded with a suitable lynx habitat index (Beauvais et al. 2001), and 2) a coverage delineating federally managed lands in Wyoming. The lynx habitat index coverage was clipped using the management coverage to obtain a new coverage containing lynx habitat indices for federally managed lands in Wyoming. Beauvais et al. (2001) created the habitat index by first assigning a habitat score to the GAP landcover types (Table 1). For each polygon, cover type scores are multiplied by the percentage of the polygon occupied by each cover type. These were then added together for each polygon to yield a final habitat index score (from Beauvais et al. 2001):

$$\begin{aligned} \text{Index} = & \quad (\text{Primary cover type score} * [\% \text{ coverage of primary type} / 100]) + \\ & \quad (\text{Secondary cover type score} * [\% \text{ coverage of secondary type} / 100]) + \\ & \quad (\text{Tertiary cover type score} * [\% \text{ coverage of tertiary type} / 100]) \end{aligned}$$

RESULTS AND DISCUSSION

LAUs on lands administered by the BLM

There are 3 areas large enough to be considered LAUs on lands administered by the BLM (Figure 1). Two of the LAUs are adjacent to the southern end of the Bridger-Teton National Forest, and are 7,825 ha (30 square miles) and 8,629 ha (33 square miles), respectively. These BLM LAUs are about 15 miles apart (Figure 2). It may be possible to combine these 2 LAUs, as well as similar areas of suitable habitat on BLM land, with adjacent LAUs on the Bridger-Teton National Forest.

The third LAU is in central Wyoming on Green Mountain, and is 8,111 ha (31 square miles; Figure 3). The Green Mountain LAU is surrounded by sagebrush shrublands and is about 40 miles from the nearest LAU, which is in the Shoshone National Forest. The Green Mountain LAU is also about 75 miles from the Medicine Bow-Routt National Forest in southeast Wyoming, and is about 130 miles from the nearest of the other two BLM LAUs. There is suitable habitat on land administered by the BLM nearer to the Green Mountain LAU (5-8 miles away), but these areas are too small to qualify as LAUs themselves.

There is suitable habitat in other parts of Wyoming on land administered by the BLM, but none of these areas are large enough to meet the minimum size requirement of 6,500 ha (Figure 1), which is a conservative estimate for the southern portion of lynx range in the United States. Of the 1,083 total polygons on BLM land with suitable habitat, 1,055 are less than 1,000 ha in size. Twenty-two of the remaining polygons have between 1,000-5,000 ha of suitable habitat, and 3 polygons have between 5,001-6,000 ha of suitable habitat.

Authors of the LCAS suggest that, in the western U.S., 5th or 6th order hydrologic unit codes (HUCs) be used to divide areas with suitable habitat into LAUs the size of a female lynx homerange. We elected to not divide lynx habitat on BLM land using HUCs, because there is so little lynx habitat on BLM land in Wyoming, that division of these small islands of habitat based on HUC boundaries would leave too little habitat in each HUC to be classified as LAUs. The 3 segments of BLM land large enough to qualify as LAUs (6,500 ha) have a long, linear shape and are highly dissected (Figures 2

and 3). Each of these areas intersects 5-6 6th order HUCs, with only a small amount of lynx habitat falling within each HUC.

Ten-mile buffers were placed around the 3 BLM LAUs to determine areas on National Forest land that may be affected by proposed actions on BLM land (Figures 1-3). The 10-mile buffers indicate that actions proposed for the BLM LAUs adjacent to the Bridger-Teton National Forest may affect lynx on that forest. The 10-mile buffer around the Green Mountain LAU does not overlap any land administered by the Forest Service. This buffer does overlap 2 areas of nearby BLM land that contain lynx habitat, although these areas are too small to qualify as LAUs themselves. This grouping of suitable habitat in south-central Wyoming is isolated from other LAUs and most other areas of suitable habitat that are too small to be LAUs.

State-wide lynx habitat

Nearly all suitable lynx habitat in Wyoming lies on lands administered by the Forest Service or the National Park Service (Figure 4). Within Wyoming, the majority of suitable lynx habitat is in the northwestern corner of the state, formed mostly by Yellowstone National Park, Grand Teton National Park, Bridger-Teton National Forest, Shoshone National Forest, and Caribou-Targhee National Forest.

Suitable lynx habitat elsewhere in Wyoming is more fragmented and generally separated by large tracts of shrublands. While this analysis is not meant to assess lynx dispersal potential, it appears that distances between large portions of suitable habitat in Wyoming generally exceed recorded lynx travel distances. In the northern part of its range, lynx (age and time frame are not specified) typically travel over 100 km (62 miles). However, no successful dispersals have been documented in the southern part of the range (Aubry et al. 2000). The Bighorn National Forest is about 60 miles east of the Shoshone National Forest, and is at least this distant from other suitable habitat in Wyoming. The portions of the Wasatch-Cache and Ashley National Forests within Wyoming are about 80 miles from the Bridger-Teton National Forest. At their closest point (in Colorado), the Ashley and Medicine Bow-Routt National Forests are about 95 miles apart. Due to high mobility of lynx, such separation is likely not an absolute barrier to dispersal through areas of suitable habitat, although it may be a substantial barrier to

successful dispersal and is likely a barrier to successful lynx colonization (McKelvey et al. 2000), particularly since much of the intervening land is not classified as suitable lynx habitat.

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Table 1. Lynx habitat suitability scores (0 – 6) for cover types identified by Merrill et al. (1996), taken from Beauvais et al. (2001).

| SCORE | COVER TYPES |
|--------------|---|
| 0 | Open water / human settlements / surface mining operations / irrigated crops / dry-land crops |
| 1 | Active sand dunes / black sagebrush steppe / unvegetated playa / basin exposed rock and soil / Great Basin foothills grassland / mixed grass prairie / short grass prairie / grass dominated wetland / grass dominated riparian / saltbush fans and flats |
| 2 | Bitterbrush shrub steppe / desert shrub / greasewood fans and flats / vegetated dunes |
| 3 | Basin big sagebrush / Wyoming big sagebrush / bur oak woodland / shrub dominated riparian / mesic upland shrub / xeric upland shrub |
| 4 | Mountain big sagebrush / permanent snow / alpine exposed rock and soil / forest dominated riparian |
| 5 | Limber pine woodland / ponderosa pine / juniper woodland / aspen / subalpine meadow / meadow tundra |
| 6 | Spruce-fir / Douglas fir / lodgepole pine / clearcut conifer / whitebark pine / burned conifer |

Figure 1. Lynx analysis units on Bureau of Land Management and Forest Service land in Wyoming. Red polygons represent BLM LAUs. Red circles indicate 10-mile buffers around the BLM LAUs.

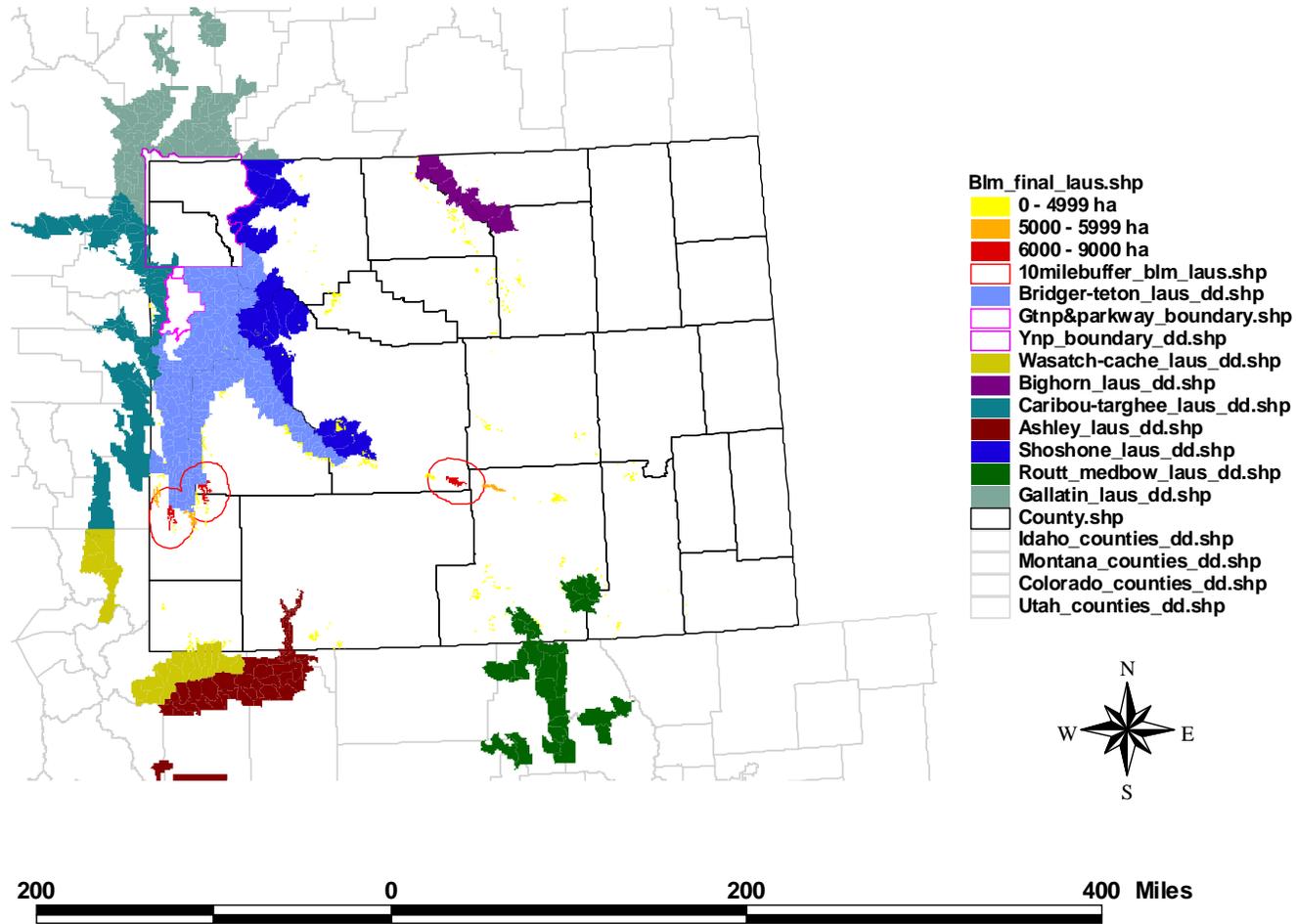


Figure 2. Bureau of Land Management LAUs adjacent to the Bridger-Teton National Forest. Red polygons represent BLM LAUs. Red circles indicate 10-mile buffers around the BLM LAUs.

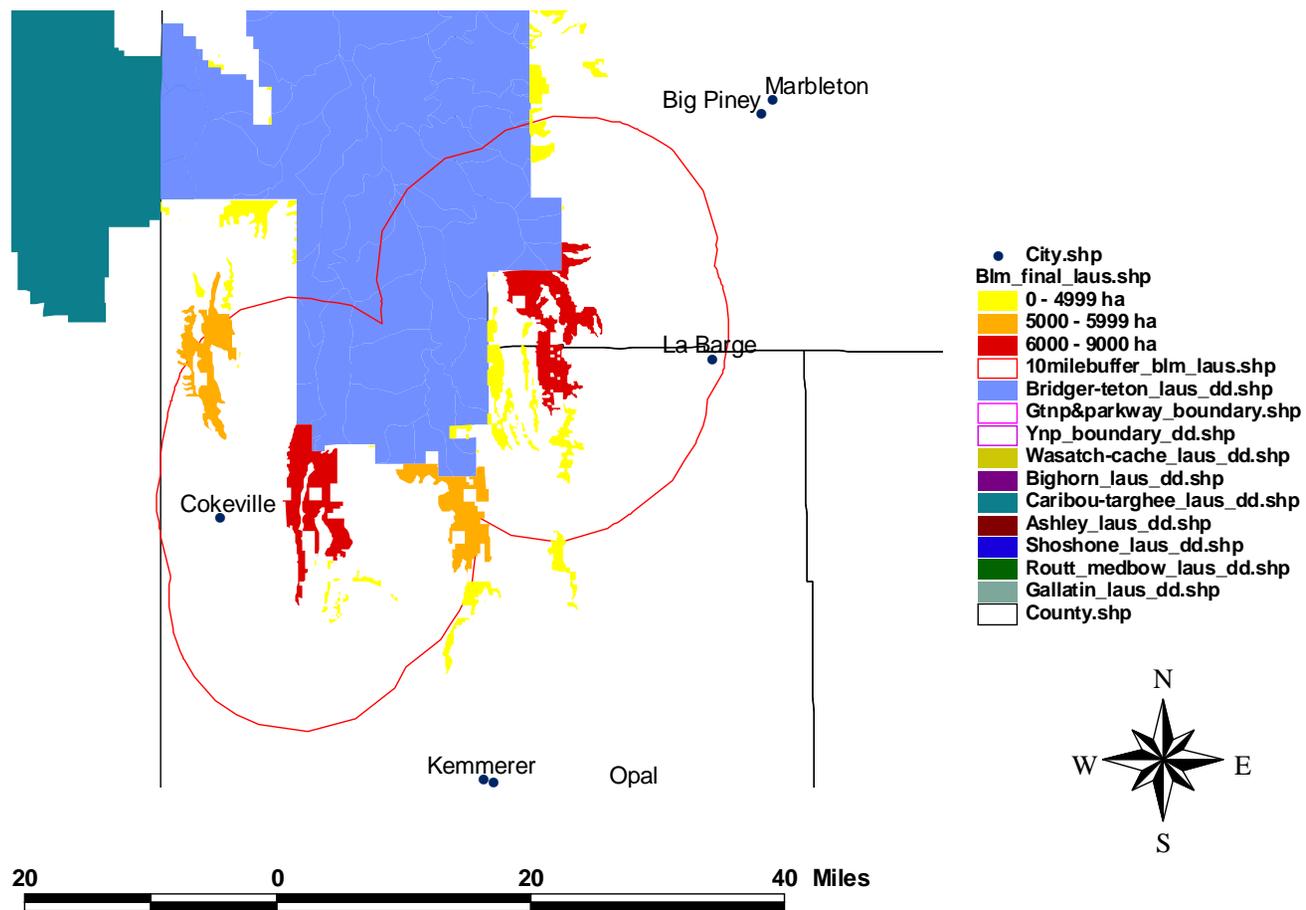


Figure 3. Bureau of Land Management LAU on Green Mountain in south-central Wyoming. The red polygon represents the BLM LAU. The red circle indicates the extent of the 10-mile buffer around the LAU.

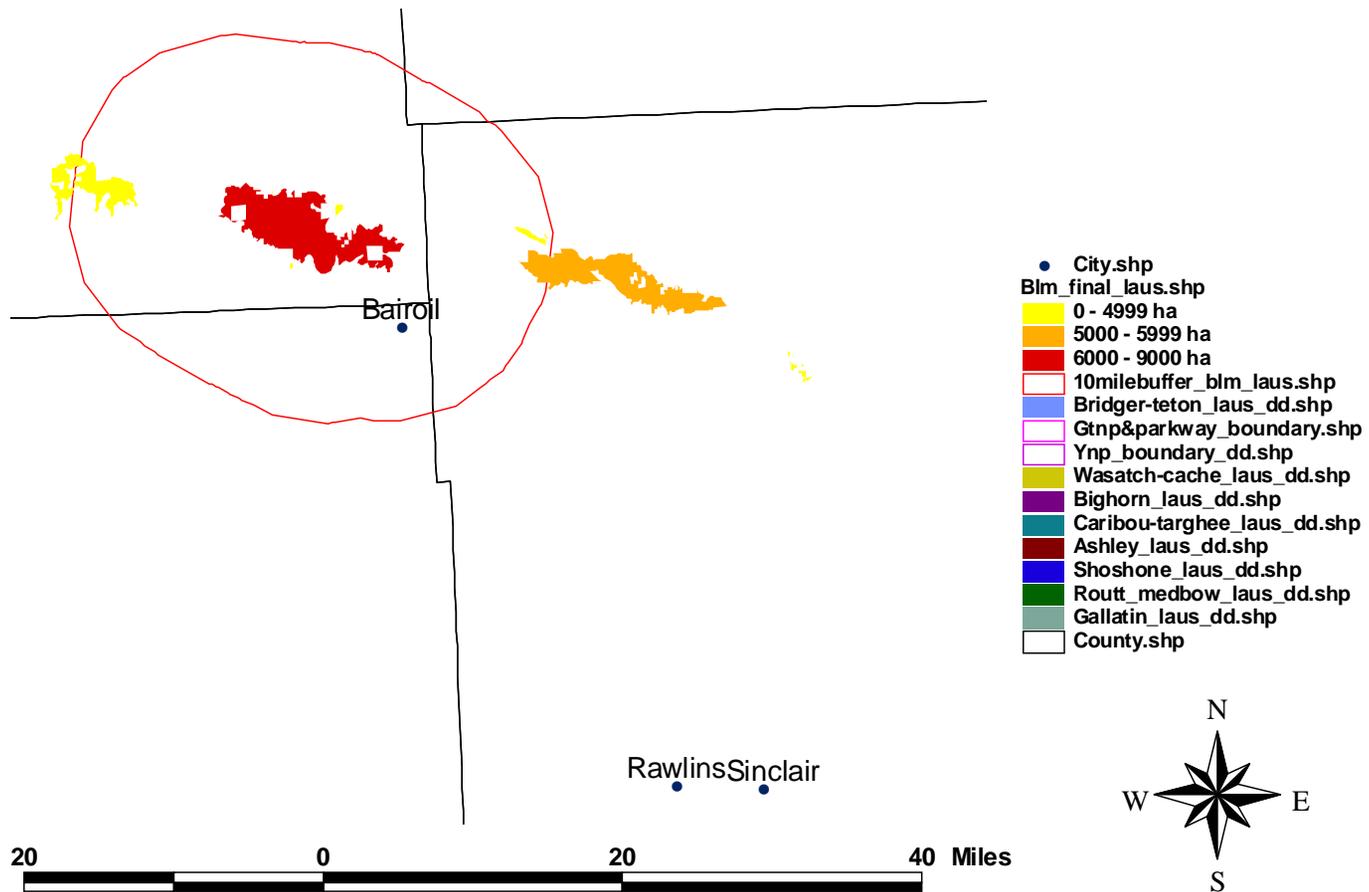
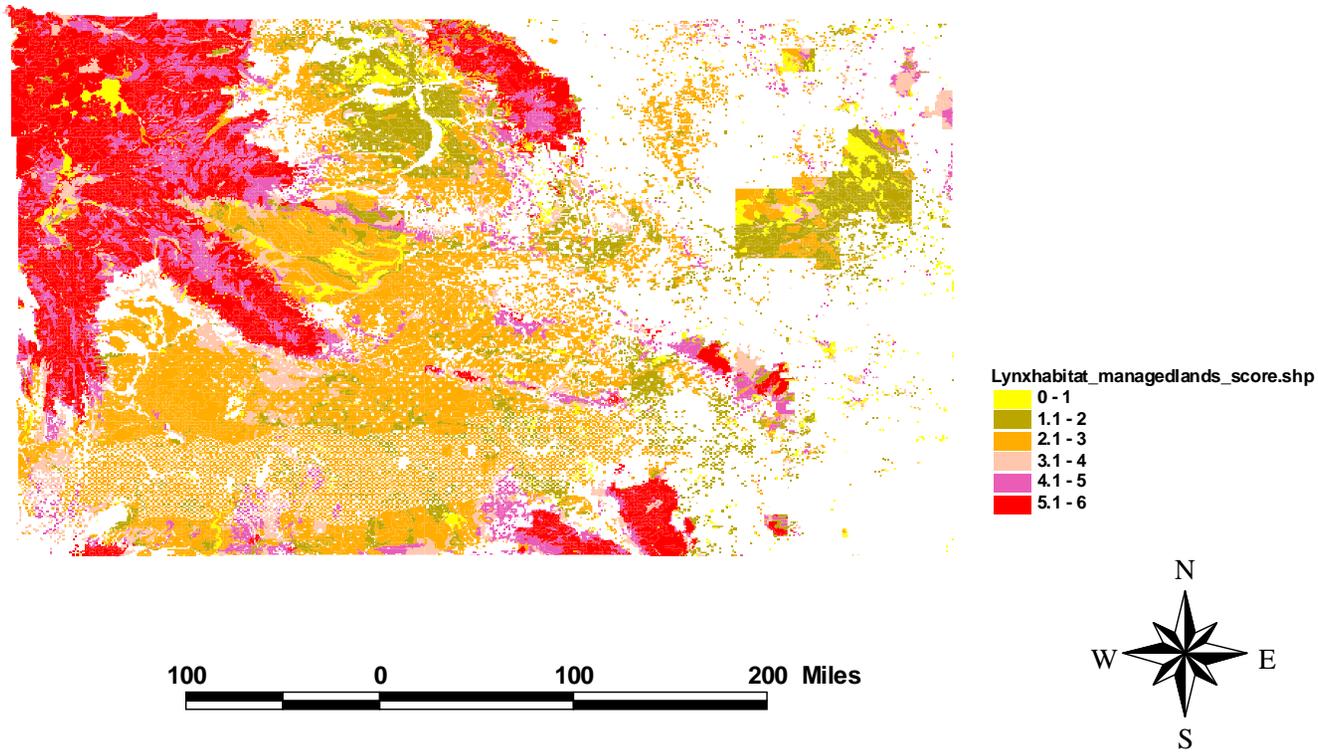


Figure 4. Index of lynx habitat suitability for managed lands in Wyoming, adapted from Beauvais et al. (2001). Higher scores indicate higher habitat suitability. A list of cover types assigned to each score is in Table 1.



Appendix

IDENTIFICATION_INFORMATION

Citation:

Citation_Information:

Originator: Wyoming Natural Diversity Database

Publication_Date: 20020502

Title: Habitat Mapping of Lynx Analysis Units on Bureau of Land
Management Lands and Surrounding Areas in Wyoming

Edition:

Geospatial_Data_Presentation_Form: Map

Publication_Information:

Publication_Place: Laramie, Wyoming

Publisher: Wyoming Natural Diversity Database

Description: Shapefile of lynx analysis units on lands administered by the
Bureau of Land Management in Wyoming

Abstract:

A GIS coverage of Lynx Analysis Units (LAUs) on lands administered by the Bureau of Land Management was created following the guidelines in the Canada Lynx Conservation Assessment and Strategy (LCAS). Over 153,000 ha of land administered by the BLM in Wyoming contains suitable habitat. However, only three areas are large enough (>6,500 ha) to qualify as LAUs. Two of these LAUs are at the southern end of, and adjacent to, the Bridger-Teton National Forest. The third LAU is in the Green Mountain area in south-central Wyoming.

Purpose:

Supplemental_Information:

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date:

Ending_Date:

Currentness_Reference: 20020502

Status:

Progress: In work

Maintenance_and_Update_Frequency: None planned

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North_Bounding_Coordinate: 45.1461

South_Bounding_Coordinate: 40.8521

Keywords:

Theme:

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Theme_Keyword: Wyoming lynx analysis units

Theme_Keyword: BLM lynx analysis units

Place:

Place_Keyword_Thesaurus: None

Access_Constraints:

Use_Constraints:

Persons using the information presented should fully understand the data collection, development, and attribution procedures as described in the metadata. The burden for determining applicability for analysis purposes lies entirely with the user. For purposes of publication or

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Point_of_Contact:

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Contact_Organization_Primary:

Contact_Organization: Wyoming Natural Diversity Database

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Contact_Facsimile_Telephone: 307-766-3026

Contact_Electronic_Mail_Address: wndd@uwyo.edu

Hours_of_Service: 8am to 5pm

Native_Data_Set_Environment:

ArcView version 3.2 shapefile format

DATA_QUALITY_INFORMATION

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Attribute_Accuracy_Report:

The attributes associated with this coverage are as accurate as attributes in the source coverages.

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Vertical_Positional_Accuracy_Report:

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Source_Citation:

Citation_Information:

Originator: Merrill et al.

Publication_Date: 20021201

Title: Wyoming Gap landcover

Edition:

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place:

Publisher:

Other_Citation_Details:

Online_Linkage:

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 Publication_Date: unknown
 Title: Lands administered by the Bureau of Land Management in Wyoming
 Edition:
 Geospatial_Data_Presentation_Form: map
 Publication_Information:
 Publication_Place:
 Publisher:
 Other_Citation_Details:
 Online_Linkage:
 Larger_Work_Citation:
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 Ending_Date:
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 Source_Citation_Abbreviation:
 Source_Contribution:
 Process_Step:
 Process_Description:
 The Gap landcover coverage was edited to include the primary forest types of aspen, Douglas-fir, lodgepole pine, and Spruce-fir. The edited Gap coverage was clipped in ArcView using the coverage of lands in Wyoming administered by the Bureau of Land Management.
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 Process_Contact:
 Contact_Information:
 Contact_Person_Primary:
 Contact_Organization: Wyoming Natural Diversity Database
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 Contact_Position: Data Manager
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 Address_Type: mailing and physical address

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Contact_Facsimile_Telephone: 307-766-3026
Contact_Electronic_Mail_Address: wndd@uwyo.edu
Hours_of_Service: 8am to 5pm

SPATIAL_DATA_ORGANIZATION_INFORMATION

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 891

SPATIAL_REFERENCE_INFORMATION

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Semi-major_Axis: 6378206.4000000
Denominator_of_Flattening_Ratio: 294.98

DISTRIBUTION_INFORMATION

Distributor:
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Hours_of_Service: 8am to 5pm

Resource_Description:

Distribution_Liability:

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METADATA_REFERENCE_INFORMATION

Metadata_Date: 20020502

Metadata_Review_Date:

Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: Wyoming Natural Diversity Database

Contact_Person:

Contact_Position: Data Manager

Contact_Address:

Address_Type: Mailing and physical address

Address: P.O. Box 3381

City: Laramie

State_or_Province: WY

Postal_Code: 82071-3381

Country: USA

Contact_Voice_Telephone: 307-766-3023

Contact_Facsimile_Telephone: 307-766-3026

Contact_Electronic_Mail_Address: wndd@uwyo.edu

Hours_of_Service: 8am to 5pm

Metadata_Standard_Name: FGDC CSDGM

Metadata_Standard_Version: FGDC-STD-001-1998

IDENTIFICATION_INFORMATION

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Publication_Date: 20020502
Title: Index of lynx habitat suitability for managed lands in Wyoming
Edition:
Geospatial_Data_Presentation_Form: Map
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Publication_Place: Laramie, Wyoming
Publisher:

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Larger_Work_Citation:

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Publication_Date: 20020502
Title: Habitat Mapping of Lynx Analysis Units on Bureau of Land
Management Lands and Surrounding Areas in Wyoming
Publication_Information:
Publication_Place:
Publisher:
Online_Linkage:

Description:

Abstract:

A GIS coverage of an index of lynx habitat suitability for managed lands in Wyoming was created to gain a broader-scale perspective of lynx habitat and habitat connectivity on managed lands in Wyoming. Nearly all of the suitable lynx habitat in Wyoming lies on lands administered by the Forest Service and the National Park Service. Within Wyoming, the majority of suitable lynx habitat is in the northwestern corner of the state. Suitable lynx habitat elsewhere in Wyoming is more fragmented and generally separated by large tracts of shrublands.

Purpose:

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Time_Period_of_Content:

Time_Period_Information:

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Ending_Date:

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Status:

Progress: In work
Maintenance_and_Update_Frequency: None planned

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Theme_Keyword: lynx habitat

Theme_Keyword: Wyoming lynx habitat
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Use_Constraints:
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Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address: P.O. Box 3381
City: Laramie
State_or_Province: Wyoming
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Contact_Facsimile_Telephone: 307-766-3026
Contact_Electronic_Mail_Address: wndd@uwyo.edu
Hours_of_Service: 8am to 5pm
Native_Data_Set_Environment:
ArcView version 3.2 shapefile format

DATA_QUALITY_INFORMATION

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Attribute_Accuracy_Report:
The attributes associated with this coverage are as accurate as the attributes in the source coverages.
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Completeness_Report:
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Horizontal_Positional_Accuracy_Report:
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report:
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Originator:
Publication_Date: 20020502
Title: Index of lynx habitat suitability for managed lands in Wyoming
Edition:
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Laramie, WY
Publisher: Wyoming Natural Diversity Database
Other_Citation_Details:
Online_Linkage:
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Originator: Wyoming Natural Diversity Database
Publication_Date: 20020502

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Type_of_Source_Media:

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date:

Ending_Date:

Source_Currentness_Reference:

Source_Citation_Abbreviation:

Source_Contribution:

Process_Step:

Process_Description:

A coverage of managed lands in Wyoming (which did not contain Bureau of Land Management lands) was unioned with a coverage of BLM lands. The resulting coverage was then intersected with a map showing suitable lynx habitat indices for the entire state (Beauvais et al. 2001).

Source_Used_Citation_Abbreviation:

Process_Date:

Source_Produced_Citation_Abbreviation:

Process_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Organization: Wyoming Natural Diversity Database

Contact_Person:

Contact_Position: Data Manager

Contact_Address:

Address_Type: mailing and physical address

Address: P.O. Box 3381

City: Laramie

State_or_Province: WY

Postal_Code: 82071-3381

Country: USA

Contact_Voice_Telephone: 307-766-3023

Contact_Facsimile_Telephone: 307-766-3026

Contact_Electronic_Mail_Address: wndd@uwyo.edu

Hours_of_Service: 8am to 5pm

SPATIAL_DATA_ORGANIZATION_INFORMATION

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains

Point_and_Vector_Object_Count: 38116

SPATIAL_REFERENCE_INFORMATION

Horizontal_Coordinate_System_Definition:

Geographic:

Latitude_Resolution:

Longitude_Resolution:
Geographic_Coordinate_Units: Decimal Degrees
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis:
Denominator_of_Flattening_Ratio:

ENTITY_AND_ATTRIBUTE_INFORMATION

Overview_Description:

Entity_and_Attribute_Overview:

Index Cover Type

0 Open water / human settlements / surface mining operations / irrigated crops / dry-land crops
1 Active sand dunes / black sagebrush steppe / unvegetated playa / basin exposed rock and soil / Great Basin foothills grassland / mixed-grass prairie / short-grass prairie / grass-dominated wetland / grass-dominated riparian / saltbush fans and flats
2 Bitterbrush shrub steppe / desert shrub / greasewood fans and flats / vegetated dunes
3 Basin big sagebrush / Wyoming big sagebrush / bur oak woodland / shrub-dominated riparian / mesic upland shrub / xeric upland shrub
4 Mountain big sagebrush / permanent snow / alpine exposed rock / forest-dominated riparian
5 Limber pine woodland / ponderosa pine / juniper woodland / aspen / subalpine meadow / meadow tundra
6 Spruce-fir / Douglas-fir / lodgepole pine / clearcut conifer / whitebark pine / burned conifer

Entity_and_Attribute_Detail_Citation:

DISTRIBUTION_INFORMATION

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: Wyoming Natural Diversity Database

Contact_Person:

Contact_Position: Data Manager

Contact_Address:

Address_Type: mailing and physical address

Address: P.O. Box 3381

City: Laramie

State_or_Province: WY

Postal_Code: 82071-3381

Country: USA

Contact_Voice_Telephone: 307-766-3023

Contact_Facsimile_Telephone: 307-766-3026

Contact_Electronic_Mail_Address: wndd@uwyo.edu

Hours_of_Service: 8am to 5pm

Resource_Description:

Distribution_Liability:

This coverage was developed using ArcView 3.2. Although this data has been successfully processed on computer systems at the Wyoming Natural Diversity Database, no

warranty, expressed or implied, is made regarding the accuracy or utility of the data on any other systems for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. WYNDD shall not be held liable for improper or incorrect use of the data described and/or contained herein.

Standard_Order_Process:

Digital_Form:

Digital_Transfer_Information:

Format_Name:

Digital_Transfer_Option:

Offline_Option:

Offline_Media:

Recording_Format:

Compatibility_Information:

Fees:

Ordering_Instructions:

METADATA_REFERENCE_INFORMATION

Metadata_Date: 20020502

Metadata_Review_Date:

Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: Wyoming Natural Diversity Database

Contact_Person:

Contact_Position: Data Manager

Contact_Address:

Address_Type: Mailing and physical address

Address: P.O. Box 3381

City: Laramie

State_or_Province: WY

Postal_Code: 82071-3381

Country: USA

Contact_Voice_Telephone: 307-766-3023

Contact_Facsimile_Telephone: 307-766-3026

Contact_Electronic_Mail_Address: wndd@uwyo.edu

Hours_of_Service: 8am to 5pm

Metadata_Standard_Name: FGDC CSDGM

Metadata_Standard_Version: FGDC-STD-001-1998