Conserving Woodland Caribou Habitat:
A Pilot Study of the Churchill River Upland Ecoregion of Northern Saskatchewan, Canada

Background

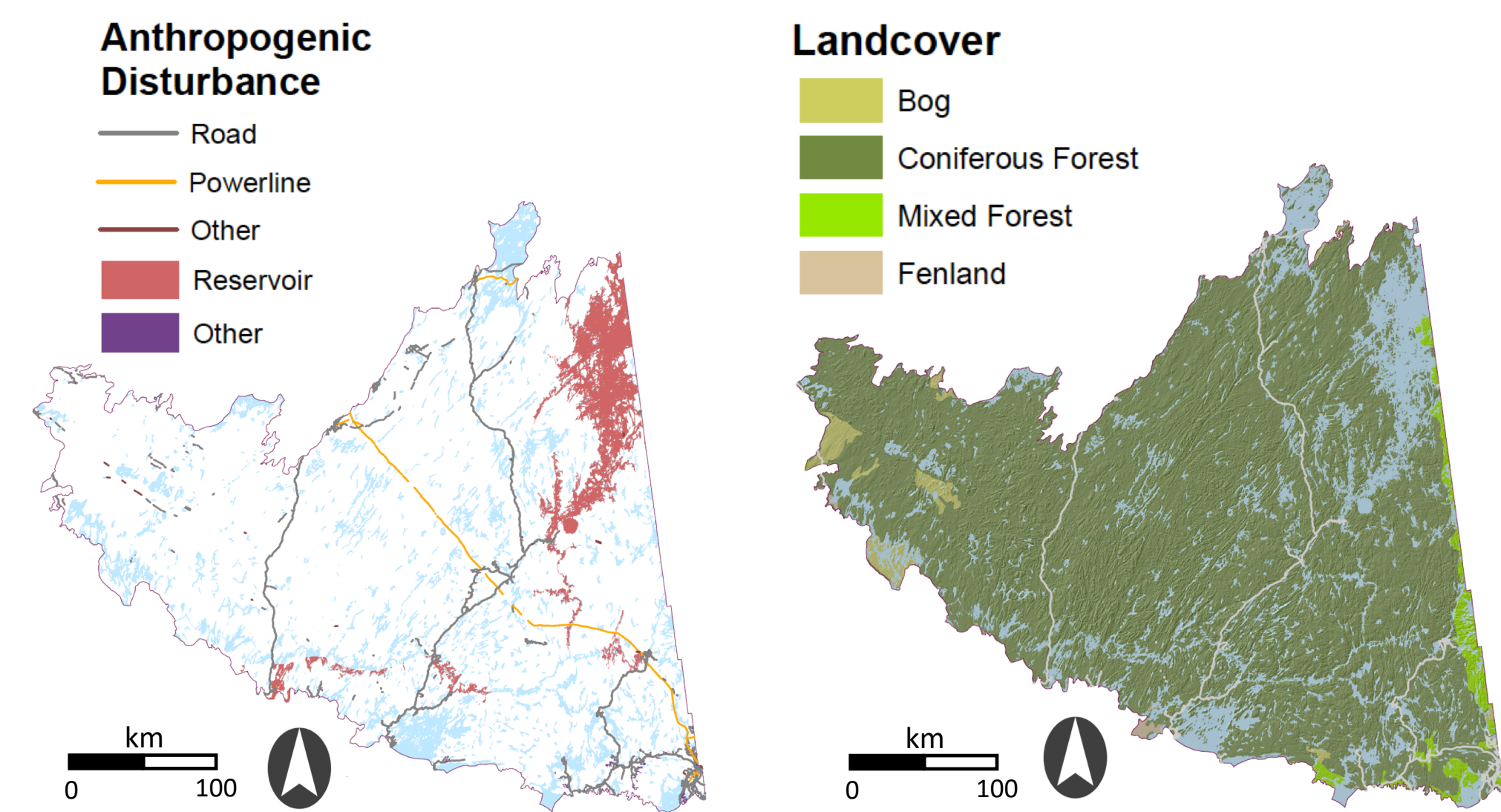CANADA

This pilot, in the Churchill River Upland Ecoregion of Northern Saskatchewan, explores the feasibility of modelling anthropogenic-related encroachment upon preferred woodland caribou habitat. The woodland caribou, which reside within the boreal forested region of northern Canada, require large contiguous tracts of land and are currently classified as threatened under the Species at Risk Act.[1] Anthropogenic disturbance has degraded the quality and has led to the fragmentation of caribou habitat. Modeling encroachment upon woodland caribou habitat from anthropogenic disturbances can provide guidance for the development of strategies to connect fragmented habitat and recover degraded habitat. For example, this model could provide guidance on potentially suitable locations to create forested corridors to connect areas of preferred habitat. The aim of this project is to develop a GIS model that can be replicated throughout the boreal forested regions of Canada, in order to examine anthropogenic encroachment on preferred woodland caribou habitat.

Methods

Anthropogenic Disturbance
- Road
- Powerline
- Other
- Reservoir
- Other

Landcover
- Bog
- Coniferous Forest
- Mixed Forest
- Fenland

Preferred woodland caribou habitat is characterized in this model as coniferous forested, hilly areas with northward facing slopes, which are far from anthropogenic disturbances. To create the composite evaluation map (composed of 100m cells), I used anthropogenic disturbance data (2008-2010; 1:50,000), landcover data (1996; 1:1 million), and Canadian digital elevation data (2016; 0.75 arcseconds). Sites within the Churchill River Upland Ecoregion of Saskatchewan were ranked from 0 to 3, with a score of 0 being 'unsuitable' for woodland caribou habitat, a score of 1 being 'poor', a score of 2 being 'possibly ok', and a score of 3 being 'preferred habitat', as defined by the parameters of this model (i.e. slope, aspect, landcover, distance from linear and polygonal anthropogenic disturbances).

Habitat Suitability
- Poor
- Possibly OK
- Preferred Habitat
- Protected Areas

Churchill River Upland

Reindeer Lake

Highway 914

CanAm Highway

Kilometers
0   100
UTM Zone 12N
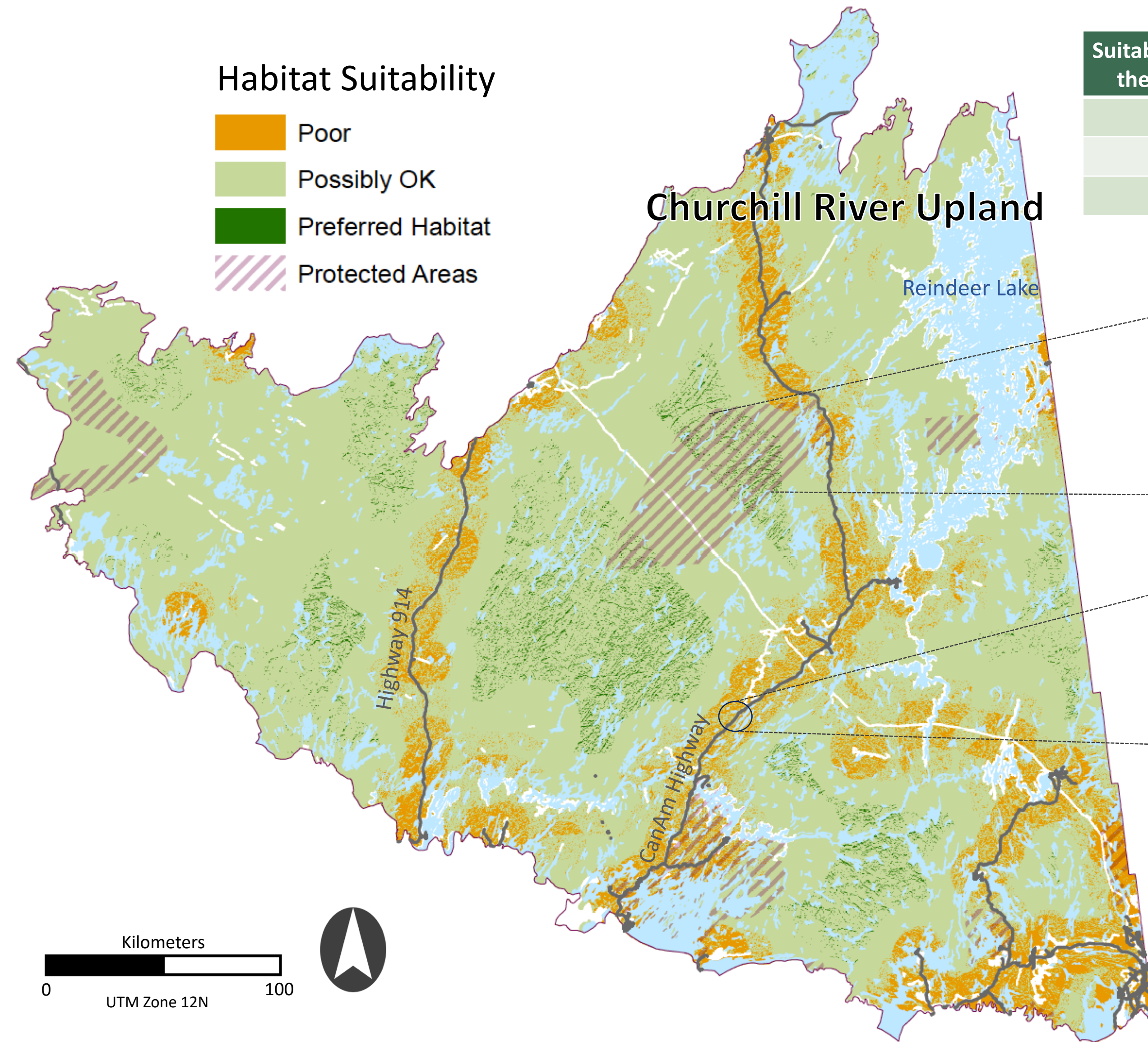
Suitability Score in Composite Analysis for the Churchill River Upland Ecoregion	Total Land Area (Ha)
Poor	1,280,445
Possibly OK	8,646,750
Preferred Habitat	186,658

Pink Lake Ecological Reserve
This reserve of about 366,000 hectares was established as part of the Representative Areas Network initiative, which aims to protect lands within the ecoregions of Saskatchewan. This model scored 10,579 hectares of land within this ecological reserve as 'poor', 337,624 hectares as 'possibly ok', and 15,757 hectares as 'preferred habitat'.
Image from: https://www.panow.com/article/356370/new-ecological-reserve-designated-north-sask
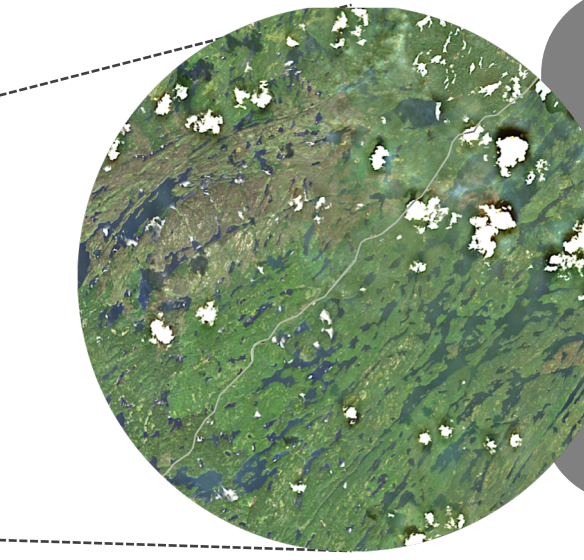
Example of heavily disturbed land
According to this model, anthropogenic disturbance along the CanAm highway has fragmented woodland caribou habitat. This model scored 24,147 hectares of land within the circled area as 'poor' and 42,808 hectares as 'possibly ok'. Developing a forested corridor in this region may help to connect areas of preferred habitat.
Image from: ESRI World Imagery Basemap

Composite Evaluation
The following weights were given to each factor:

20% Distance from linear anthropogenic disturbances
20% Distance from polygonal anthropogenic disturbances
20% Landcover
20% Slope
20% Aspect

Suitability Factors

Slope suitability
- Poor
- Possibly OK
- Preferred Habitat

km
0   100

Woodland caribou habitat should have hills. Caribou require hilly areas in order to escape from predators. Canadian Digital Elevation Model (CDEM) data were used to estimate slopes. Slope gradients of 0-3% were scored as 'possibly ok', slope gradients >3% were scored as 'preferred habitat'.

Aspect suitability
- Poor
- Possibly OK
- Preferred Habitat

km
0   100

Slopes within woodland caribou habitat should face northwards to support lichen growth. Northward facing slopes provide favorable conditions for lichen growth, the preferred food source of woodland caribou. CDEM data were used to examine aspect. Slopes facing N, NE, and NW, were scored as 'preferred habitat'; slopes facing S and flat surfaces were scored as 'poor'; slopes facing W, SW, E, and SE, were scored as 'possibly ok'.

Landcover suitability
- Possibly OK
- Preferred Habitat

km
0   100
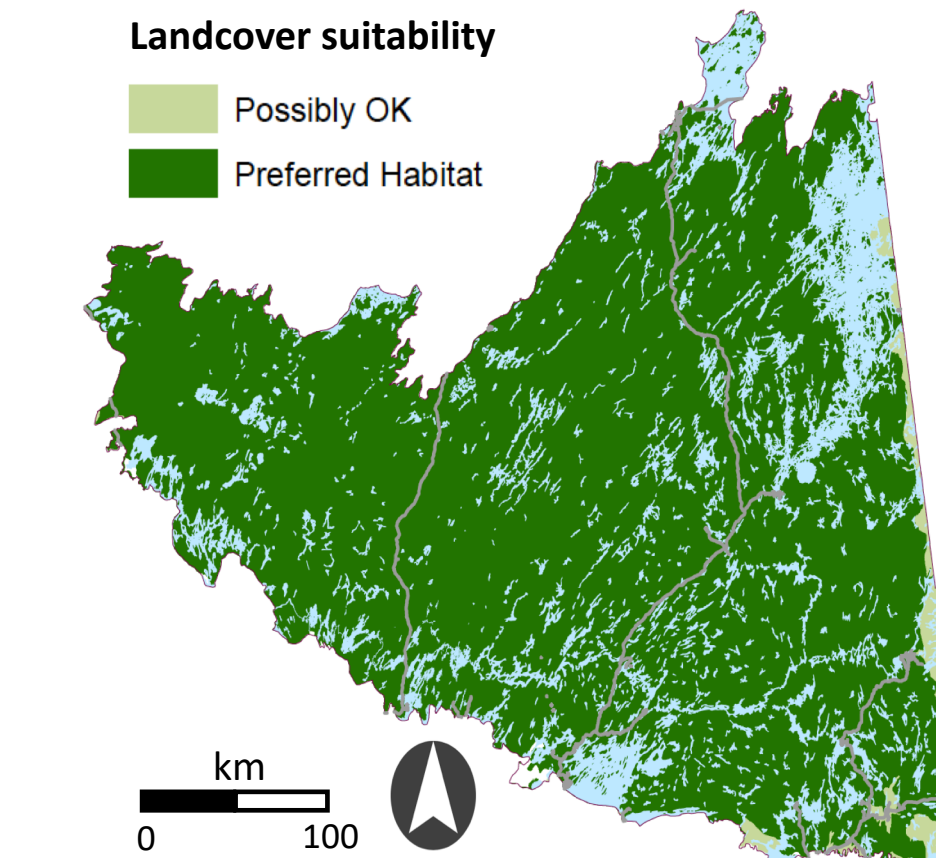
Woodland caribou prefer coniferous forested areas. The most recent landcover dataset for Northern Saskatchewan from the Centre for Land and Biological Resource Research was used to identify types of landcover. Coniferous forest landcover was assigned a score of 'preferred habitat'. Other landcover types were assigned a score of 'possibly ok'.

Distance from anthropogenic disturbance (linear)
- Poor
- Possibly OK
- Preferred Habitat

km
0   100
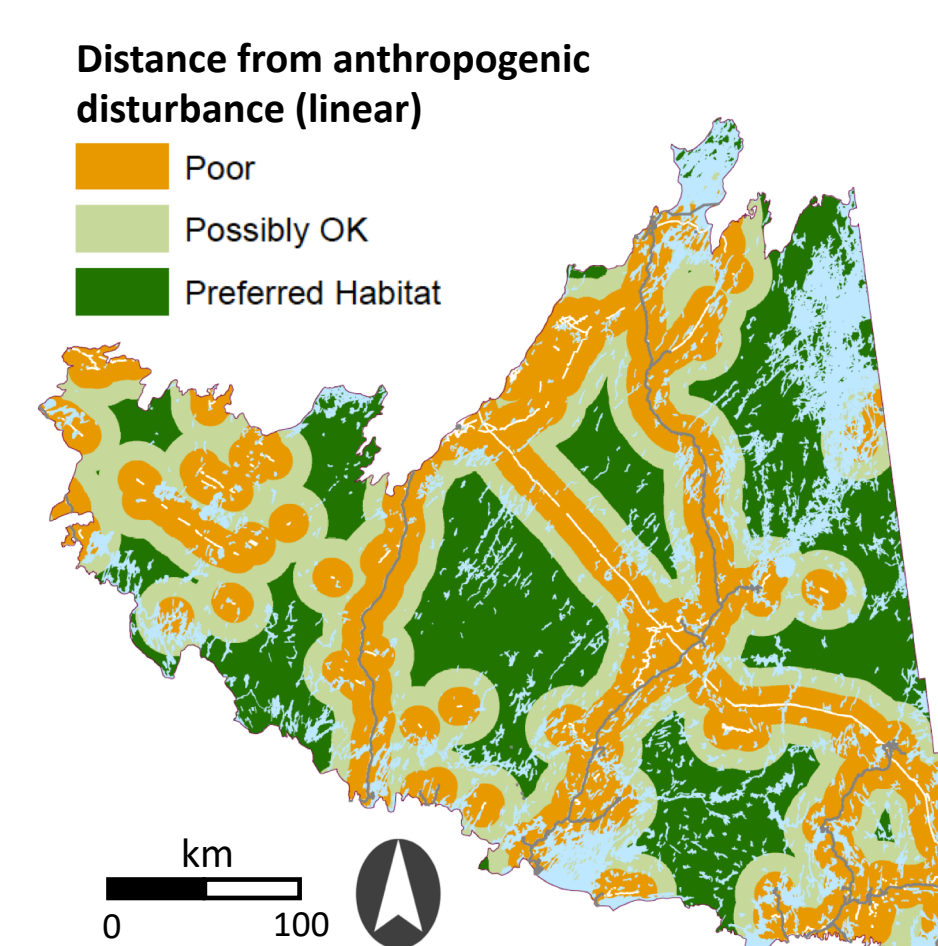
Preferred habitat is far from anthropogenic disturbances. Anthropogenic disturbances can induce a stress response in caribou and attract predators of caribou (i.e. wolves).[2] A Euclidean distance function was run using anthropogenic disturbance data from Environment & Climate Change Canada (ECCC) to estimate distance from disturbances. As per ECCC classification, this model classifies any lands within 500m of anthropogenic disturbance as unsuitable, disturbed habitat (i.e. 'NoData'). Cells were assigned a score of 'poor' if located >500m & <10km away, 'possibly OK' if >10km & <20km, and 'preferred' if >20km.

Distance from anthropogenic disturbance (polygonal)
- Poor
- Possibly OK
- Preferred Habitat

km
0   100

Conclusions

This model estimates that there are 186,658 ha of preferred habitat within the Churchill River Upland Ecoregion of Saskatchewan. Additionally, this model estimates that areas of preferred habitat are fragmented due to anthropogenic encroachment. One of the main limitations of this model was the lack of more recent landcover and anthropogenic disturbance data for northern Saskatchewan. With more recent landcover data, I would expect to see a decrease in the estimated coniferous forested area since 1996, an increase in area subject to anthropogenic disturbance since 2010, and thus a decrease in the area of preferred habitat. Additionally, with the granularity of 1:50,000, the anthropogenic disturbance data likely missed relatively small disturbances such as hunting huts and small ice roads that may be used during the winters. This model could be further improved by taking into account that different disturbance types may be further reaching than others, and by more accurately defining the size of the disturbed areas for each different disturbance type. Furthermore, this model could take into account the susceptibility of different sites to forest fires, which can temporarily degrade and fragment woodland caribou habitat.
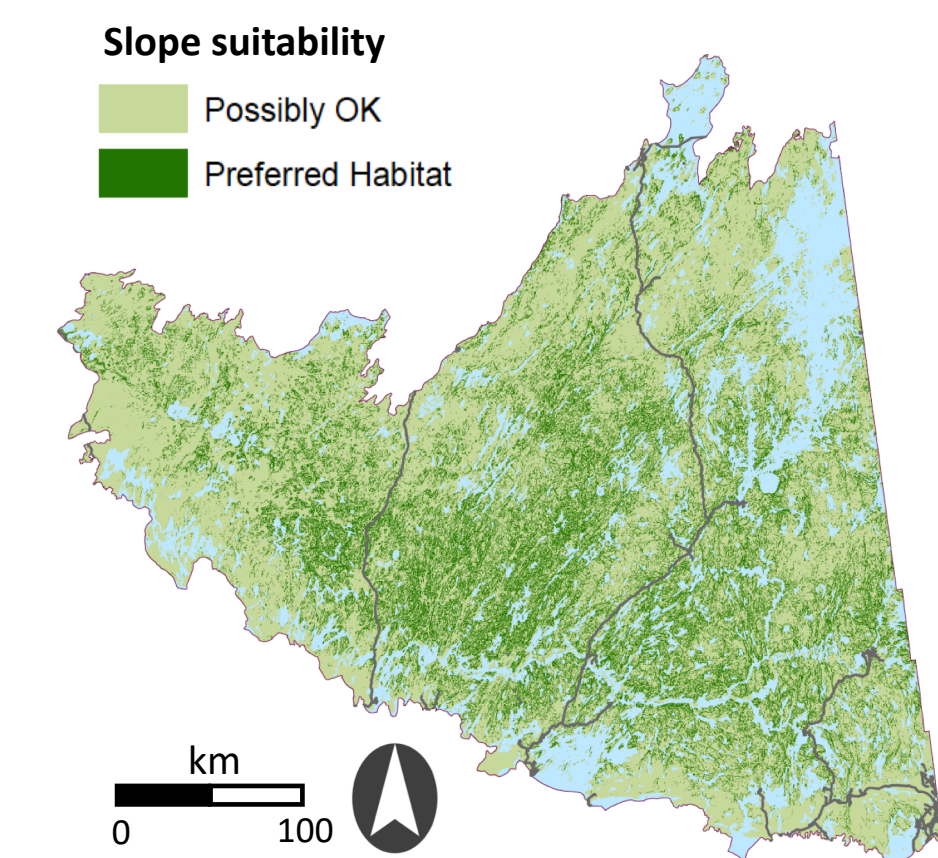
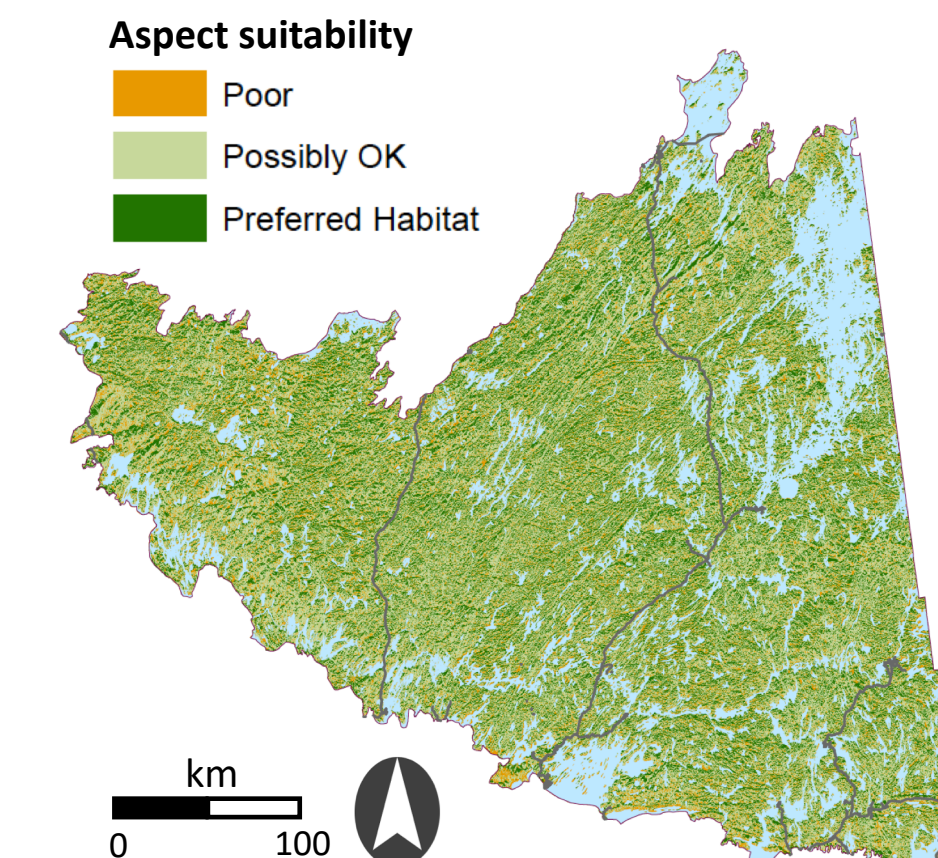### Jessica Wallingford
Fundamentals of GIS, NUTR 231, Fall 2018

References:
Province Boundaries: Boundary Files, 2016 Census, Statistics Canada
Ecoregion Boundaries: Ecoregions of Canada, version 1, June 1995, Environment Canada
Hydrography: Boundary Files, 2016 Census, Statistics Canada
Roads: OpenStreetMap, 2017
Anthropogenic disturbance (1:50,000): Government of Canada, Environment & Climate Change Canada, 2008-2010
Landcover (1:1 million): Centre for Land and Biological Resources Research, December 1996, Soil Landscapes of Canada, v.2.2, Research Branch, Agriculture & Agri-Food Canada
Digital Elevation Model (0.75 arcseconds): Canadian Digital Elevation Model, October 2016, Natural Resources Canada
Protected Areas: Conservation Areas Reporting and Tracking System, 2017, Canadian Council on Ecological Areas
[1] Government of Canada (2016). Woodland caribou, boreal population: range plan guidance 2016
[2] Wittmer, H., Sinclair, A. R.E., McLellan, B. N. (2005). The role of predation in the decline and extirpation of woodland caribou. Oecologia, 144:257-267

Tufts UNIVERSITY
Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

Image from: https://www.nrdc.org/stories/mapping-future-boreal-caribou