Amount and Distribution of Human-created Habitat Edge in Alberta

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SUMMARY

- Native habitat is being altered by human activities throughout Alberta. The amount of remaining natural habitat, and its distance from human disturbance, can be used to indicate ecological condition.

- Different species respond to habitat edge at different scales. We mapped the amount of native habitat remaining using three different widths of habitat edge, in each natural sub-region of Alberta.

- Overall, regions dominated by private land had less intact native habitat than did those dominated by crown land.

KEY MESSAGES

- The quality of native habitat remaining in sub-regions dominated by private land may be degraded by factors extending beyond the edge of mapped human footprint.

- The intermixing of human footprint and native habitat in some sub-regions dominated by Crown land created substantial edge habitat, which may lead to lower ecological condition.

- It may be beneficial to focus conservation and restoration around remaining large patches of native habitat to reduce edge effects. River valleys may provide nuclei from which to build conservation areas.
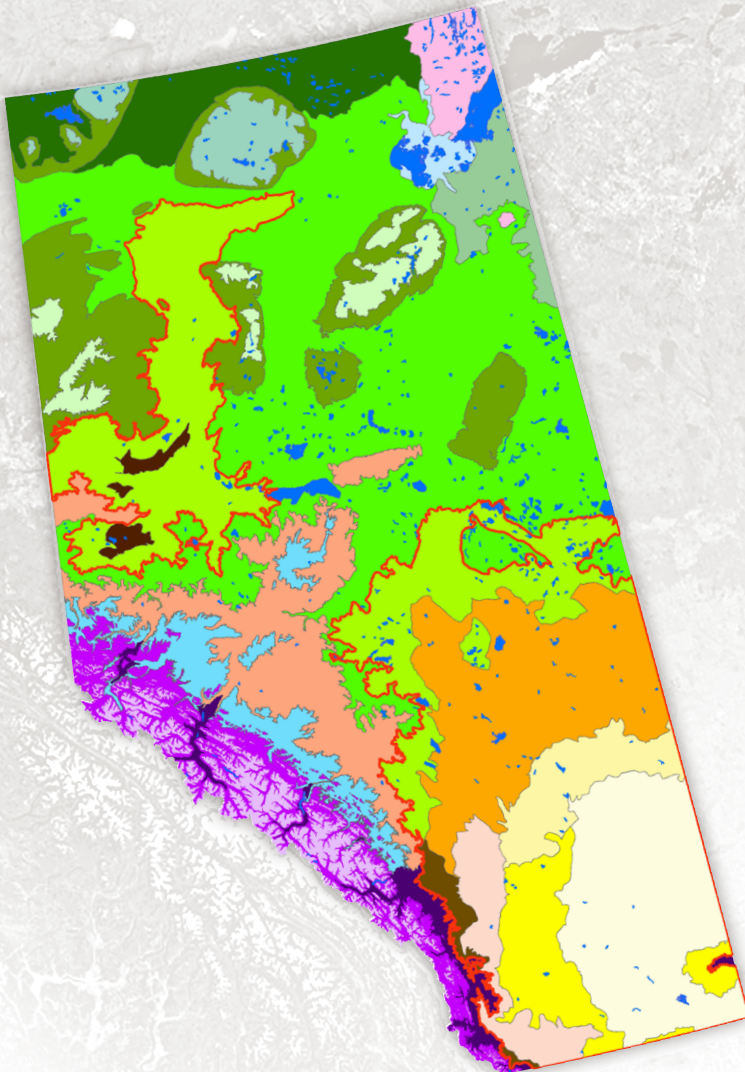
FIGURE 1

Natural sub-regions in Alberta. The red line divides sub-regions that are dominated by private land from those dominated by crown land.

GRASSLAND
- Dry Mixedgrass
- Mixedgrass
- Northern Fescue
- Foothills Fescue

PARKLAND
- Foothills Parkland
- Central Parkland
- Peace River Parkland

BOREAL
- Dry Mixedwood
- Central Mixedwood
- Northern Mixedwood
- Lower Boreal Highlands
- Upper Boreal Highlands
- Boreal Subarctic
- Athabasca Plain
- Peace-Athabasca Delta

SHIELD
- Kazan Uplands

FOOTHILLS
- Lower Foothills
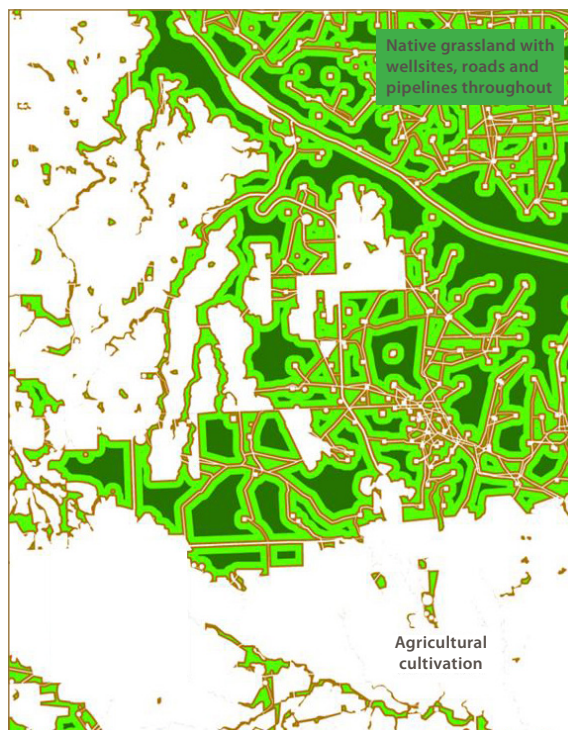- Upper Foothills

ROCKY MOUNTAINS
- Montane
- Subalpine
- Alpine
- Lake

BACKGROUND

Human activities, including agriculture, resource extraction, and urban expansion, have converted native habitat into alternative habitat types throughout Alberta[1]. These new habitat are often less suitable for native biota[2], causing many native species to decline in abundance. In addition, the native habitats that remain are divided into smaller patches separated by disturbed areas, and are expected to support smaller populations of native species than would have been present in the original landscape[3].

FIGURE 2
Example of edge effects and remaining intact habitat

Native grassland with wellsites, roads and pipelines throughout

Agricultural cultivation

Amount of intact habitat remaining in three distance categories measured from the edge of human footprint

- ○ Human Footprint
- ● 0 – 50 m
- ● 50 – 200 m
- ● > 200 m

The amount of remaining native habitat, and its distance it is from human disturbance, can be used as rough indicators of ecological condition (for example, as in the Lower Athabasca Regional Management Plan[4]). To highlight this information for each natural sub-region in Alberta (Figure 1), we mapped human footprint and the amount of native habitat within three distance categories of its edge. We expected that landscapes with abundant native habitat and little edge would provide the highest quality habitat for many native species.

METHODS

We used a GIS layer describing the location of human footprint throughout Alberta, freely available from the Alberta Biodiversity Monitoring Institute[5], to identify where native habitats remained. We did not include seismic lines as human footprint because they are narrow, usually have native habitat re-growing[6], and are easily crossed by many species[7].

We expected that edge effects would decrease with distance from human footprint, with most species and micro-climates affected little > 50 m from the edge[8]. However, we expected that some species would be affected 200 m or more from human footprint. Thus, we mapped intact habitat 0–50 m, 50–200 m, and > 200 m from human footprint (see example in Figure 2) to illustrate three sizes of edge effect. This approach allows users to combine categories as desired, for example to assess interior habitat or edge habitat for a given species.

We present information for each natural sub-region (shown in Figure 1). We also summarize information separately for sub-regions dominated by Crown land (mostly forested; Shield, Boreal [except Dry Mixedwood], Foothills and Rocky Mountain) and for sub-regions dominated by private land (mostly grassy or shrubby; Grassland, Parkland, Dry Mixedwood), as the types of human disturbance and management activities differ between them.

1   Alberta Biodiversity Monitoring Institute. 2016. Status of human footprint in Alberta. http://www.abmi.ca.
2   Saunders, D., R. Hobbs & C. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology 5: 18–32.
3   Ramalho, C., E. Laliberté, P. Poot & R. Hobbs. 2014. Complex effects of fragmentation on remnant woodland plant communities of a rapidly urbanizing biodiversity hotspot. Ecology 95:2466–2478
4   Alberta Environment and Parks. 2015. Lower Athabasca regional plan strategies. URL: http://esrd.alberta.ca/focus/cumulative-effects/cumulative-effects-management/management-frameworks/documents/LARP-FactSheet-Strategies-Feb13-2014.pdf.
5   Alberta Biodiversity Monitoring Institute. 2014. ABMI Human Footprint Inventory for 2012 conditions (Version 3). URL: http://www.abmi.ca.
6   Bayne, E., H. Lankau & J. Tigner. 2011. Ecologically-based criteria to assess the impact and recovery of seismic lines: The importance of width, regeneration, and seismic density. Report No. 192 (Environmental Studies Research Funds) Edmonton, AB.
7   Lankau, H. 2014. Songbird responses to regenerating seismic lines in the boreal forest. MSc. Thesis, Department of Biological Sciences, University of Alberta, Edmonton, AB
8   Huggard, D. & L. Kremsater. 2015. Recommendations for habitat interior and old-forest indicators for the Biodiversity Management Framework. Unpublished document commissioned by the Alberta Biodiversity Management Framework Science Team, Edmonton, AB.
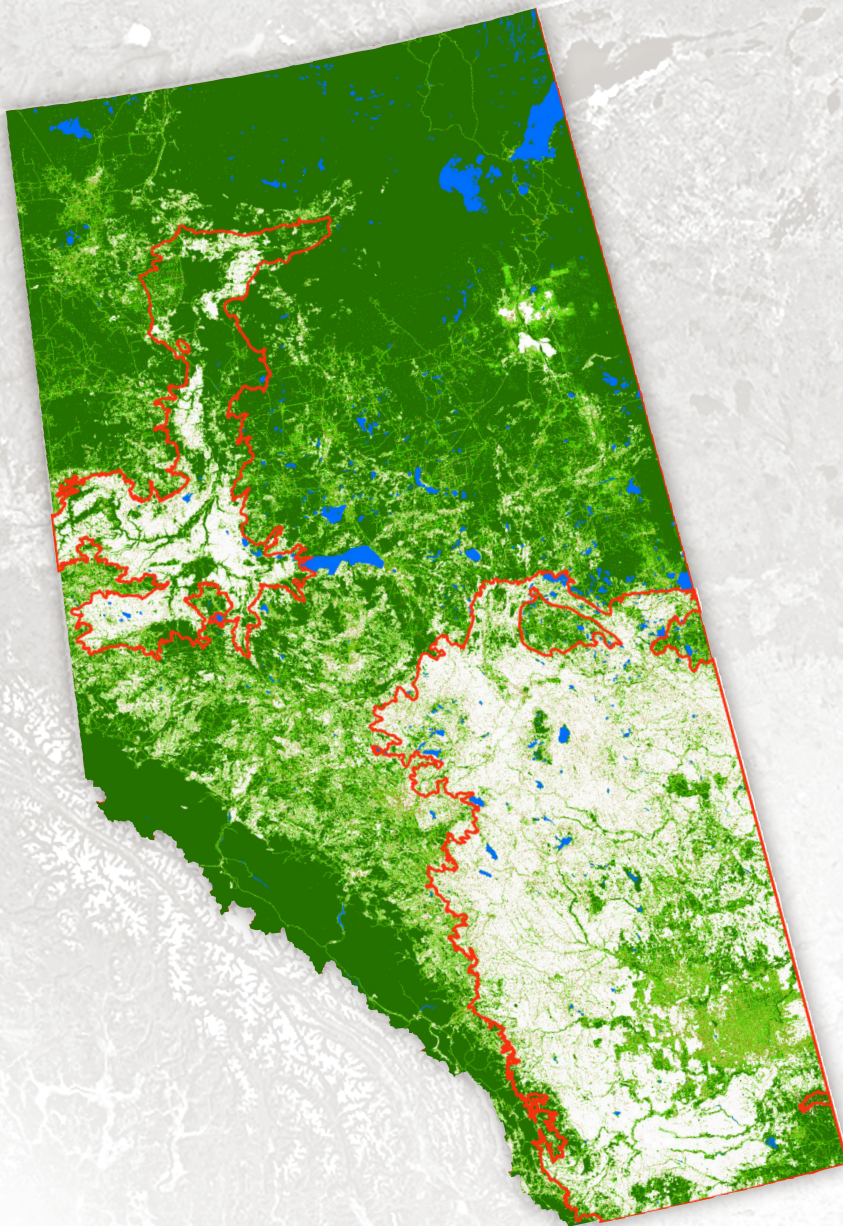
FIGURE 3
Location of human footprint and native habitat throughout Alberta. Native habitat was categorized based on distance categories from human footprint (0–50 m, 50–200 m, > 200 m).

Distance to Human Footprint
- ○ Human Footprint
- ● 0–50 m
- ● 50–200 m
- ● > 200 m
- — Area Dominated by Private vs. Crown Land

RESULTS

Sub-regions Dominated by Private Land: Human footprints, especially agricultural cultivation[9], were very common in sub-regions dominated by private land (Figure 3), with > 60% of the area converted to human footprint (Table 1). The native habitat currently remaining in these sub-regions was distributed approximately equally among the three edge categories (0–50 m, 50–200 m, > 200 m). There were two large areas of native habitat: one in the Dry Mixedwood sub-region north of Peace River, and the other in the Dry Mixedgrass sub-region in southeastern Alberta. Native habitat 50–200 m from human footprint was concentrated in the northern portion of the Dry Mixedgrass sub-region. There were areas of native habitat along all major river systems (e.g., Peace River, Smokey River, North Saskatchewan River, Battle River, Red Deer River, Bow River, South Saskatchewan River, Milk River) and along many of the smaller streams. Some of this native habitat was > 200 m from human footprint (Figure 3).

Sub-regions Dominated by Crown Land: Relatively little native habitat was converted to human footprint in sub-regions dominated by crown land (Figure 3, Table 1), and correspondingly little of these areas had native habitat within 0–50 m or 50–200 m of human footprint. Averaged across these sub-regions, 80% of the area remained as native habitat outside the edge buffers. However, there was more human footprint in the Lower and Upper Foothills sub-regions (mostly created from forest harvest1) and more of the native habitat was near human footprint than in other crown-land dominated sub-regions. Large tracts of native habitat were distant from human footprint in northeastern Alberta and in the Rocky Mountains. Throughout the Upper and Lower Foothills, and to a lesser extent throughout the Montane and Central Mixedwood regions, there were extensive areas where human footprint and native habitat were strongly intermixed.

9   Schieck, J, P Sólymos and D Huggard. 2014. Human Footprint in Alberta. Science Letters, Issue 1, Alberta Biodiversity Monitoring Institute. URL: http://www.abmi.ca.

TABLE 1
Percentage of each natural sub-region converted to human footprint. Native habitat is summarized based on the distance (0–50 m, 50–200 m, > 200 m) it was from human footprint. Note that categories may be combined as desired, depending on the species of interest. For example, to determine the amount of native habitat remaining for a species that responds to habitat edge at a scale of 50 m in the Dry Mixedgrass sub-region, combine the % of habitat remaining in the 50–200 m (22%) and 200 m (19%) categories, for a total of 41% remaining. Or, to find the amount of otherwise intact habitat lost as edge to a species that responds to habitat edge at a scale of 200 m in the Mixedgrass sub-region, combine the % of habitat in the 0–50 m (8%) and 50–200 m (12%) categories, for a total of 20%.

Natural Sub-region	% Converted to Human Footprint	% of Remaining Native Habitat in Distance Category from Human Footprint		
		0–50 m	50–200 m	> 200 m
Private Land-dominated Sub-regions				
GRASSLAND				
Dry Mixedgrass	45	14	22	19
Mixedgrass	64	8	12	17
Northern Fescue	60	12	16	13
Foothills Fescue	66	9	11	14
PARKLAND				
Foothills Parkland	50	13	18	20
Central Parkland	78	9	8	4
Peace River Parkland	77	7	7	9
BOREAL				
Dry Mixedwood	49	10	13	29
AVERAGE	**61**	**10**	**13**	**16**
Crown Land-dominated Sub-regions				
BOREAL				
Central Mixedwood	10	7	14	69
Northern Mixedwood	< 1	1	2	96
Lower Boreal Highlands	6	5	12	77
Upper Boreal Highlands	1	2	6	91
Boreal Subarctic	< 1	0	1	99
Athabasca Plain	1	1	4	94
Peace-Athabasca Delta	< 1	1	2	98
CANADIAN SHIELD				
Kazan Uplands	< 1	< 1	< 1	99
FOOTHILLS				
Lower Foothills	26	15	25	34
Upper Foothills	23	12	20	46
ROCKY MOUNTAIN				
Montane	15	10	17	59
Subalpine	5	3	6	87
Alpine	1	< 1	1	98
AVERAGE	**7**	**4**	**8**	**80**

MANAGEMENT IMPLICATIONS

Sub-regions Dominated by Private Land:

- A high percentage of these sub-regions was converted by human footprint and most remaining native habitat was close to human footprint. Thus, edge effects are expected to be high and ecological condition relatively low throughout most of these sub-regions.

- The Central and Peace River Parkland sub-regions had the most human footprint and the least native habitat that was distant from edge.

- The quality of native habitat remaining in sub-regions dominated by private land may be degraded by factors that extend well beyond the mapped human footprint edges (e.g., livestock grazing).

- It may be valuable to focus conservation and restoration around the remaining large patches of native habitat in these regions so that edge effects are decreased. River valleys may provide nuclei from which to build these conservation areas.

Sub-regions Dominated by Crown Land:

- The amount of human footprint was low, and remaining native habitat was high in sub-regions dominated by crown land. Thus, ecological condition is expected to be relatively high throughout most of these sub-regions.

- The broad intermixing of human footprint (mainly harvest areas) and native habitat in the Upper Foothills, Lower Foothills, Montane, and Central Mixedwood regions created substantial edge habitat, potentially leading to lower ecological condition.

INTERPRETATION CAVEATS

- As a simplifying assumption, we assumed that all human footprints created edges where they abutted natural vegetation. This is an oversimplification because some footprints eventually recover to native habitat (e.g., harvest areas and seismic lines), and thus are expected to have reduced effects over time.

- Distance to human footprint (as measured by edge buffers) provides only a coarse assessment of ecological condition in a landscape. Many species are sensitive to other changes and these species must be monitored explicitly to understand their status and change over time.

- Although edge and other landscape characteristics affect the abundance and distribution of native species, the types of habitat that remain on the landscape have a much larger effect[10].

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10 Huggard, D, and J. Schieck. 2015. What explains variation in abundance of prairie species in Alberta? Science Letters, Issue 2, Alberta Biodiversity Monitoring Institute. http://www.abmi.ca.

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