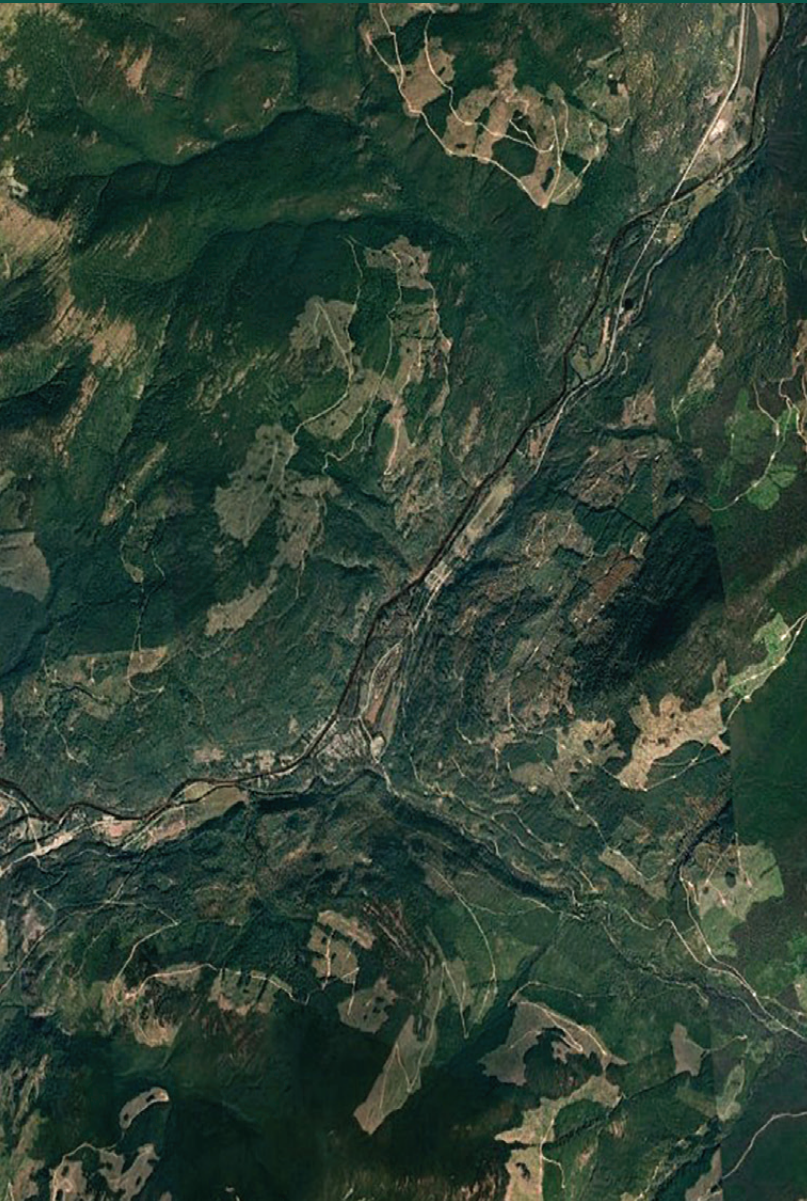


TOGETHER FOR WILDLIFE - ACTION 10

Spatial Analysis of Disturbance within
Habitat Designations in British Columbia



TOGETHER
FOR WILDLIFE



BRITISH
COLUMBIA



FREP
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Evaluation Program

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EXECUTIVE SUMMARY

The Together for Wildlife Strategy outlines 24 actions intended to improve wildlife and habitat stewardship in British Columbia (BC). Action 10 of the strategy outlines a timeline for assessing the effectiveness of habitat designations in BC established under the *Land Act*, *Wildlife Act*, *Oil and Gas Activities Act*, and *Forest and Range Practices Act*. This report summarizes initial work conducted during 2020-2022 to support aspects of the Action 10 goals. Action 10 of Goal 3 (*Stewardship actions achieve tangible benefits for wildlife and their habitats*) states:

In 2021, we will complete a comprehensive review of land designations under the *Land Act*, *Wildlife Act*, *Oil and Gas Activities Act*, and *Forest and Range Practices Act* that contribute to conservation to ensure they effectively target the intended habitats, now and in the future, and in light of climate change impacts and habitat alterations. The results of the review will identify gaps and opportunities to improve the effectiveness of those designations for wildlife.

The report provides a preliminary estimate of the extent and amount of natural (wildfires and insect damage) and anthropogenic (forest harvesting, various resource development infrastructure, and roads) disturbances in wildlife habitat designations across BC. Higher levels of disturbance might indicate areas at higher risk of having degraded or lower quality habitat for some wildlife species. Areas that were analyzed included Ungulate Winter Ranges (UWRs), Wildlife Habitat Areas (WHAs), and Conservation Lands (CLs), which included Wildlife Management Areas (WMAs), other administered lands, and non-administered lands. Results of the analysis may be used to support prioritization of more detailed assessments of habitat designations that might be at greater risk of being ineffective due to relatively high disturbance levels.

Results of the analysis indicated that there are approximately 27,336,826 ha of UWRs in BC for eight distinct wildlife species and four subspecies. A specified area for thimhorn sheep accounts for 47.1% of this total area, which was established to prevent disease transmission. With this special area removed, the total area of UWRs managed for habitat provincially is 14,466,055 ha. Stone's sheep account for 25% of the provincial UWR area, followed by boreal and northern caribou at 18.4% and 16.6%, and mule deer at 11.6%. Approximately 80.6% of the UWR area is subject to conditional harvesting, and only 2.5% of these UWRs overlap with Old Growth Management Areas (OGMAs).

WHAs encompass less area, with approximately 4,949,669 ha for 57 species. Grizzly bear WHAs accounts for approximately half (46.5%) of this area followed by northern caribou at 20%. As with UWRs, the majority (59%) of WHAs are subject to conditional harvesting.

Conservation Lands include 32 WMAs covering 253,645 ha, 715 other administered lands covering 24,721 ha, and 291 non-administered lands covering 627,544 ha.

Provincially, 29.5% of UWRs, 25.0% of WHAs, and 62.5% of CLs have disturbance other than roads within their boundaries. When analyzing just disturbance from roads, all designations had higher levels disturbance, with 63.9% of UWRs, 50.1% of WHAs, and 85.9% of CLs having disturbance from roads. The mean disturbance, based on area, excluding roads, within the boundaries of these designations is 16.8% for UWRs, 38.9% for WHAs, and 23.2% for CLs. Roads have a greater level of disturbance, with mean levels of road disturbance for UWRs and CLs of 54.2% and 60.2% respectively, while WHAs have a lower average disturbance from roads at 22.3%. It must be noted that disturbance from roads was based on major roads such as highways buffered by 500 m and resource roads buffered by 150 m. The greatest source of disturbance for UWRs is insect-induced tree mortality, which affects the UWRs of caribou, mule deer, and moose. Roads have the most far-reaching impact for a variety of ungulate species, with over 60% of the UWRs having impacts from roads of varying degrees, and over 50% having high levels (>50%) of road disturbance. For WHAs, the major sources of disturbance are roads, urban/agriculture/recreation development, post-

1995 harvesting, and insect-induced tree mortality. After roads, urban and agricultural development have the next largest impacts on Conservation Lands.

Results of this analysis provide a preliminary assessment of how disturbances might influence the effectiveness of habitat designations across BC. However, there are limitations with the analysis that require consideration before applying the results. Specifically, the disturbance data only provided a coarse-scale estimate of the location of disturbances, and no disturbance analysis was conducted in areas surrounding the habitat designations. Habitat quality surrounding designations likely influence habitat quality within designated areas; therefore, a broader landscape context may be needed to assess the effectiveness of a designation. Furthermore, not all disturbances influence habitat equally and the impacts of each disturbance type will not be equivalent across all species. It must be noted that many wildlife habitat designations do not preclude disturbance, whether natural or anthropogenic, and thus some disturbances should be expected within some designations. Given these limitations, additional data and information will be needed to support detailed assessments of wildlife habitat designations.

The results of this analysis may be used to support a preliminarily coarse-scale assessment of the relative risk of habitat designations to disturbance. Habitat designations with higher levels of disturbances may have higher risk of being ineffective. To support additional work on Action 10, recommendations include:

1. Confirm and refine an approach for completing a detailed assessment of habitat designations.
2. Identify tools to facilitate road management in wildlife habitat designations. Support the development of tools to manage road impacts of wildlife where they are absent.
3. Communicate and apply results of the report to support planning initiatives (e.g. forest landscape plans) and in development of policy tools to improve wildlife habitat stewardship.

INTRODUCTION

British Columbia (BC) is known for wilderness landscapes, complex ecosystems, and biologically diverse areas. Various landscape designations have been implemented by the BC government that are intended to help protect valuable habitat in the province. While these designations are vital for wildlife through habitat protection, many factors can reduce their effectiveness. These include limitations in the scope and objectives of the designations (which threats can be legally managed), the size of the designations, and the impacts of various natural and anthropogenic disturbances. To overcome some of these limitations, the government has implemented several programs to evaluate the effectiveness and monitor the conditions in these habitat designations. For example, the Forest and Range Evaluation Program (FREP) under the *Forest and Range Practices Act* (FRPA), which is designed to evaluate Ungulate Winter Ranges (UWRs) and Wildlife Habitat Areas (WHAs) to determine whether these designations are effective at meeting the habitat requirements for various species and to ensure the species survivorship over time. The Together for Wildlife Strategy (2020) has also committed to several stewardship objectives under various goals and actions. Action 10 of Goal 3 (*Stewardship actions achieve tangible benefits for wildlife and their habitats*) states:

In 2021, we will complete a comprehensive review of land designations under the *Land Act*, *Wildlife Act*, *Oil and Gas Activities Act*, and *Forest and Range Practices Act* that contribute to conservation to ensure they effectively target the intended habitats, now and in the future, and in light of climate change impacts and habitat alterations. The results of the review will identify gaps and opportunities to improve the effectiveness of those designations for wildlife.

Beginning in 2022, the province also committed to completing detailed assessments for 10% of these habitat designations every year under Action 10.

Goals and Objectives

In 2020/2021, the province began an initial review and analysis of specific habitat designations as guided by Action 10 of the Together for Wildlife Strategy. The overall goal of this review was to assess current conditions by overlaying disturbance data available in the BC Geographic Warehouse. The subset of land designations that were analysed are specifically intended to conserve and manage important habitat for the benefit of regionally or internationally significant fish and wildlife. This subset included: Ungulate Winter Ranges, Wildlife Habitat Areas, and Conservation Lands, which include Wildlife Management Areas, other administered lands, and non-administered lands (notations of interest and *Land Act* Section 15, 16, and 17 designations).

The goal of the analysis was to provide a preliminary estimate of the extent and severity of natural and anthropogenic disturbance within habitat designations to identify key disturbance areas and/or individual species or groups of species most affected by spatialized disturbance. The analysis was conducted at provincial and regional scales and will help support further work to identify land designations to be prioritised for more detailed assessments starting in 2022.

BACKGROUND AND DEFINITIONS

Disturbance

The term disturbance refers to any event that modifies or changes ecosystem structure, composition, and function, and includes both anthropogenic (human-caused) and natural disturbances (Federal, Provincial and Territorial Governments of Canada 2010). For this analysis, only anthropogenic and natural disturbances with a physical footprint quantified through available datasets were considered.

Anthropogenic disturbances typically involve a physical footprint that can range from a semi-permanent conversion of an ecosystem to a relatively short-term modification of vegetation structure and composition. Natural disturbances include discrete events (e.g., wildfire, insect infestations, windthrow, etc.) that cause significant changes to ecosystem structure, function, and composition. Other forms of disturbance not associated with a physical footprint can reduce the functioning of an ecosystem through direct (e.g., mortality, harassment) or indirect (e.g., habitat avoidance, the introduction of invasive species) effects on native wildlife. These forms of disturbance are often associated with vehicle and human access and may include hunting, adventure tourism, and public recreation. For this analysis, these additional human-caused disturbances were only captured within the road disturbance analysis even though it is well known that many other types of noise disturbance can impact the effectiveness of wildlife habitat.

For this analysis, three types of disturbance are defined:

- **Anthropogenic disturbance** – forest harvesting, urban/agricultural development, mining, oil and gas sector developments, and rights-of-way associated with transmission lines, pipelines, or railways;
- **Natural disturbance** – wildfire and insects; and
- **Road disturbance** – road-related disturbance is calculated using a spatial buffer to reflect the secondary effect of roads on habitat functioning (see Methods section).

Land Designations

Land designations refer to any legally established and spatially defined area containing specific management measures or objectives that apply to one or more activities within them for the purposes of conserving wildlife habitat and functioning ecosystems. Designations established under different forms of legislation may not apply to all types of activities (e.g., designations under FRPA only apply to forest and range practices and not other activities). The management restrictions within designations include a range of modifications of the type or rate of industrial activity. Thus, most designations allow activities that have a physical footprint that have usually been negotiated with industrial stakeholders. In many circumstances, existing policy and negotiated implementation has emphasized spatial overlap of designations to reduce the impact of management measures on industrial activities.

This analysis focused on three key types of designations legally established for the conservation or management of wildlife habitats, including:

- Ungulate Winter Ranges (UWRs);
- Wildlife Habitat Areas (WHAs); and
- Conservation Lands, including Wildlife Management Areas (WMAs), other administered lands, and non-administered lands.

In addition to the above, Old Growth Management Areas (OGMAs) were partially included as a separate input. OGMAs are legal designations focused on conserving areas of old growth forest and are often spatially co-located with other land designations, which is the rationale for including them in this analysis. Spatial co-location is intended to limit the impact designations have on the timber harvesting land base (THLB), and in some cases, co-locating OGMAs recognizes the attributes of old forests.

Ungulate Winter Ranges and Wildlife Habitat Areas

Under FRPA, the minister responsible for the *Wildlife Act* may establish one or more categories identifying species of wildlife for special management attention to address the impacts of forest and range activities on Crown land.¹ These two categories of wildlife are species at risk and regionally important wildlife (Province of British Columbia 2004).²

Species at risk – includes endangered, threatened, or vulnerable species of vertebrates and invertebrates, and endangered or threatened plants and plant communities that are negatively affected by forest or range management on Crown land and whose habitat is not adequately managed by other mechanisms. The species included in this category form the basis for the Identified Wildlife Management Strategy.³

Regionally important wildlife – includes species that are considered important to a region of British Columbia, rely on habitats that are not otherwise managed under FRPA, and may be adversely impacted by forest or range practices.

The establishment of species categories enables several provisions under FRPA to be used to manage wildlife species, including the establishment of WHAs and UWRs. WHAs are established to manage forest and range activities to limit the potential impacts of activities on identified wildlife species. Similarly, UWRs are established to mitigate the potential impacts of development activities on habitat necessary to meet winter habitat requirements of an ungulate species. Both WHAs and UWRs can include specified areas, which are larger areas with specific but less restrictive management requirements. Within these designated areas, management objectives or targets are established to maintain habitats through general wildlife measures (GWMs). The specific GWMs that apply to each WHA or UWR order can vary from habitat protection to disease prevention. The timber harvest code characterizes some designations as conditional harvest areas where the rate or spatial extent of forest harvesting is constrained to ensure adequate mature forest cover is maintained, or others as no harvest areas where forest harvesting activities are prohibited.

¹ <http://www.env.gov.bc.ca/wld/frpa/species.html>

² Two categories of wildlife—species at risk and regionally important wildlife—are referred to as identified wildlife under the Identified Wildlife Management Strategy (IWMS). More information on the IWMS can be found here: <http://www.env.gov.bc.ca/wld/frpa/iwms/index.html>

³ <https://www.env.gov.bc.ca/wld/frpa/iwms/index.html>

Conservation Lands

The primary purpose of Conservation Lands is to conserve and manage important habitat for the benefit of regionally or internationally significant fish and wildlife species.⁴ These lands include habitat that is vital for sensitive, vulnerable, or at-risk species; critical species' life-cycle phases; species migration routes or other movement corridors; and land which supports unusually high species productivity or diversity.

Conservation Lands are comprised of Wildlife Management Areas, other administered lands, and non-administered lands.

Wildlife Management Areas (WMAs) – These are areas of land designated under Section 4(2) of the *Wildlife Act* for the benefit of regionally to internationally significant fish and wildlife species or their habitats and are a type of administered Conservation Lands. There are tools under the *Wildlife Act* that can be used in WMAs to help conserve values and manage concerns (e.g., regional manager orders, regulations). Section 4(4) of the *Wildlife Act* states that any use of land and resources in a WMA requires the permission of the regional manager.

Other administered lands – These are lands over which legal administration and management authority have been acquired under the authority of Section 3(a) of the *Wildlife Act* but are not designated as a WMA. These lands include:

- Fee simple acquisition through direct purchase, land exchange, or donation of private land;
- Securement of privately owned land that is leased to the province, usually for a long-term duration (99 years); and
- Crown transfer of administration under Section 106 of the *Land Act*, or a similar legal mechanism.

Non-administered lands (also known as reserve lands) – These are lands over which a recorded interest has been secured for fish and wildlife, but without administration and management authority. The majority of these have been obtained through *Land Act* mechanisms that either preclude or constrain certain uses or tenures for a specified period or require that the holder of the interest be contacted regarding proposed changes in land use. These legal mechanisms include:

- *Land Act* Section 15 Order-in-Council reserve (OIC reserve),
- *Land Act* Section 16 Temporary Withdrawal (or map reserve),
- *Land Act* Section 17 Conditional Withdrawal (or Designated Use Area), and
- Notation of Interest.

⁴ <https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-habitats/conservation-lands>

Old Growth Management Areas

Objectives for old growth forest management in BC have been established under the *Forest and Range Practices Act (FRPA)* and the *Land Act*. Default targets for the management of old growth forest are also specified in the Provincial Non-Spatial Old Growth Forest Order (PNOGO) (Province of British Columbia 2004), which sets out a percent amount of old forest to be maintained across the province. The PNOGO establishes landscape units and sets out targets for the percentage of old forest to be retained within each landscape unit by biogeoclimatic ecosystem classification (BEC) variant, consistent with direction in the Biodiversity Guidebook (Province of British Columbia 1995) and the Landscape Unit Planning Guide (Province of British Columbia 1999). Subsequent land-use orders have superseded the PNOGO in many parts of the province. The direction for managing old growth forests has evolved as new strategic land-use plans are completed and legal objectives established. Overall, there are generally three approaches to old growth forest management in BC:

- Legal non-spatial objectives for old growth forest retention – Targets are set by BEC unit (zone, subzone, variant, or site series/site series surrogate) and are typically analyzed by landscape unit, unless otherwise specified in the order.
- Legal spatial OGMAs – The boundaries of OGMAs are spatially defined in an order under FRPA or the *Land Act*. Forest tenure holders must apply results and strategies to meet objectives for OGMAs in their forest stewardship plans (FSPs) and must abide by direction in the order with respect to incursion limits and requirements for replacement. OGMAs have also been established under the *Oil and Gas Activities Act (OGAA)* in some areas of the province.
- Non-legal spatial OGMAs – In some regions, the province has spatially defined OGMAs, but they are either: (a) in draft form awaiting legal establishment, or (b) will not be made legally binding. Where OGMAs have not been made legally binding, tenure holders can choose whether to use these OGMAs or choose another approach to meeting objectives for old growth forest retention. Once tenure holders include non-legal OGMAs in approved FSPs, they become legal.

The distribution of the three types of OGMAs in BC is presented in Figure 1.

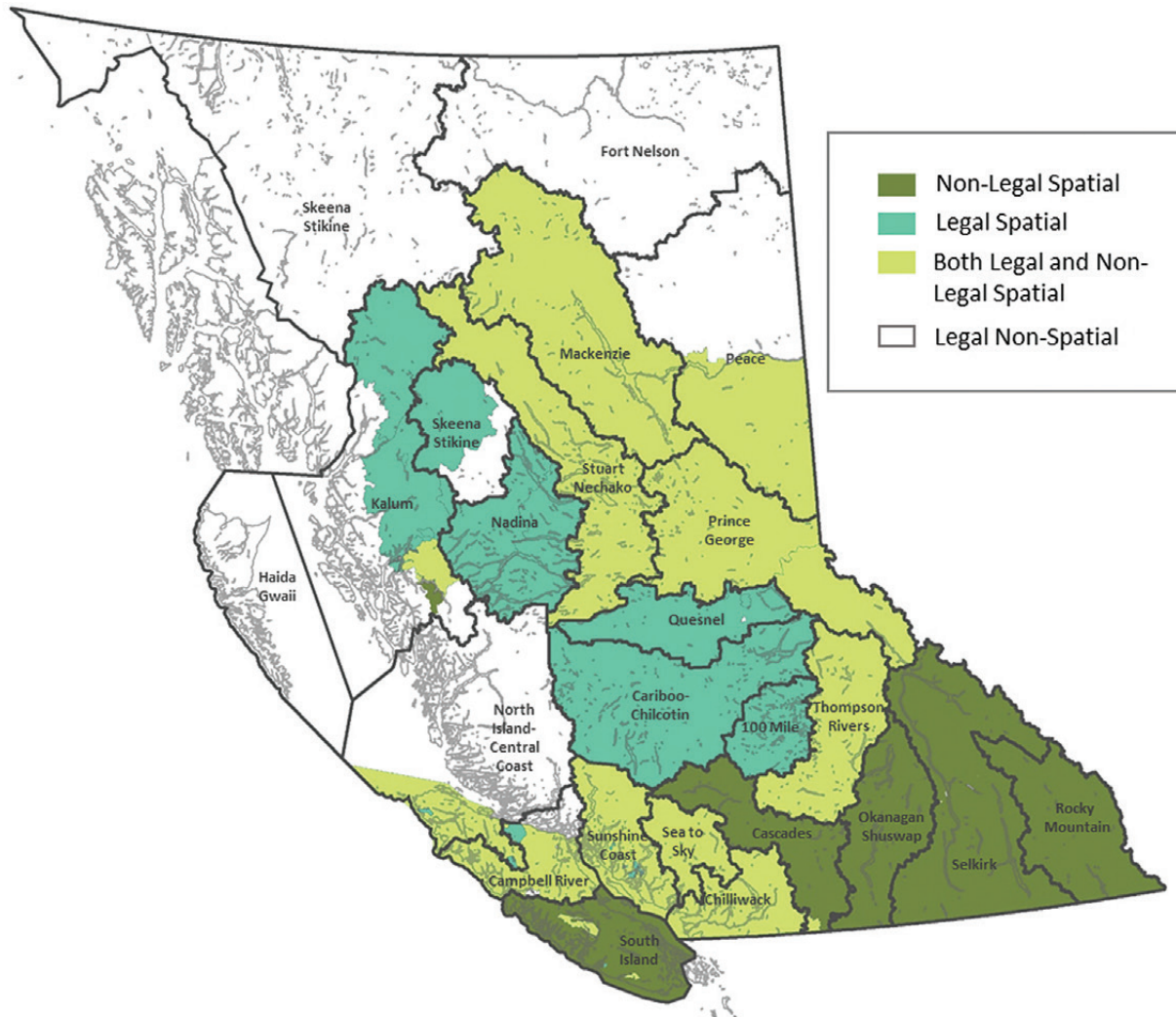


Figure 1. Areas of the province with legal spatial, legal non-spatial, non-legal spatial, and both legal and non-legal spatial Old Growth Management Areas (OGMAs) themed by timber supply area.

METHODS

Summary of Data Sources

Administrative boundaries and wildlife and land designations

The most current publicly available government geospatial data sources were used to represent the natural resource areas and the three types of designations in this analysis (Table 1). For WHAs and UWRs, we used currently approved designations up to June 2021. Data for *proposed* WHAs⁵ and UWRs⁶ are available but were not considered in scope for this analysis because these designations and their management measures are not currently in effect. Individual UWRs within an order are referred to as units in this analysis.

Table 1. Publicly available geospatial designation and boundary data sources used in the analysis

Data Type	Data Source
Administrative boundaries	Information for administrative geospatial boundaries can be found here: https://catalogue.data.gov.bc.ca/dataset/natural-resource-nr-regions
Wildlife Habitat Areas	Information on approved Wildlife Habitat Areas by region can be found here: http://www.env.gov.bc.ca/wld/frpa/iwms/wha.html The data layer for approved Wildlife Habitat Areas can be found here: https://catalogue.data.gov.bc.ca/dataset/wildlife-habitat-areas-approved
Ungulate Winter Ranges	Information on approved Ungulate Winter Ranges by region can be found here: http://www.env.gov.bc.ca/wld/frpa/urw/approved_urw.html The data layer for approved Ungulate Winter Ranges by region can be found here: https://catalogue.data.gov.bc.ca/dataset/ungulate-winter-range-approved
Conservation Lands	The data layer for Conservation Lands and Wildlife Management Areas can be found here: https://catalogue.data.gov.bc.ca/dataset/conservation-lands https://catalogue.data.gov.bc.ca/dataset/wildlife-management-areas
Old Growth Management Areas	The data layer for legal and non-legal spatial Old Growth Management Areas can be found here: https://catalogue.data.gov.bc.ca/dataset/old-growth-management-areas-legal-current https://catalogue.data.gov.bc.ca/dataset/old-growth-management-areas-non-legal-current

⁵ [https://catalogue.data.gov.bc.ca/dataset/wildlife-habitat-areas-proposed#:~:text=Comments%3A%20Wildlife%20habitat%20areas%20\(WHAs,which%20the%20area%20was%20established.](https://catalogue.data.gov.bc.ca/dataset/wildlife-habitat-areas-proposed#:~:text=Comments%3A%20Wildlife%20habitat%20areas%20(WHAs,which%20the%20area%20was%20established.)

⁶ [https://catalogue.data.gov.bc.ca/dataset/ungulate-winter-range-proposed#:~:text=An%20Ungulate%20Winter%20Range%20\(UWR,requirements%20of%20an%20ungulate%20species.](https://catalogue.data.gov.bc.ca/dataset/ungulate-winter-range-proposed#:~:text=An%20Ungulate%20Winter%20Range%20(UWR,requirements%20of%20an%20ungulate%20species.)

Natural, Anthropogenic, and Road Disturbances

Publicly available datasets from the BC Geographic Warehouse used in this analysis (Table 2). These were categorized as natural, anthropogenic, and road disturbances. Datasets include wildfires, insects, forest harvesting, roads and linear features, and other non-forest sector land uses such as urban/agricultural development, mining, oil and gas sector developments, and rights-of-way associated with transmission lines, pipelines, or railways.

Table 2. Publicly available geospatial disturbance data sources used in the analysis

Natural disturbances	Data sources
Wildfires	The provincial fire burn severity data layer was used to represent historical wildfire burn severity for wildfires between 2015-2019. This dataset uses burned area reflectance classification (BARC) mapping to assign burn severity categories within the wildfire perimeter. Only Medium and High severity wildfire data was considered in disturbance calculations. https://catalogue.data.gov.bc.ca/dataset/fire-burn-severity-historical
Insects	This layer was created by combining insect layers from the provincial data sets of spruce beetle (IBS), mountain pine beetle (IBM) and Douglas-fir beetle (IBD). The combined insect layer removes overlaps between IBS, IBM and IBD. The overlapping area takes the highest mortality severity rate, but the combined insect layer does not indicate which insect caused the mortality. Only Severe and Very Severe insect attack was considered in disturbance calculations.
Anthropogenic disturbances	Data sources
Forest harvesting	The provincial consolidated cutblock layer was used to spatialize the forest harvesting data. This data depicts the cutblock boundaries and year of forest harvesting on Crown lands. https://catalogue.data.gov.bc.ca/dataset/harvested-areas-of-bc-consolidated-cutblocks- and includes harvested blocks up to and including 2020
Other human disturbances	The Cumulative Effects Framework (CEF) human disturbance layer was used to spatialize a consolidated human disturbance footprint. This data set was designed for a strategic level cumulative effects analysis and is only meant for coarse GIS analysis. (See Appendix 1 for more detail). https://catalogue.data.gov.bc.ca/dataset/ce-disturbance-2021
Road disturbance	Date sources
Roads and linear features	The provincial CEF integrated road layer was used to spatialize a detailed look at the disturbance of roads. Various spatial buffers, termed “areas of influence” were added adjacent to the roads (150 m-500 m), depending on the type of road classification. https://catalogue.data.gov.bc.ca/dataset/ce-roads-2021

Analysis of Land Designations

Summaries of the amount of specific land designations were calculated based strictly on data available from the BC Geographic Warehouse. Due to the coarse scale of the data and the methods used to spatialize land designations (e.g., some layers do not align with BC’s natural resource region boundaries), area calculations should not be used for operational purposes. Since GIS-based spatial analyses often produce “slivers”, all areas smaller than 0.1 ha were removed in the analysis. Where land designations were broken into multiple units or polygons that bridge landscape units or regional boundaries, no additional merging of units was conducted, and all unique units were counted and summarized.

A spatial overlap of OGMAs and land designations was also performed to examine the extent of overlap and the degree to which co-location of reserve types reduces disturbance. These results were not summarized extensively in this report.

Analysis of Disturbance in Designations

To analyse the extent to which each designation is affected by individual or combined anthropogenic and natural disturbances, datasets were intersected in an ArcGIS environment. The area of overlap between individual designations and disturbed polygons was calculated, and the percent disturbances were grouped into various disturbance categories (Not Affected, Light, Low, Moderate, High, Very High) (Table 3). Similarly, the area of the wildlife designation potentially affected by the influence of roads or linear feature developments was categorized in the same fashion (Table 3).

Disturbances that affect the forest canopy (wildfires, insects, and forest harvesting) use multi-year datasets. The disturbance footprints could overlap within the spatial area (e.g., wildfire following insect attack or post-disturbance timber salvage activities). Therefore, to avoid double or triple counting the area affected by disturbance, a hierarchy was applied where the disturbance with the greatest potential to negatively affect wildlife habitat was assigned priority. The hierarchy chosen for this analysis was harvesting → wildfire → insect damage. For example, where forest harvesting and wildfire overlap, the area is counted as harvesting. If wildfire and insect overlap, it is counted as wildfire. All other anthropogenic disturbance types were associated with a development footprint and were assumed to be separate from natural disturbances that affect forest canopy.

Roads were not analyzed within the subset of the anthropogenic disturbance data for this project but were instead evaluated separately for a more detailed assessment of the overall ecological influence of road disturbances. A zone of influence was applied as a buffer around the road footprint based on the road category and this was reported separately from the combined disturbance associated with physical habitat alteration from wildfire, insects, and forestry operations.

Table 3. The percent area categories of each designation affected by anthropogenic or natural disturbance⁷ and within road buffers or linear features

Disturbance category	Percent of total area affected by anthropogenic or natural disturbances	Percent of designation within road buffers or linear features
Not Affected	0%	0%
Light	<10%	<10%
Low	10-30%	10-30%
Moderate	31-50%	31-50%
High	51-70%	51-70%
Very High	>70%	>70%

⁷ Natural disturbances include the Moderate and High burn severity categories for wildfires and the Moderate, Severe, and Very Severe cumulative insect attack categories as these are considered to have a significant effect on ecosystem structure and composition.

Wildfires

The wildfire dataset used burned area reflectance classification (BARC) mapping (Hudak et al. 2004) to assign burn severity categories (Unburned, Low, Medium, High) within the wildfire perimeter (Table 4). Medium and High categories were used in the disturbance calculations.

Table 4. Burn severity categories from provincial burned area reflectance classification (BARC) mapping and preliminary estimated average and range of overstory tree mortality associated with each class

Burn severity category	Estimated percent (%) overstory tree mortality mean	Estimated percent (%) overstory tree mortality range
Unburned	0%	0-10%
Low	20%	10-40%
Medium*	70%	40-90%
High*	95%	90-100%

*Burn severity categories used in the analysis.

Insects

Disturbance from insects is represented using cumulative forest mortality from 1999 to 2019 for three primary insects: mountain pine beetle (IBM) (*Dendroctonus ponderosae*), Spruce beetle (IBB) (*Dendroctonus rufipennis*), and Douglas-fir beetle (IBD) (*Dendroctonus pseudotsugae*). Original datasets are themed by insect, year of attack, and severity of attack (% tree mortality)⁸ as derived from forest health overview flight surveys. Mortality severity ratings are used to represent categories of the percentage of trees recently killed in a mapped area⁹ (Table 5).

Combined cumulative percent insect mortality up to 2019 was estimated by totaling the percent tree mortality for each year. For example, over multiple years from 1999 to 2005, if year 1999 mortality = 0.5%, year 2000 mortality = 5%, year 2001 mortality = 15%, year 2002 mortality = 30%, year 2003 mortality = 30%, year 2004 mortality = 15%, and year 2005 mortality = 0.5%, then the combined mortality for that period = 96% and would be categorized as Very Severe (>50%). In many cases where percent mortality is Moderate, Severe, or Very Severe for several years, the percent mortality will exceed 100% using this calculation method. It must be considered that the percent mortality in any given year is based on the proportion of living host trees from the previous year. For example, 5% tree mortality in 1999 means only 95% of the stand could be affected in 2000, and therefore the number should never exceed 100% mortality. However, this approach represents an estimate and once percent mortality accumulates to values >50% or Very Severe, the outcome is the same (A. Walton, pers. comm. 2020).

Table 5. Mortality severity ratings used to characterize the extent of insect attack within a mapped forest polygon

Mortality severity rating	Percent of trees in polygon recently killed	Percent tree mortality assigned
Not recorded	0	0
Trace (T)	<1%	0.5%
Light (L)	1-10%	5%
Moderate (M)	11-29%	15%
Severe (S)	30-49%	30%
Very Severe (V)	>50%	75%

⁸ Courtesy of Adrian Walton, Forest Analysis Inventory Branch (FAIB).

⁹ <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/aerial-overview-surveys>

Forest harvesting

The consolidated cutblock layer is created from the provincial Vegetation Resource Inventory (VRI) dataset, from the RESULTS reporting system, from forest tenure applications, and from satellite imagery using change detection processes. This method represents the gross opening area when derived from forest cover, RESULTS, or forest tenure data. Cutblocks do not exclude non-harvested reserved areas that are within the boundary of the area depicted as harvested.

Other resource sector anthropogenic disturbances

Other land uses that convert or alienate wildlife habitats, including urban and agricultural developments, transmission lines, rights-of-way (e.g., railways and highways), oil and gas developments, seismic lines, and mining are distinguished using a provincial Cumulative Effects Framework (CEF) human layer. This data set was designed for strategic-level cumulative effects analysis by large areas, such as landscape units, and is based on only coarse GIS analysis. To avoid double accounting of areas on the land base where there may be overlapping disturbance, data from a variety of layers were combined, in hierarchical order, such that more current and permanent disturbance would overwrite data spatially beneath it (Table 6). Non-disturbed natural areas from baseline thematic mapping data (1995) were also included to provide 100% area coverage. Disturbance was classified as current (within 20 years of 2021) or historical (pre-2001). Recent disturbances including urban, recreational, agricultural, mining and extraction, forest harvesting, oil and gas activities, and utilities were extracted from various data sets. These data layers do not include clearings from roads or natural disturbances (e.g., wildfires or pests). These types of disturbances were included in other datasets.

Table 6. General description of land cover categories used to characterize key anthropogenic disturbances used in the analysis, including the associated ranking order

Rank	Land cover category	Description
1	Mining and extraction	Mines, quarries, gravel pits, mine spoils and tailings
2	Rail and infrastructure	Railways and airports
3	Oil and gas infrastructure	Oil and gas pipelines, well sites, and ancillary features
4	Power	Dams and transmission lines
5	ROW	Surveyed rights-of-way for rail, pipelines, or transmission lines
6	Urban	Urban – built-up areas or residential agriculture mixtures
7	Recreation	Recreational areas (e.g., ski resorts and golf courses)
8	OGC geophysical	Seismic survey activities (seismic lines)
9	Cutblocks	Current and historic cutblocks
10	Agriculture and clearings	Clearings and agricultural areas
11	Cutblock reserves	Harvest reserves
12	Baseline thematic mapping (BTM) natural land base	Range lands, forest lands, shrub lands, swamps, wetlands, marshes, bogs or fens, mud flats, inter tidal areas, rivers, lakes, salt water, alpine, sub-alpine, barren rock, glaciers, and permanent snow

Roads and linear features

The CEF integrated roads layer provides a reasonable first approximation of potential impacts of roads on wildlife habitat. This layer is created by consolidating various BC Geographic Warehouse road sources in a hierarchical order, including the Digital Road Atlas, forest tenures roads, and mineral tenure roads. The layers include highways, resource roads including main roads and in-block roads, and roads associated with oil and gas development. Data on the status or condition of resource roads and human use or traffic volumes is not currently sufficient to allow for more detailed analysis. Further work is required to improve information on road and linear feature condition and use, and the effects of roads and associated disturbance activities on habitat designations.

The road and linear feature datasets were ranked as outlined in Table 7 to avoid double counting with overlapping road footprints.

Table 7. Road data layers and sources used in the analysis. Rank refers to the order applied to each road data layer.

Rank	Data layer	Data source
1	Digital Road Atlas	WHSE_BASEMAPPING.DRA_DGTL_ROAD_ATLAS_MPAR_SP
2	Forest tenure road – active	WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW – active
3	Forest tenure road – retired	WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW – retired (retired means no longer under permit, but road may still exist)
4	RESULTS roads – (source polys converted to centerlines)	WHSE_FOREST_VEGETATION.RSLT_FOREST_COVER_INV_SVW
5		WHSE_FOREST_TENURE.ABR_ROAD_SECTION_LINE
6		WHSE_MINERAL_TENURE.OG_PETRLM_DEV_RDS_PRE06_PUB_SP
7	Mineral tenure roads	WHSE_MINERAL_TENURE.OG_ROAD_SEGMENT_PERMIT_SP
8		WHSE_MINERAL_TENURE.OG_ROAD_AREA_PERMIT_SP (source polys converted to centerlines)

In addition, the road analysis used a buffer around the actual footprint of the road or linear feature to better quantify an area of influence associated with the effects of roads and linear features. The effects of roads and linear features on wildlife have been well documented in the literature (e.g., Forman and Alexander 1998, Fahrig and Rytwinski 2000, Trombulak and Frissell 2000, Benitez-Lopez et al. 2010). Most road-related effects occur within the first 100 to 200 m from a road, but for some species, habitat displacement or avoidance of roads can affect species abundance within 500 m and up to 1,000 m or greater (Benitez-Lopez et al. 2010). A 500-m buffer was used on all highways, arterial roads, and primary forest roads to reflect the larger road surface area and the higher level of traffic associated with these types of roads (Table 8). A 150-m buffer was applied to all other roads, including most resource roads, in-block roads, and seismic lines. This reflects what is assumed to be more limited vehicle access, reduced human use, and where the effects of forest vegetation and topography are more likely to mitigate the influence of roads (Table 8). In some cases, many of these secondary or tertiary roads may be de-activated (purposefully decommissioned to reduce vehicle access and manage water run-off) which limits human access by vehicle, although roads may still be accessible via off-road vehicles, horseback or on foot. In other cases, these roads may be intentionally rehabilitated, overgrown with vegetation, or affected by disturbance events (slides, slumps, or water damage) that restrict any type of vehicle use. Therefore, when interpreting an analysis using this data layer, several assumptions are required, including:

1. Along roads where buffer widths were applied, no distinction was made as to the volume of traffic, or the amount and/or type of activity;
2. All roads were assumed to be open and accessible (i.e., no gates or deactivation/rehabilitation that would restrict access); and
3. All portions of roads were assumed to be used equally and have an equal probability of effect along their length.

Table 8. Road classification descriptions and buffer widths as quantified in the provincial Cumulative Effects Framework (CEF) integrated roads layer

Road classification	Description	Buffer width (m)
Highway/arterial	Freeway, highway, arterial, collector, ramp	500 m
Primary – paved	Local, resource, strata, alleyway, lane driveway	500 m
Secondary – FSR local	Forest Service Road (FSR) local, service, recreational, resource, OGC long-term – all weather	150 m
Tertiary other	Permit roads, in-block, restricted, proposed, seasonal, overgrown, decommissioned, trail, runway	150 m

RESULTS

Ungulate Winter Range

Ungulate Winter Range summary

A total of 89 UWR orders, comprised of 201,102 UWR units covering approximately 27,336,826 ha, have been designated to manage habitat for eight distinct ungulate species with four subspecies and three identified ecotypes (Figure 2; Table 9). A large UWR order in the Skeena Region is a specified area (SA-6-292) for thinhorn sheep (*Ovis dalli dalli*) that covers approximately 12,870,000 ha (47.1% of the total UWR area). This area was established to prevent disease transmission from domestic sheep and does not limit forestry activities. Approximately 19.4% of the total UWR area in the province is designated as no harvesting, while 80.6% allows conditional harvesting (Table 10). With the specified area removed, the area of conditional harvesting is 11,485,785 ha or 77.4% of the total UWR area. Excluding the specified, the total area of managed UWR habitat is 14,466,055 ha of which 25% is Stone's sheep, followed by boreal and northern caribou at 18.4% and 16.6% respectively, and mule deer at 11.6% (Table 11). These UWRs (Stone's sheep, caribou, and mule deer) account for 71.6% of the provincial UWR areas that are intended for habitat protection.

Table 9. The number and area (ha) of Ungulate Winter Ranges (UWRs) in each region

Region	Number of UWR orders	Total number of UWRs units	Total UWR area (ha)	Percent of total provincial UWRs	
				No.	Area
West Coast	14	1,879	209,718.5	0.9%	1.4%
South Coast	11	1,202	221,625.5	0.6%	1.5%
Thompson/Okanagan	13	4,034	1,456,745.3	2.0%	10.1%
Kootenay/Boundary	7	183,816	1,801,426.6	91.7%	12.5%
Cariboo	5	96	714,670.5	0.0%	4.9%
Skeena (excluding specified area) *	11	4,372	638,257.6	2.2%	4.4%
Skeena (specified area) *	1	669	12,870,771.3	NA	NA
Omineca	21	4,653	6,692,507.3	2.3%	46.3%
Northeast	6	381	2,731,103.8	0.2%	18.9%
Total (excluding specified area) *	88	200,433	14,466,055.1	100%	100%
Total (including specified area) *	89	201,102	27,336,826.4	NA	NA
Total species			8		

Note: Some regional totals maybe slightly inaccurate due to historical regional boundary changes and/or some designations bridging two regions.

*Specified area is for thinhorn sheep (*Ovis dalli dalli*) to prevent disease transmission.

Table 10. Area and percent of provincial Ungulate Winter Ranges (UWRs) by timber harvest code

Timber harvest code	Percent of total UWRs units	Percent of total UWR area	Total area (ha)
No harvest	4.5%	12.1%	3,307,756.0
Conditional harvest	95.5%	87.9%	24,029,070.4
Total (including specified area) *	100.0%	100.0%	27,336,826.4

*Specified area is for thinhorn sheep.

Table 11. Provincial area within Ungulate Winter Ranges (UWRs) by species

Common name	Latin name	UWR by species		Percent (%) of provincial total	
		# of UWR units	Area (ha)	UWR units	Area
Thinhorn sheep	<i>Ovis dalli dalli</i>	669	12,870,771.3	0.3%	47.1%
Stone's sheep	<i>Ovis dalli stonei</i>	1,608	3,618,049.9	0.8%*	25.0%*
Boreal caribou	<i>Rangifer tarandus caribou</i>	231	2,657,604.4	0.1%*	18.4%*
Northern caribou	<i>Rangifer tarandus caribou</i>	778	2,406,675.8	0.4%*	16.6%*
Mule deer	<i>Odocoileus hemionus</i>	3,870	1,679,013.2	1.9%*	11.6%*
Mountain caribou	<i>Rangifer tarandus caribou</i>	3,289	1,233,849.9	1.6%*	8.5%*
Mountain goat	<i>Oreamnos americanus</i>	5147	944259.4633	2.6%*	6.5%*
Moose	<i>Alces alces</i>	74,978	753,662.8	37.4%*	5.2%*
Bighorn sheep	<i>Ovis canadensis</i>	2,308	636,316.5	1.2%*	4.4%*
Elk, mule deer, bighorn sheep	<i>Cervus canadensis, Odocoileus hemionus, Ovis canadensis</i>	62,671	250,183.6	31.3%*	1.7%*
Black-tailed deer	<i>Odocoileus hemionus columbianus</i>	1,008	91,148.7	0.5%*	0.6%*
Moose, elk, bighorn sheep, white-tailed deer	<i>Alces alces, Cervus canadensis, Ovis canadensis, Odocoileus virginianus</i>	16,883	78,202.9	8.4%*	0.5%*
Moose, elk, mule deer, bighorn sheep	<i>Alces alces, Cervus canadensis, Odocoileus hemionus, Ovis canadensis</i>	20,991	38,545.0	10.5%*	0.3%*
Elk	<i>Cervus canadensis</i>	81	37,525.7	0.0%*	0.3%*
Elk, mule deer	<i>Cervus canadensis, Odocoileus hemionus</i>	6,408	23,950.7	3.2%*	0.2%*
Roosevelt elk	<i>Cervus canadensis roosevelti</i>	171	13,087.0	0.1%*	0.1%*
White-tailed deer	<i>Odocoileus virginianus</i>	11	3,979.5	0.0%*	0.0%*
Total (including specified area)		201,102	27,336,826.4	n/a	n/a
Total (excluding specified area)		200,433*	14,466,055.1*	100.0%*	100.0%*

*Specified area for thinhorn sheep is excluded in these numbers.

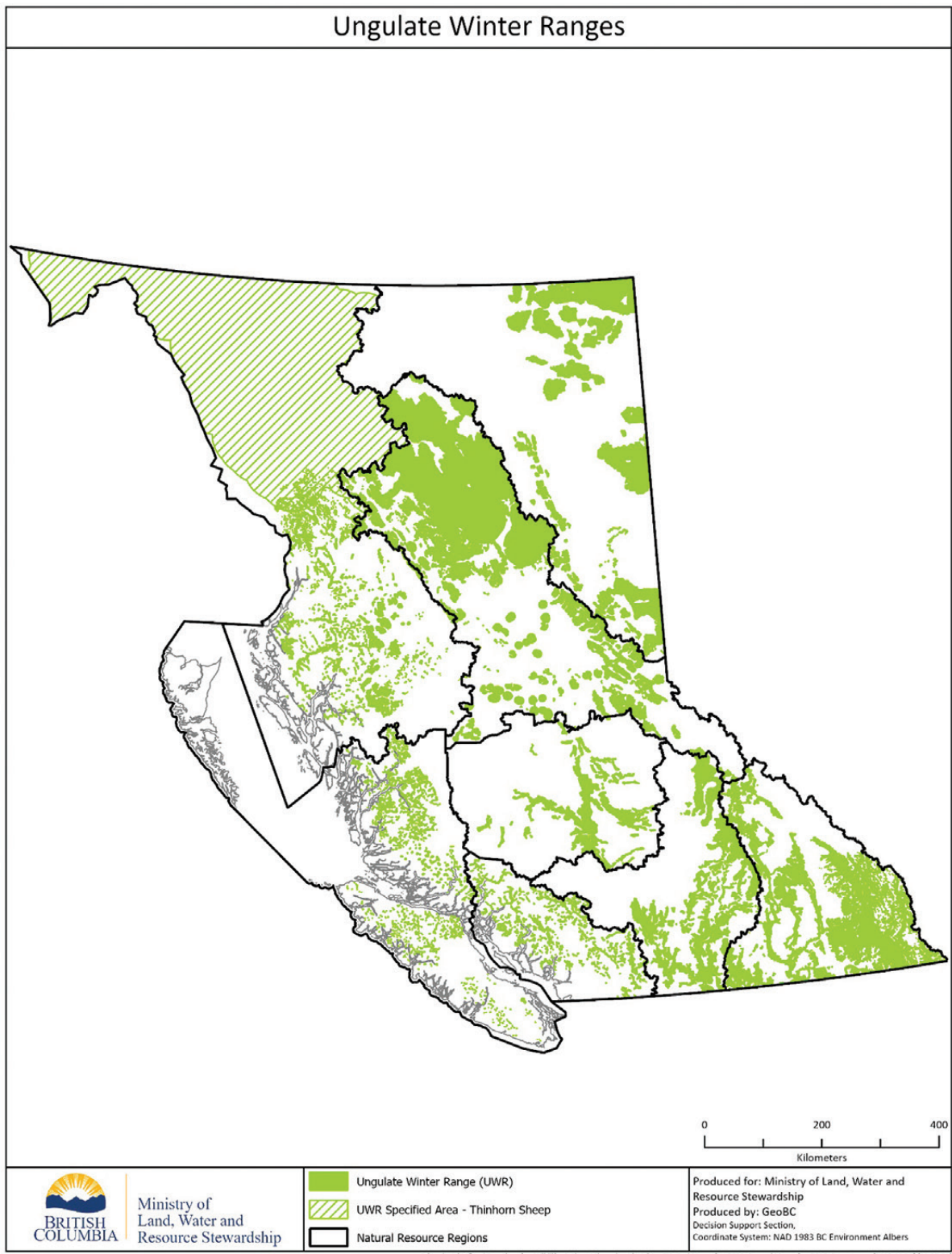


Figure 2. Distribution of Ungulate Winter Ranges (UWRs) in British Columbia.

Disturbances within Ungulate Winter Ranges

Nearly 30% of all UWR units in BC have disturbance within their boundaries (Table 12, Figure 3). Approximately 16% of UWRs units have disturbance levels of >50% within their boundaries, with an average disturbance level of 16.8% (Table 12). Roads have a much greater impact on UWR units, with >60% of UWRs having disturbance from roads, and 54.6% having disturbance levels of >50% (Table 12, Figure 3). The mean disturbance from roads in each UWR unit is approximately 54.2% (Table 12) with 54.5% having a high or very high level of disturbance (Figure 4). The Cariboo Region has the highest amount of disturbance, with a mean of 35.3% (Table 12). The Kootenay-Boundary Region has the highest level of road disturbance with a mean of 56.9% (Table 12).

Table 12. Summary of area impacts from disturbance to total Ungulate Winter Range (UWR) units in each region

Region	% UWR units with disturbance	% UWR units with road disturbance	% UWR units with >50% disturbance	% UWR units with >50% road disturbance	Mean % disturbance* within each UWR unit	Mean % disturbance* from roads affecting each UWR unit
West Coast	16.8%	45.8%	0.3%	7.9%	0.8%	11.9%
South Coast	36.1%	52.1%	0.3%	5.1%	2.7%	7.8%
Thompson-Okanagan	61.1%	77.0%	6.8%	40.2%	11.8%	39.2%
Kootenay-Boundary	29.2%	65.5%	16.8%	57.4%	17.5%	56.9%
Cariboo	100.0%	100.0%	17.2%	48.3%	35.3%	48.2%
Skeena	14.0%	17.7%	4.5%	5.8%	4.7%	6.4%
Omineca	24.1%	12.7%	7.3%	1.9%	8.0%	3.0%
Northeast	90.0%	79.1%	3.6%	1.6%	7.7%	13.1%
Provincial Total	29.5%	63.9%	16.0%	54.6%	16.8%	54.2%

*Based on area.

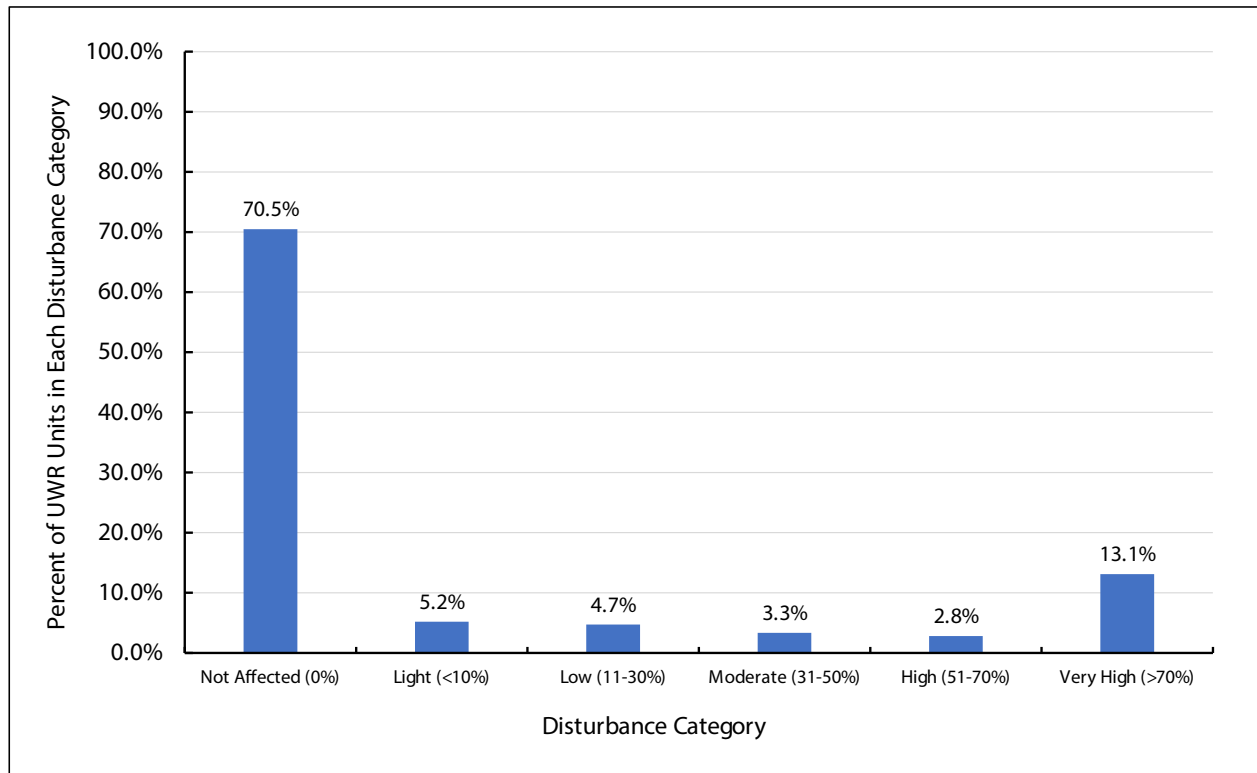


Figure 3. Percent of Ungulate Winter Range (UWR) units in each disturbance category for all disturbances not including roads.

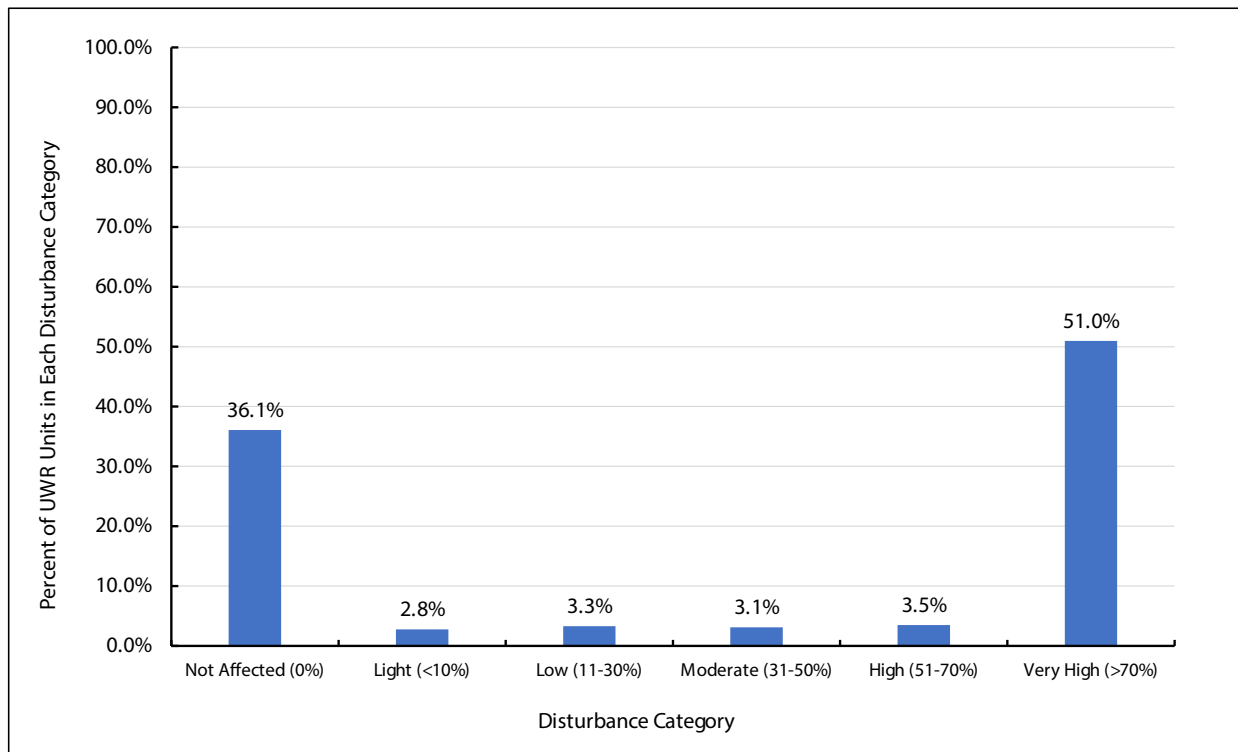


Figure 4. Percent of Ungulate Winter Range (UWR) units in each disturbance category for road disturbance only.

Disturbance factors in Ungulate Winter Ranges

The main disturbances (excluding roads) affecting UWRs at the provincial scale are insects, followed by forest harvest and wildfire (Figure 5). Of the 30 UWR orders with the highest levels of disturbance, insect-induced tree mortality accounted for >30% of disturbance levels on over half of the orders (Figure 5, Table 13).

Mountain pine beetle-induced tree mortality over the past 20 years was the main disturbance in the majority (8 of 9) of UWR orders, with a disturbance level of >50% (Table 13). The UWRs most affected by mountain pine beetle-induced tree mortality are northern caribou and mule deer winter ranges that occur in the Omineca Region. Mountain pine beetle-induced tree mortality was the primary disturbance agent contributing to disturbance levels of 31-50% in eight UWR orders (Table 13). Urban and agricultural land use contribute to most disturbances in one UWR order for bighorn sheep in the Kootenay-Boundary Region.

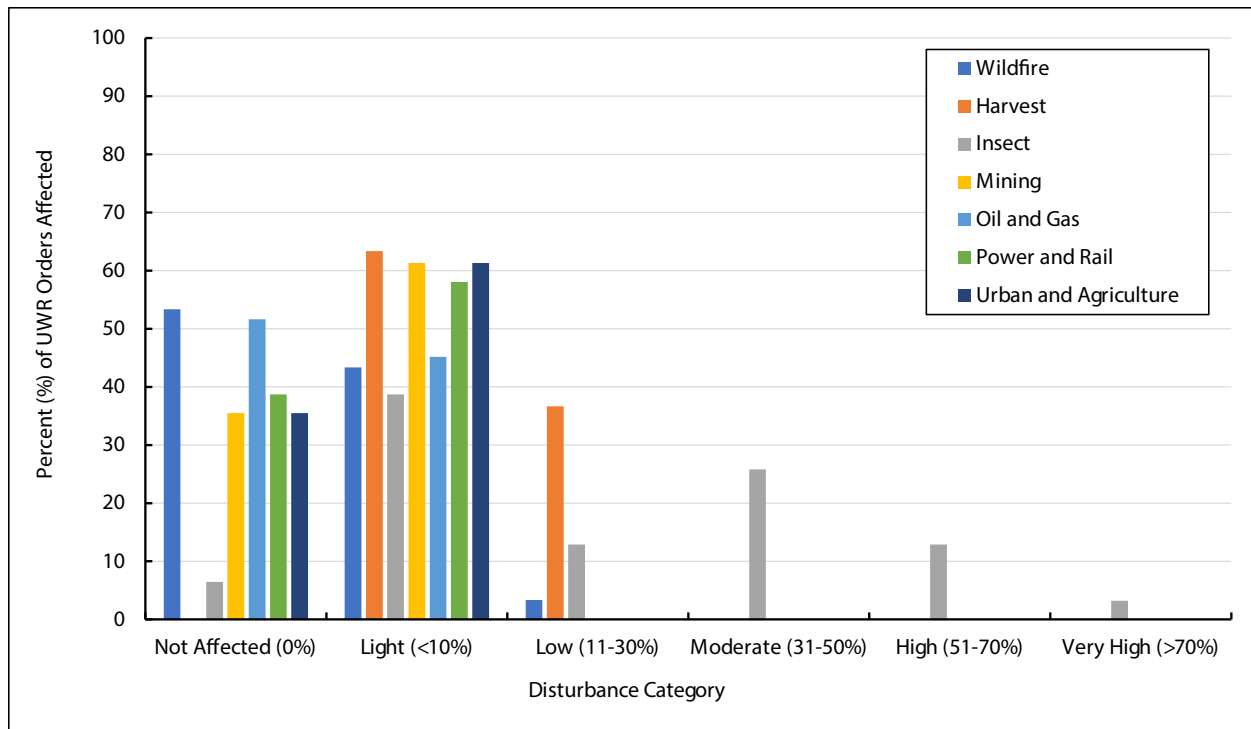


Figure 5. Percent of Ungulate Winter Range (UWR) orders affected by disturbance type and level of disturbance (excluding roads).

Disturbance from roads of >50% of the UWR area affected eight UWR orders in the South Coast, Thompson-Okanagan, and Kootenay-Boundary Regions, impacting elk, moose, mule deer, and white-tailed deer UWRs (Table 14). The Kootenay-Boundary Region had the highest level of road disturbance, with 14 of the UWR orders in this region having >50% disturbance (Table 14).

Table 13. Summary of anthropogenic, natural, and road disturbances for all Ungulate Winter Range (UWR) orders with >20% combined disturbance

Region	UWR Order	Species Common name	Species Code	Timber Harvest Code	UWR Order Area (Ha)	Wildfire (Med.-High Burn Severity) Area (%)	Area Harvested after 1995 (%)	Severe (>30% Tree mortality) Insect Attack (%)	Mining (%)	Oil and gas Development (%)	Power lines,Rail, or other Right-of-ways (%)	Urban, Agricultural or Recreation Uses (%)	Total Percent (%) Disturbance	Percent of UWR units with >50% Disturbance	Percent of UWR units with >50% Area affected by Road
Omenica	u-7-012	Caribou	M-RATA-15	Conditional Harvest Zone	26067.15	0.0	11.7	78.0	0.0	0.0	0.0	0.1	89.87	100	27.78
Omenica	u-7-001	Caribou	M-RATA-15	Conditional Harvest Zone	2893.96	0.0	15.3	68.2	0.0	0.0	2.6	0.1	86.18	100	0
Omenica	u-7-011	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	2327.85	18.1	2.2	62.0	0.0	0.0	0.0	0.0	82.37	100	0
Omenica	u-7-012	Caribou	M-RATA-15	No Harvest Zone	22629.24	0.0	1.1	70.1	0.6	0.0	0.0	0.0	71.79	100	0
Omenica	u-7-007	Caribou	M-RATA-15	Conditional Harvest Zone	54633.39	0.0	9.4	60.0	0.0	0.0	0.1	0.1	69.66	75	28
Kootenay Boundary	u-4-001	Mountain Goat	M-ODVI	Conditional Harvest Zone	3979.54	0.0	1.3	0.0	0.3	0.0	1.1	52.0	54.69	50	100
Omenica	u-7-026	Caribou	M-RATA	Conditional Harvest Zone	10002.13	0.9	3.8	49.1	0.0	0.0	0.0	0.0	53.8	33.33	0
Omenica	u-7-025	Caribou	M-RATA	Conditional Harvest Zone	497162.82	0.1	6.2	45.6	0.0	0.0	0.1	0.0	52.02	48.57	8.57
Omenica	u-7-017	Moose	M-ALAL	Conditional Harvest Zone	15397.78	0.0	4.6	47.0	0.0	0.0	0.0	0.0	51.63	50	0
Skeena	u-6-017	Mountain Goat	M-ORAM	No Harvest Zone	5096.11	0.7	4.5	39.4	0.5	0.0	0.0	0.0	45.1	61.46	13.54
Northeast	u-9-004	Caribou	M-RATA-15	Conditional Harvest Zone	8994.69	0.0	9.5	31.2	0.0	0.5	0.0	0.0	41.2	60	20
Omenica	u-7-013	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	9743.25	0.0	8.6	32.2	0.0	0.0	0.0	0.2	41.12	60.98	19.51
Cariboo	u-5-001	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	71421.55	0.9	8.2	23.4	0.2	0.2	0.6	7.6	41.06	25	50
Omenica	u-7-008	Elk	M-CEEL	Conditional Harvest Zone	6963.75	0.0	0.1	38.8	0.0	0.0	0.0	0.7	39.63	33.33	0
Omenica	u-7-013	Mule Deer/Black-tailed Deer	M-ODHE	No Harvest Zone	322.48	0.0	7.4	26.8	0.0	0.0	0.0	0.0	34.14	0	0
Cariboo	u-5-003	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	172688.95	4.2	4.6	21.6	0.1	0.1	0.5	3.0	34.06	38.46	53.85
Omenica	u-7-002	Mule Deer/Black-tailed Deer	M-ODHE	No Harvest Zone	176.1	0.0	0.0	34.0	0.0	0.0	0.0	0.0	34.03	0	0
Kootenay Boundary	u-4-006	Elk, Mule Deer	M-CEEL,M-ODHE	Conditional Harvest Zone	1629.31	0.3	8.8	1.3	0.9	0.3	1.6	13.9	26.99	23.96	69.2
Northeast	u-9-004	Caribou	M-RATA-15	No Harvest Zone	64639.59	0.0	0.0	26.6	0.0	0.3	0.0	0.0	26.92	16.67	0
Omenica	u-7-015	Caribou	M-RATA-15	Conditional Harvest Zone	52606.2	0.0	1.4	25.5	0.0	0.0	0.0	0.0	26.87	50	0
Kootenay Boundary	u-4-006	Moose	M-ALAL	Conditional Harvest Zone	179683.57	0.6	18.2	2.8	1.0	0.2	0.6	3.1	26.59	18.78	58.36
Cariboo	u-5-002	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	474110.78	4.6	5.4	12.9	0.1	0.0	0.4	3.1	26.48	6.12	44.9
Kootenay Boundary	u-4-006	Elk, Mule Deer, Bighorn Sheep	M-CEEL,M-ODHE,M-ODVI	Conditional Harvest Zone	166374.77	0.2	11.5	0.7	0.2	0.2	0.5	12.1	25.34	17.83	60.4
Kootenay Boundary	u-4-008	Elk, Mule Deer, Bighorn Sheep	M-CEEL,M-ODHE,M-ODVI	Conditional Harvest Zone	83808.84	0.1	10.2	0.3	0.1	0.0	0.7	13.4	24.93	15.79	54.73
Okanagan	u-8-007	Moose	M-ALAL	Conditional Harvest Zone	91015.81	0.0	21.4	0.3	0.1	0.0	0.3	2.1	24.2	0	100
Omenica	u-7-002	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	3481.14	0.0	3.3	20.4	0.0	0.0	0.0	0.0	23.7	21.43	0
Kootenay Boundary	u-4-008	Moose	M-ALAL	Conditional Harvest Zone	49025.1	1.0	18.4	1.9	0.1	0.0	0.8	1.3	23.43	15.79	46.55
Kootenay Boundary	u-4-006	Moose,Elk,Bighorn Sheep, White-tailed Deer	M-CEEL,M-ODHE,M-ODVI	Conditional Harvest Zone	43707.08	0.0	15.7	1.5	0.2	0.2	0.7	4.6	23.06	15.7	61.17
Thompson Okanagan	u-3-003	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	280126.53	0.2	10.9	10.3	0.6	0.1	0.4	0.3	22.85	14.19	47.92
Kootenay Boundary	u-4-001	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	201305.7	0.4	7.9	1.4	0.2	0.1	1.3	11.4	22.74	5.26	69.38
Kootenay Boundary	u-4-008	Elk, Mule Deer	M-CEEL,M-ODHE	Conditional Harvest Zone	22321.39	0.0	19.6	2.9	0.1	0.0	0.0	0.1	22.71	15.98	56.27
Kootenay Boundary	u-4-013	Caribou	M-RATA-01	Conditional Harvest Zone	513.42	0.0	11.7	10.9	0.0	0.0	0.0	0.0	22.56	28.57	28.57
Kootenay Boundary	u-4-001	Elk	M-CEEL	Conditional Harvest Zone	10592.49	0.0	5.3	2.3	0.1	0.0	0.1	14.5	22.31	0	90.91
Okanagan	u-8-006	Moose	M-ALAL	Conditional Harvest Zone	232139.4	0.1	16.7	2.6	0.0	0.0	0.5	1.2	21.2	9.09	81.82
Kootenay Boundary	u-4-008	Moose,Elk,Bighorn Sheep, White-tailed Deer	M-CEEL,M-ODHE,M-ODVI	Conditional Harvest Zone	34495.85	0.3	17.3	0.6	0.0	0.0	0.7	1.8	20.74	15.71	58.93
Northeast	u-9-002	Caribou	M-RATA-15	Conditional Harvest Zone	330255.33	0.0	7.6	9.7	0.1	2.5	0.2	0.0	20.05	0	0

Table 14. Summary of Ungulate Winter Ranges (UWRs) with >30% of the orders affected by road disturbance of >50%

Region	UWR Order	Species Common name	Species Code	Timber Harvest Code	UWR Order Area (Ha)	Wildfire (Med.-High Burn Severity) Area (%)	Area Harvested after 1995 (%)	Severe (>30% Tree mortality Insect Attack (%))	Mining (%)	Oil and gas Development (%)	Power lines,Rail, or other Right-of-ways (%)	Urban, Agricultural or Recreation Uses (%)	Total Percent (%) Disturbance	Percent of UWR units with >50% Area Disturbance	Percent of UWR units with >50%Area affected by Road
Kootenay Boundary	u-4-001	Elk, Mule Deer, White-tailed Deer and Moose	M-ODVI	Conditional Harvest Zone	3979.54	0.0	1.3	0.0	0.3	0.0	1.1	52.0	54.69	50	100
Okanagan	u-8-007	Moose	M-ALAL	Conditional Harvest Zone	91015.81	0.0	21.4	0.3	0.1	0.0	0.3	2.1	24.2	0	100
South Coast	u-2-010	Moose	M-ALAL	Conditional Harvest Zone	1215.84	0.0	2.2	0.0	0.0	0.0	0.0	0.0	2.19	0	100
West Coast	u-1-009	Elk	M-CEEL	Conditional Harvest Zone	507.58	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.65	0	100
Kootenay Boundary	u-4-001	Elk	M-CEEL	Conditional Harvest Zone	10592.49	0.0	5.3	2.3	0.1	0.0	0.1	14.5	22.31	0	90.91
Kootenay Boundary	u-4-001	Moose	M-ALAL	Conditional Harvest Zone	60497.1	0.0	16.9	0.3	0.1	0.2	0.5	1.4	19.38	0	89.66
Okanagan	u-8-006	Moose	M-ALAL	Conditional Harvest Zone	232139.4	0.1	16.7	2.6	0.0	0.0	0.5	1.2	21.2	9.09	81.82
West Coast	u-1-013	Elk	M-CEEL	No Harvest Zone	403.74	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.26	0	75
West Coast	u-1-014	Elk	M-CEEL	No Harvest Zone	2574.31	0.0	1.0	0.0	0.0	0.0	0.5	0.0	1.45	0	70
Kootenay Boundary	u-4-001	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	201305.7	0.4	7.9	1.4	0.2	0.1	1.3	11.4	22.74	5.26	69.38
Kootenay Boundary	u-4-006	Elk/Mule Deer	M-CEEL,M-ODHE	Conditional Harvest Zone	1629.31	0.3	8.8	1.3	0.9	0.3	1.6	13.9	26.99	23.96	69.2
Okanagan	u-8-008	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	65919.9	0.5	11.3	0.2	0.1	0.1	0.4	1.3	13.92	0	68.24
Kootenay Boundary	u-4-006	White-tailed Deer, Mule Deer, Moose, Elk, Bighorn Sheep, Mountain Goat	M-ALAL,M-CEEL,M-ODHE,M-ODVI	Conditional Harvest Zone	10817.22	0.0	7.4	1.4	0.2	0.2	0.3	5.9	15.36	13.66	67
Kootenay Boundary	u-4-012	Caribou	M-RATA-01	Conditional Harvest Zone	286.24	0.0	11.6	1.1	0.0	0.0	0.0	0.0	12.69	0	66.67
Kootenay Boundary	u-4-008	White-tailed Deer, Mule Deer, Moose, Elk, Bighorn Sheep, Mountain Goat	M-ALAL,M-CEEL,M-ODHE,M-ODVI	Conditional Harvest Zone	27727.75	0.0	11.9	0.3	0.1	0.0	1.3	5.9	19.43	14.15	61.7
Kootenay Boundary	u-4-006	Moose,Elk,Bighorn Sheep,White-tailed Deer	M-CEEL,M-OVCA,M-ODHE	Conditional Harvest Zone	43707.08	0.0	15.7	1.5	0.2	0.2	0.7	4.6	23.06	15.7	61.17
Kootenay Boundary	u-4-006	Elk,Mule Deer,Bighorn Sheep	M-CEEL,M-OVCA,M-ODHE	Conditional Harvest Zone	166374.77	0.2	11.5	0.7	0.2	0.2	0.5	12.1	25.34	17.83	60.4
West Coast	u-1-017	Elk	M-CEEL	Conditional Harvest Zone	1983.39	0.0	7.3	0.0	0.0	0.0	0.0	0.0	7.37	0	60
Kootenay Boundary	u-4-008	Moose,Elk,Bighorn Sheep,White-tailed Deer	M-CEEL,M-OVCA,M-ODHE	Conditional Harvest Zone	34495.85	0.3	17.3	0.6	0.0	0.0	0.7	1.8	20.74	15.71	58.93
Kootenay Boundary	u-4-006	Moose	M-ALAL	Conditional Harvest Zone	179683.57	0.6	18.2	2.8	1.0	0.2	0.6	3.1	26.59	18.78	58.36
Kootenay Boundary	u-4-008	Elk/Mule Deer	M-CEEL,M-ODHE	Conditional Harvest Zone	23231.39	0.0	19.6	2.9	0.1	0.0	0.0	0.1	22.71	15.98	56.27
Okanagan	u-8-001	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	397346.36	1.2	4.8	1.2	0.2	0.1	0.6	10.6	18.7	6.64	55.07
Skeena	u-5-009	Moose	M-ALAL	Conditional Harvest Zone	55293.17	0.0	2.4	0.3	0.1	0.4	1.3	1.2	5.74	2.38	54.76
Kootenay Boundary	u-4-008	Elk,Mule Deer,Bighorn Sheep	M-CEEL,M-OVCA,M-ODHE	Conditional Harvest Zone	88808.84	0.1	10.2	0.3	0.1	0.0	0.7	13.4	24.93	15.79	54.73
Cariboo	u-5-003	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	172688.95	4.2	4.6	21.6	0.1	0.1	0.5	3.0	34.06	38.46	53.85
South Coast	u-2-010	Moose	M-ALAL	No Harvest Zone	312.62	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.33	0	53.33
West Coast	u-1-004	Elk	M-CEEL	No Harvest Zone	937.26	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.13	0	52.94
Cariboo	u-5-001	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	71421.55	0.9	8.2	23.4	0.2	0.2	0.6	7.6	41.06	25	50
Okanagan	u-8-010	Bighorn Sheep	M-OVCA	Conditional Harvest Zone	1988.05	0.1	1.9	0.0	0.1	1.0	2.0	2.6	7.74	0	50
Thompson Okanagan	u-3-003	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	280126.53	0.2	10.9	10.3	0.6	0.1	0.4	0.3	22.85	14.19	47.92
Kootenay Boundary	u-4-008	Moose	M-ALAL	Conditional Harvest Zone	49025.1	1.0	18.4	1.9	0.1	0.0	0.8	1.3	23.43	15.79	46.55
Thompson Okanagan	u-3-004	Caribou	M-RATA-01	Conditional Harvest Zone	76068.55	0.0	12.6	0.9	0.0	0.0	0.1	0.0	13.69	12.37	45.36
West Coast	u-1-001	Elk	M-CEEL	No Harvest Zone	1000.63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0	45
Cariboo	u-5-002	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	474110.78	4.6	5.4	12.9	0.1	0.0	0.4	3.1	26.48	6.12	44.9
West Coast	u-1-011	Elk	M-CEEL	No Harvest Zone	537.09	0.0	3.2	0.0	0.0	0.0	0.1	0.0	3.34	0	41.67
West Coast	u-1-017	Elk	M-CEEL	No Harvest Zone	596.45	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.41	0	41.18
West Coast	u-1-002	Mule Deer/Black-tailed Deer	M-ODHE	No Harvest Zone	1366.37	0.0	1.7	0.0	0.0	0.0	0.0	0.0	1.73	0	32.43
South Coast	u-2-005	Mule Deer/Black-tailed Deer	M-ODHE	Conditional Harvest Zone	7017.81	0.0	6.4	3.4	0.1	0.0	0.6	0.1	10.74	1.96	31.37

Co-location of Ungulate Winter Ranges and Old Growth Management Areas

The area of UWR and spatial OGMA overlap is 675,094 ha (315,140 legal and 359,954 non-legal) or 2.5% of the total UWR area (Table 15). This number increases to 4.7% of the total UWR area when the specified thinhorn sheep area in the Skeena Region is excluded.

Table 15. Summary of overlap between spatial legal and non-legal Old Growth Management Areas (OGMAs) and Ungulate Winter Ranges (UWRs) by natural resource region

Region	# UWR orders	UWR area (ha)	# UWR orders with OGMA overlap		Area of OGMA and UWR overlap (ha)		Percent OGMA and UWR overlap	
			Legal	Non-legal	Legal	Non-legal	Legal	Non-legal
West Coast	36	209,718.8	9	3	23,818.2	3,800.4	11.4%	1.8%
South Coast	17	221,818.8	6	5	25,992.9	2,789.4	11.7%	1.3%
Thompson-Okanagan	8	1,428,024.8	4	7	39,284.8	110,198.3	2.8%	7.7%
Kootenay-Boundary	28	1,829,544.6	1	13	4,010.6	241,781.9	0.2%	13.2%
Cariboo	3	717,813.5	3	0	124,112.6	0.0	17.3%	0.0%
Skeena (all)	14	13,507,989.3	8	1	16,166.4	17.1	0.1%	0.0%
Skeena (excluding specified area)	13	637,218.0	8	1	16,166.4	17.1	2.5%	0.0%
Omineca	30	6,691,469.7	7	2	35,826.2	1,366.9	0.5%	0.0%
Northeast	12	2,731,271.3	2	0	45,928.3	0.0	1.7%	0.0%
Total (including specified area)	148	27,337,650.8	40	31	315,140.0	359,954.0	1.2%	1.3%
Total (excluding specified area)	147	14,466,879.5	40	31	315,140.0	359,954.0	2.2%	2.5%

Wildlife Habitat Areas

Wildlife Habitat Areas summary

As of June 2021, there are a total of 2,494 WHA orders in BC, with 6,778 legally established WHAs encompassing 4,949,669.9 ha and approximately 57 identified wildlife species (Table 16). The Skeena Natural Resource Region has the greatest number of WHAs, while the Thompson-Okanagan and Northeast Regions have the greatest total area of WHAs. Approximately 15.8% of the total number of WHAs are subject to conditional harvesting, while 84.2% are no harvesting. Moreover, 59.0% of the total WHA area is subject to conditional harvesting (Table 17). These Wildlife Habitat Areas are not evenly distributed among species, with 47.1% allocated to thinhorn sheep (specified area to prevent disease transmission), and 46.5% of the total WHA area allocated to grizzly bear and 20% to northern caribou. Grizzly bears have the highest number of WHAs at 4,580 or 67.6% of the total, followed by northern caribou at 1,014,227.5 ha (Table 18). Figure 6 shows the distribution of Wildlife Habitat Areas across the province.

Table 16. Total number and area (ha) of Wildlife Habitat Areas (WHAs) in each region

Region	Number of WHA orders	Total number of WHA units	WHA area (ha)	Percent (%) of total provincial WHAs	
				No.	Area
West Coast	438	845	76,211.4	12.5%	1.5%
South Coast	590	861	264,271.3	12.7%	5.3%
Thompson-Okanagan	429	400	1,480,098.4	5.9%	29.9%
Kootenay-Boundary	240	438	649,587.0	6.5%	13.1%
Cariboo	458	114	660,620.7	1.7%	13.3%
Skeena	88	3,883	451,624.7	57.3%	9.1%
Omineca	66	80	404,535.6	1.2%	8.2%
Northeast	185	157	962,720.7	2.3%	19.5%
Total	2494	6,778	4,949,669.9	100.0%	100.0%
Total species				57*	

* Some species are identified as data sensitive and are not reported here.

Table 17. Percent and area of provincial Wildlife Habitat Areas (WHAs) by timber harvest code

Timber harvest code	Percent of WHAs	Percent area
No harvest	84.2%	41.0%
Conditional harvest	15.8%	59.0%
Total	100.0%	100.0%

Table 18. A summary of Wildlife Habitat Areas (WHAs) by species, number of Wildlife Habitat Areas units, and percent of total Wildlife Habitat Area units and area

Common name	Latin name	Number of WHAs units	Total WHA area (ha)	Percent of total provincial WHAs (%)	Percent of total provincial WHA area (%)
Grizzly bear	<i>Ursus arctos</i>	4,580	2,301,716.3	67.6%	46.5%
Northern caribou	<i>Rangifer tarandus caribou</i>	121	1,014,227.5	1.8%	20.5%
Data sensitive	NA	456	619,084.5	6.7%	12.5%
Boreal caribou	<i>Rangifer tarandus caribou</i>	24	439,730.0	0.4%	8.9%
Mountain caribou	<i>Rangifer tarandus caribou</i>	38	277,056.3	0.6%	5.6%
Spotted Owl	<i>Strix occidentalis</i>	118	188,218.2	1.7%	3.8%
Marbled Murrelet	<i>Brachyramphus marmoratus</i>	466	48,811.6	6.9%	1.0%
American White Pelican	<i>Pelecanus erythrorhynchos</i>	19	20,869.8	0.3%	0.4%
Western Screech Owl	<i>Megascops kennicottii</i>	113	6,014.4	1.7%	0.1%
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>	150	5,947.7	2.2%	0.1%
Coastal tailed frog	<i>Ascaphus truei</i>	95	4,448.3	1.4%	0.1%
Lewis's Woodpecker	<i>Melanerpes lewis</i>	102	3,026.5	1.5%	0.1%
Northern Goshawk	<i>Accipiter gentilis laingi</i>	15	3,008.8	0.2%	0.1%
Badger	<i>Taxidea taxus</i>	40	2,870.1	0.6%	0.1%
Rocky Mountain tailed frog	<i>Ascaphus montanus</i>	42	1,238.2	0.6%	0.03%
Tall bugbane	<i>Cimicifuga elata</i>	37	1,221.8	0.5%	0.02%
Great basin spadefoot	<i>Spea intermontana</i>	20	1,176.7	0.3%	0.02%
Black-Throated Green Warbler	<i>Setophaga virens</i>	23	1,044.7	0.3%	0.02%
Sandhill Crane	<i>Grus canadensis</i>	11	1,016.7	0.2%	0.02%
Long-billed Curlew	<i>Numenius americanus</i>	11	919.5	0.2%	0.02%
Stickleback	<i>Gasterosteus sp.</i>	10	881.3	0.1%	0.02%
Ancient Murrelet/ Cassin's Auklet	<i>Synthliboramphus antiquus/ Ptychoramphus aleuticus</i>	11	802.7	0.2%	0.02%
Gillette's checkerspot	<i>Euphydryas gillettii</i>	46	722.5	0.7%	0.01%
Red-legged frog	<i>Rana aurora</i>	30	588.1	0.4%	0.01%
Mountain goat	<i>Oreamnos americanus</i>	14	542.0	0.2%	0.01%
Connecticut Warbler	<i>Oporornis agilis</i>	10	507.6	0.1%	0.01%

Table 18 cont.

Common name	Latin name	Number of WHAs units	Total WHA area (ha)	Percent of total provincial WHAs (%)	Percent of total provincial WHA area (%)
Tiger salamander	<i>Ambystoma tigrinum</i>	18	462.7	0.3%	0.01%
Pacific water shrew	<i>Sorex bendirii</i>	6	423.4	0.1%	0.01%
Bighorn sheep	<i>Ovis canadensis</i>	5	385.3	0.1%	0.01%
Half-moon hairstreak	<i>Satyrrium semiluna</i>	15	383.8	0.2%	0.01%
Flammulated Owl	<i>Psilosops flammeolus</i>	27	321.2	0.4%	0.01%
Sage Thrasher	<i>Oreoscoptes montanus</i>	3	261.5	0.0%	0.01%
Brewer's Sparrow	<i>Spizella breweri</i>	9	231.1	0.1%	0.005%
Douglas-fir/ snowberry/balsamroot	<i>Pseudotsuga menziesii/ Symphoricarpos albus/ Balsamorhiza sp.</i>	2	223.7	0.0%	0.005%
Fisher	<i>Pekania pennanti</i>	8	212.0	0.1%	0.004%
White-headed Woodpecker	<i>Picoides albolarvatus</i>	4	198.7	0.1%	0.004%
Antelope brush/ needle-and-thread grass	<i>Purshia tridentata/ Hesperostipa comata</i>	8	197.6	0.1%	0.004%
Antelope-brush/ bluebunch wheatgrass	<i>Purshia tridentata/ Pseudoroegneria spicata</i>	3	169.2	0.0%	0.003%
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	3	119.3	0.0%	0.002%

Figure 6 shows the distribution of Wildlife Habitat Areas across the province.

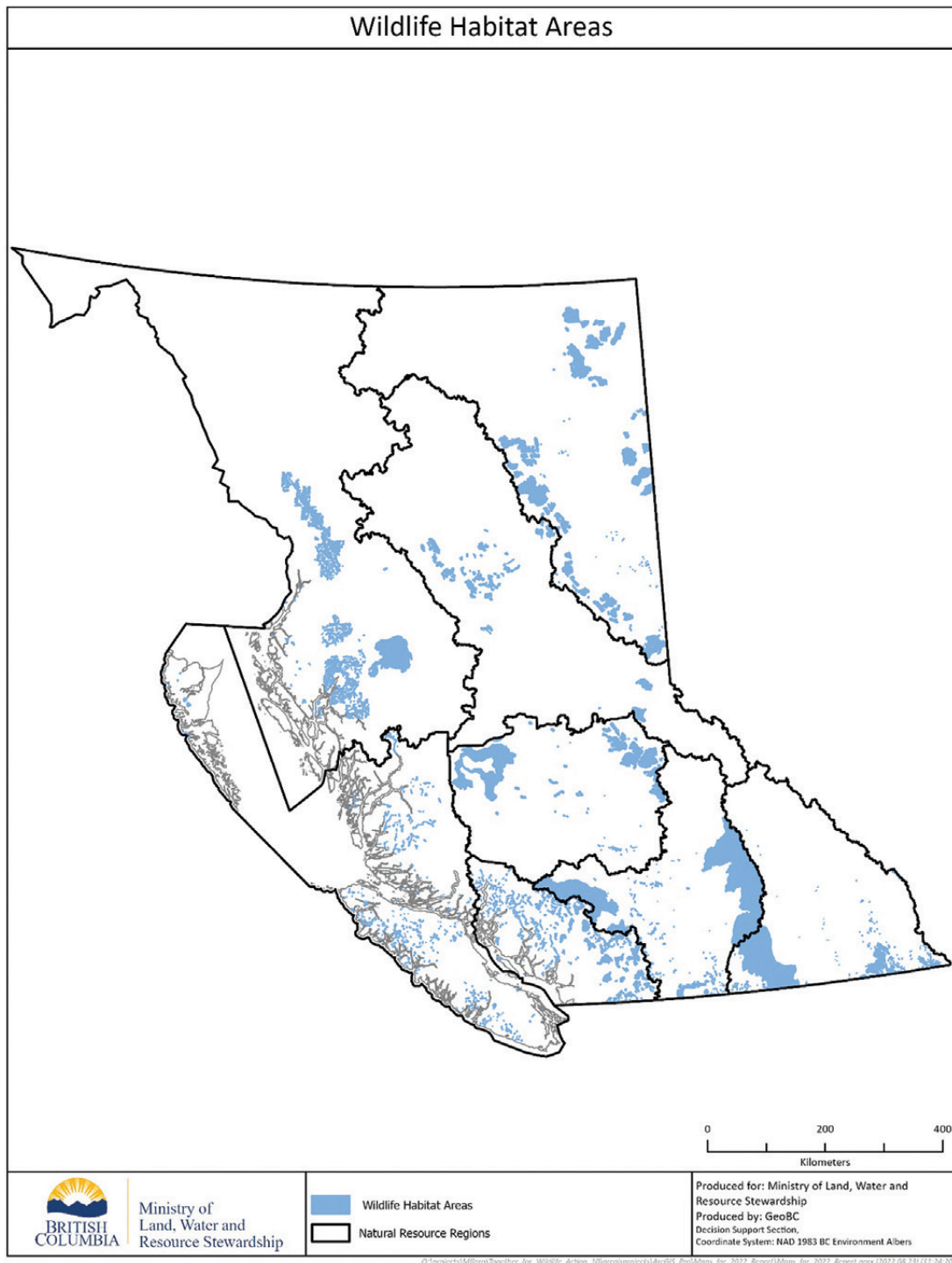


Figure 6. The distribution of Wildlife Habitat Areas (WHAs) in British Columbia.

Nearly 90% of WHAs are <200 ha and of those most (71%) are <50 ha in size. There are a small proportion of large (>10,000 ha) WHAs, including one specified area for grizzly bear in the Thompson-Okanagan Region that is 1,418,925 ha in size (Figure 7).

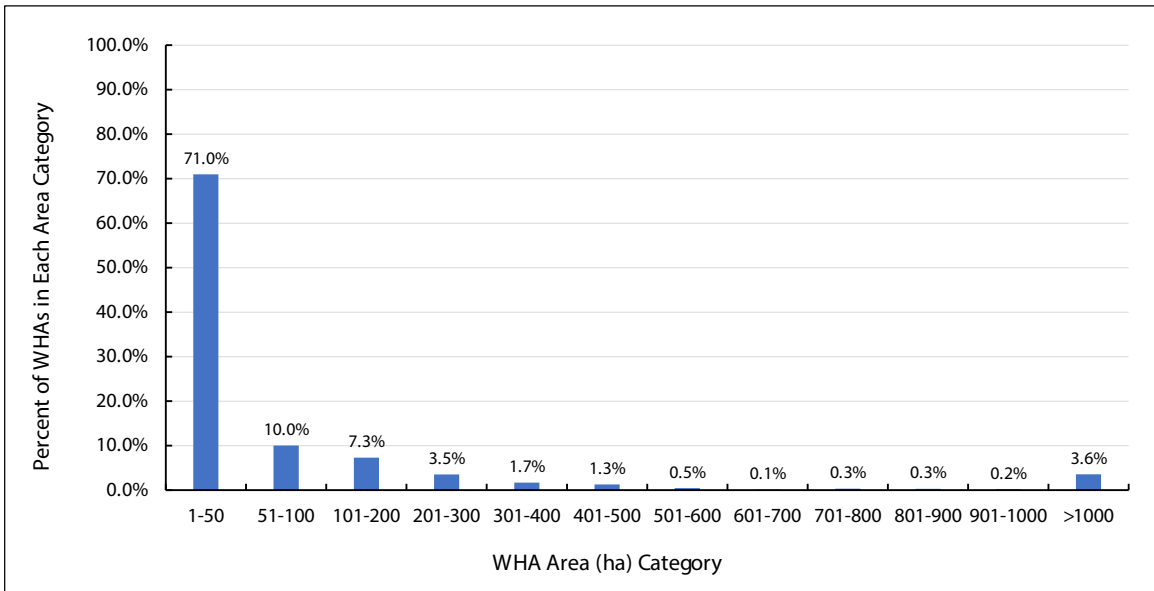


Figure 7. Percent of Wildlife Habitat Areas (WHAs) in various size (ha) categories.

Disturbances in Wildlife Habitat Areas

Approximately 25% of all WHAs have disturbance from a variety of sources within their boundaries (excluding disturbance roads; Figure 8). The mean disturbance within the boundaries of all WHAs is 38.9%, and 2.5% of all WHAs have disturbance levels of >50% (Table 19). The Northeast, Cariboo, and Omineca Regions have the highest percentage of WHAs with disturbance (>70%). The Cariboo Region has the greatest percentage of WHAs with disturbance levels of >50%, with nearly a third of the WHAs having high levels of disturbance (Table 19).

Provincially, roads affect approximately half of all WHAs with a mean disturbance of 22.3% (Table 19, Figure 9). The Kootenay-Boundary, Thompson-Okanagan, Cariboo, and Northeast Regions have the highest percentage of WHAs impacted by roads (78.8% to 94.3%; Table 19). Approximately 20% of WHAs have road disturbance levels of >50%, and the Kootenay-Boundary has the highest percentage of WHAs with high disturbance, with just over two-thirds having road disturbance of >50% (Table 19).

Table 19. Summary of disturbance from cumulative sources and roads in Wildlife Habitat Areas (WHAs) in all regions

Region	% WHAs disturbed	% WHAs with road disturbance	% WHAs with >50% disturbance	% WHAs with >50% road disturbance	Mean disturbance within each WHA	Mean road disturbance within each WHA
West Coast	26.2%	69.7%	0.6%	20.4%	1.3%	24.7%
South Coast	35.3%	66.6%	1.5%	23.8%	3.9%	26.7%
Thompson-Okanagan	52.8%	90.8%	8.3%	54.8%	12.2%	53.9%
Kootenay-Boundary	55.4%	94.3%	9.4%	68.9%	13.6%	64.8%
Cariboo	86.8%	88.6%	32.5%	22.8%	33.1%	29.7%
Skeena	10.6%	30.9%	0.4%	11.4%	1.0%	12.9%
Omineca	75.9%	44.8%	16.1%	2.3%	18.6%	5.5%
Northeast	90.7%	78.8%	5.3%	15.2%	11.8%	22.2%
Provincial total	25.0%	50.1%	2.5%	20.5%	38.9%	22.3%

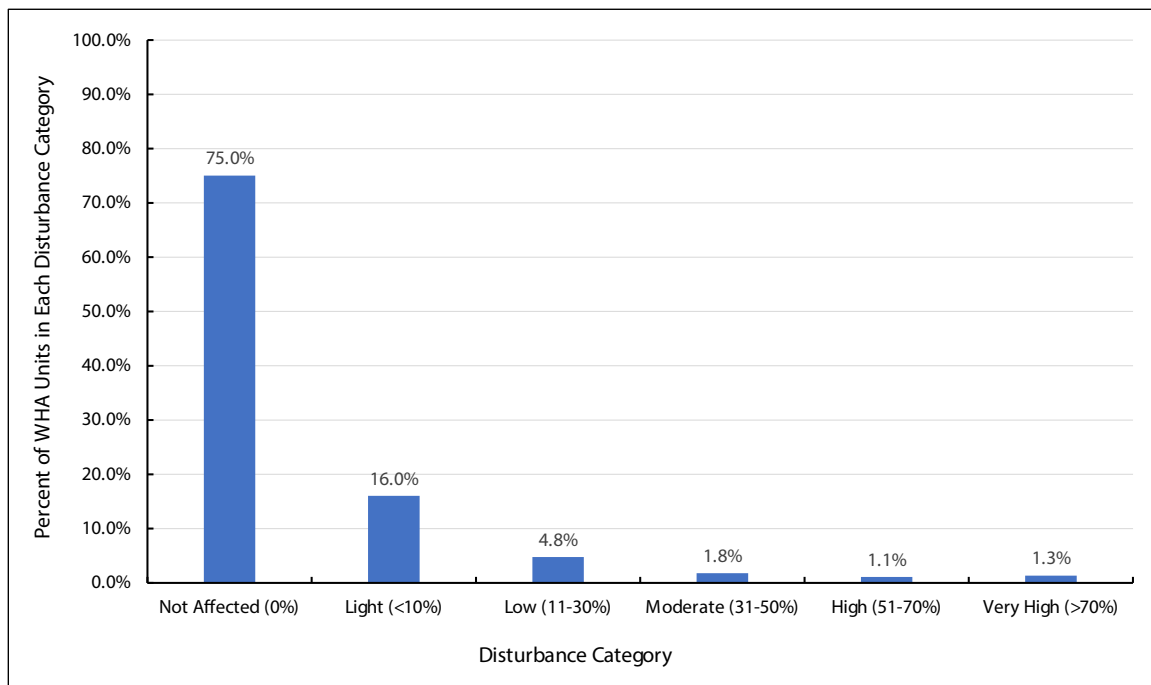


Figure 8. Percent of Wildlife Habitat Areas (WHAs) in each disturbance category (not including roads).

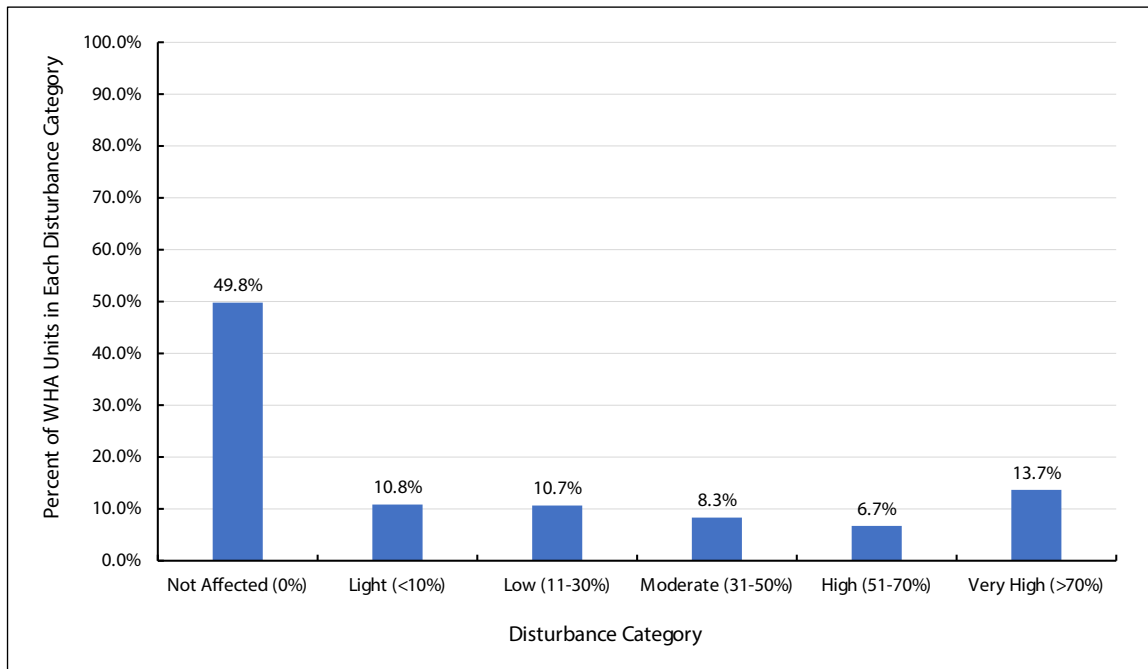


Figure 9. Percent of Wildlife Habitat Areas (WHAs) in each disturbance category for road disturbance only.

Disturbance factors in Wildlife Habitat Areas

No distinct patterns of disturbance type in WHAs are evident when these data are pooled, as species impacts are not evident at a provincial scale (Figure 10). Forest harvesting appears to have the largest overall impact on WHAs. When ranking the disturbed WHA units, the highest disturbance categories are insect-induced tree mortality, harvesting, and urban/agricultural development (Table 20). These disturbances affect many wildlife species including, but not limited to, grizzly bears, William’s Sapsucker, fisher, and spotted owl (Table 20).

Roads potentially have a far greater impact on WHA units than other disturbances. A total of 307 WHA units have road disturbance and influence in 100% of their area as opposed to cumulative disturbance where only 15 WHAs units have 100% of their area impacted by disturbance (Table 21). Roads impact many species, from Gillette’s checkerspot to grizzly bear (Table 21).

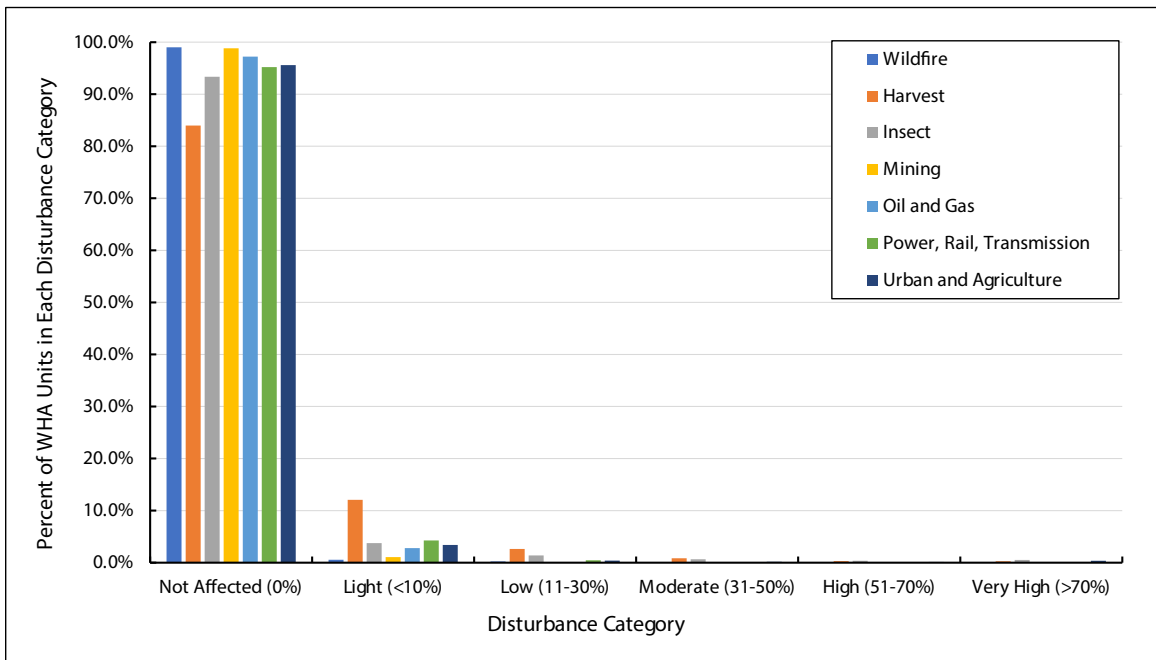


Figure 10. Percent area affected by different forms of land use or natural disturbance for 116 conditional harvest Wildlife Habitat Areas (WHAs).

Table 20. Summary of anthropogenic and natural disturbances for the 30 most affected Wildlife Habitat Areas (WHAs) ordered by total percent disturbed

Region	WHA No.	Species Common Name	Timber Harvest Code	WHA Area (Ha)	Wildfire (Med.- High Burn Severity) Area (%)	Area Harvested after 1995 (%)	Severe (>30% Tree mortality) Insect Attack (%)	Mining (%)	Oil and gas Development (%)	Power lines, Rail, or other Right-of-ways (%)	Urban, Agricultural or Recreation Uses (%)	Total Percent Disturbance	Percent (%) Area affected by Road
Northeast	9-097	Fisher	No Harvest Zone	37.5	0.0	0.0	99.4	0.0	3.5	0.0	0.0	100.0	0.9
Kootenay Boundary	4-231	Gillette's Checkerspot	Conditional Harvest Zone	1.47	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
Kootenay Boundary	8-374	Data sensitive	No Harvest Zone	3.38	0.0	0.0	0.0	0.0	9.2	0.0	90.8	100.0	100.0
Skeena	6-282	Grizzly Bear	No Harvest Zone	9.39	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	100.0
Thompson-Okanagan	8-003	Grasshopper Sparrow	Conditional Harvest Zone	15.52	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0
Thompson-Okanagan	8-004	Grasshopper Sparrow	Conditional Harvest Zone	12.86	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0
Thompson-Okanagan	8-067	Yellow-breasted Chat	No Harvest Zone	1.49	0.0	0.0	0.0	0.0	0.0	2.7	97.3	100.0	100.0
Thompson-Okanagan	8-130	Yellow-breasted Chat	No Harvest Zone	3.96	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0
South Coast	2-126	Data sensitive	Conditional Harvest Zone	1.48	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	97.3
Cariboo	5-073	Data sensitive	No Harvest Zone	11.63	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	28.6
Northeast	9-179	Data sensitive	No Harvest Zone	65.94	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0
Thompson-Okanagan	3-209	Williamson's Sapsucker	No Harvest Zone	32.24	0.0	15.7	84.3	0.0	0.0	0.0	0.0	100.0	0.0
Thompson-Okanagan	3-210	Williamson's Sapsucker	No Harvest Zone	26.06	0.0	26.6	73.4	0.0	0.0	0.0	0.0	100.0	38.5
Thompson-Okanagan	3-125	Great Basin Spadefoot	No Harvest Zone	19.59	0.0	0.0	99.9	0.0	0.0	0.0	0.0	100.0	69.8
South Coast	2-517	Spotted Owl	Conditional Harvest Zone	42.63	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.5
Thompson-Okanagan	8-348	Antelope_brush/Needle-and-thread grass	No Harvest Zone	16.81	0.0	0.0	0.0	0.0	0.0	1.1	98.9	99.9	100.0
Kootenay Boundary	4-070	Long-billed Curlew	No Harvest Zone	58.89	0.0	0.0	0.0	0.0	0.0	1.0	98.6	99.6	81.5
Kootenay Boundary	8-055	Data sensitive	Conditional Harvest Zone	19.84	0.0	0.0	0.0	0.0	6.0	0.0	93.6	99.6	100.0
Cariboo	5-874	Badger	Conditional Harvest Zone	27.18	0.0	99.3	0.3	0.0	0.0	0.0	0.0	99.6	82.1
Thompson-Okanagan	3-131	Williamson's Sapsucker	No Harvest Zone	37.93	0.0	12.1	87.3	0.0	0.0	0.1	0.0	99.5	9.0
West Coast	7-090	Northern Caribou	No Harvest Zone	375.55	0.0	0.0	99.3	0.0	0.0	0.0	0.0	99.3	0.1
Kootenay Boundary	4-126	Lewis's Woodpecker	Conditional Harvest Zone	38.48	0.0	0.0	0.0	0.0	0.0	0.0	99.2	99.2	99.4
South Coast	2-512	Pacific Tailed Frog	No Harvest Zone	6.89	0.0	1.0	98.1	0.0	0.0	0.0	0.0	99.1	30.8
Northeast	9-008	Mountain Goat	Conditional Harvest Zone	47.61	0.0	0.0	98.7	0.0	0.4	0.0	0.0	99.1	0.0
Thompson-Okanagan	3-202	Williamson's Sapsucker	No Harvest Zone	48.62	0.0	85.9	12.8	0.0	0.0	0.0	0.0	98.7	36.0
South Coast	2-126	Data sensitive	Conditional Harvest Zone	2.79	0.0	98.6	0.0	0.0	0.0	0.0	0.0	98.6	100.0
Northeast	9-046	Northern Caribou	No Harvest Zone	117.45	0.0	0.0	97.7	0.0	0.5	0.0	0.0	98.1	1.0
Kootenay Boundary	4-028	Data sensitive	No Harvest Zone	2.1	0.0	0.0	98.1	0.0	0.0	0.0	0.0	98.1	74.8
Kootenay Boundary	4-065	Long-billed Curlew	No Harvest Zone	67.77	0.0	0.0	0.0	0.0	0.0	0.0	97.3	97.3	99.6
Thompson-Okanagan	8-235	Yellow-breasted Chat	No Harvest Zone	5.67	0.0	0.0	0.0	0.0	0.0	2.3	94.4	96.7	100.0

Table 21. Summary of road disturbances for the 30 most affected Wildlife Habitat Areas (WHAs) ordered by total percent disturbed

Region	WHA No.	HABITAT_AREA_ID	Species Common Name	Timber Harvest Code	WHA Area (Ha)	Wildfire (Med.-High Burn Severity) Area (%)	Area Harvested after 1995 (%)	Severe (>30% Tree mortality) Insect Attack (%)	Mining (%)	Oil and gas Development (%)	Power lines, Rail, or other Right-of-Ways (%)	Urban, Agricultural or Recreation Uses (%)	Total Percent (%) Disturbance	Percent (%) Area affected by Road
Kootenay Boundary	4-231	990100	Gillette's Checkerspot	Conditional Harvest Zone	1.47	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
Kootenay Boundary	8-374	987628	Data sensitive	No Harvest Zone	3.38	0.0	0.0	0.0	0.0	9.2	0.0	90.8	100.0	100.0
Skeena	6-282	989400	Grizzly Bear	No Harvest Zone	9.39	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	100.0
Thompson-Okanagan	8-003	990257	Grasshopper Sparrow	Conditional Harvest Zone	15.52	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0
Thompson-Okanagan	8-004	990258	Grasshopper Sparrow	Conditional Harvest Zone	12.86	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0
Thompson-Okanagan	8-067	986089	Yellow-breasted Chat	No Harvest Zone	1.49	0.0	0.0	0.0	0.0	0.0	2.7	97.3	100.0	100.0
Thompson-Okanagan	8-130	986433	Yellow-breasted Chat	No Harvest Zone	3.96	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0
Thompson-Okanagan	8-348	987365	Antelope_brush/Needle-and-thread grass	No Harvest Zone	16.81	0.0	0.0	0.0	0.0	0.0	1.1	98.9	99.9	100.0
Kootenay Boundary	8-055	986102	Data sensitive	Conditional Harvest Zone	19.84	0.0	0.0	0.0	0.0	6.0	0.0	93.6	99.6	100.0
South Coast	2-126	987042	Data sensitive	Conditional Harvest Zone	2.79	0.0	98.6	0.0	0.0	0.0	0.0	0.0	98.6	100.0
Thompson-Okanagan	8-235	987143	Yellow-breasted Chat	No Harvest Zone	5.67	0.0	0.0	0.0	0.0	0.0	2.3	94.4	96.7	100.0
Thompson-Okanagan	3-033	987248	Western Screech Owl	No Harvest Zone	6.28	0.0	0.0	0.0	0.0	0.0	0.0	92.7	92.7	100.0
Kootenay Boundary	4-039	986331	Data sensitive	No Harvest Zone	0.75	0.0	0.0	0.0	0.0	0.0	0.0	92.0	92.0	100.0
Kootenay Boundary	4-098	986409	Western Screech Owl	Conditional Harvest Zone	11.19	0.0	91.7	0.0	0.0	0.0	0.0	0.0	91.7	100.0
Kootenay Boundary	4-066	986277	Long-billed Curlew	No Harvest Zone	55.35	0.0	2.1	0.0	0.0	0.0	0.0	84.9	87.0	100.0
West Coast	1-037	985930	Douglas-fir/Garry oak-oniongrass	No Harvest Zone	3.09	0.0	0.0	0.0	0.0	0.0	0.0	86.1	86.1	100.0
Kootenay Boundary	4-039	986332	Data sensitive	Conditional Harvest Zone	0.33	0.0	0.0	0.0	0.0	0.0	0.0	81.8	81.8	100.0
Thompson-Okanagan	3-075	987216	Lewis's Woodpecker	No Harvest Zone	31.06	0.0	0.0	0.0	0.0	0.0	3.2	76.4	79.6	100.0
Skeena	6-282	989723	Grizzly Bear	No Harvest Zone	17.34	0.0	79.4	0.0	0.0	0.0	0.0	0.0	79.4	100.0
Kootenay Boundary	4-230	990099	Gillette's Checkerspot	Conditional Harvest Zone	4.71	0.0	79.0	0.0	0.0	0.0	0.0	0.0	79.0	100.0
Kootenay Boundary	4-205	992222	Western Screech Owl	No Harvest Zone	7.8	0.0	0.0	0.0	0.0	0.0	0.0	79.0	79.0	100.0
Thompson-Okanagan	8-071	986093	Yellow-breasted Chat	No Harvest Zone	1.48	0.0	0.0	0.0	0.0	0.0	0.0	75.7	75.7	100.0
Kootenay Boundary	8-354	990183	Williamson's Sapsucker	No Harvest Zone	36.25	0.0	75.3	0.0	0.0	0.0	0.0	0.0	75.3	100.0
Skeena	6-282	989425	Grizzly Bear	No Harvest Zone	2.33	0.0	73.0	0.0	0.0	0.0	0.0	0.0	73.0	100.0
Kootenay Boundary	8-374	987629	Data sensitive	No Harvest Zone	17.17	0.0	0.0	0.0	0.0	1.3	0.6	70.8	72.7	100.0
Thompson-Okanagan	8-396	990202	Williamson's Sapsucker	No Harvest Zone	24.95	0.0	0.7	67.0	0.0	0.0	0.0	0.0	67.7	100.0
South Coast	2-525	987880	Spotted Owl	Conditional Harvest Zone	11.1	0.0	0.0	0.0	0.0	0.0	21.8	43.2	65.0	100.0
Thompson-Okanagan	8-336	990260	Great Basin Spadefoot	Conditional Harvest Zone	83	0.0	0.0	0.0	0.0	0.0	1.5	63.3	64.9	100.0
South Coast	2-250	987914	Stickleback	Conditional Harvest Zone	2.31	0.0	64.5	0.0	0.0	0.0	0.0	0.0	64.5	100.0

Co-location of Wildlife Habitat Areas and Old Growth Management Areas

The area of overlap between WHAs and OGMA is 344,832 ha (190,925 legal and 153,907 non-legal) or about 7.0 % of the province (Table 22). The West Coast Region had the highest percent overlap of WHAs and spatial OGMA at 26.7%, followed by the Skeena Region at 16.1%, and the South Coast Region at 12.4% (Table 22).

Table 22. Summary of overlap between legal and non-legal Old Growth Management Areas (OGMAs) and Wildlife Habitat Areas (WHAs) by natural resource region

Region name	No. of WHAs	WHA area (ha)	# WHAs with OGMA overlap		Area of OGMA and WHA overlap (ha)		Percent OGMA and WHA overlap	
			Legal	Non-legal	Legal	Non-legal	Legal	Non-legal
Cariboo	114	660,620.7	70	0	38,175.2	0.0	5.8%	0.0%
Kootenay-Boundary	437	649,620.1	0	198	0.0	59,980.7	0.0%	9.2%
Northeast	151	962,796.9	25	0	7,226.7	0.0	0.8%	0.0%
Omineca	87	408,969.5	16	0	28,431.3	0.0	7.0%	0.0%
Skeena	3883	451,624.2	463	47	72,268.0	386.9	16.0%	0.1%
South Coast	860	264,373.0	381	77	31,175.6	1,276.1	11.8%	0.5%
Thompson-Okanagan	400	1,480,097.9	19	124	494.8	85,076.4	0.0%	5.7%
West Coast	846	76,214.8	142	75	13,153.3	7,186.8	17.3%	9.4%
Total	6,778	4,954,317.3	1,116	521	190,924.9	153,906.8	3.9%	3.1%

Conservation Lands

Conservation Lands summary

A total of 1,038 areas designated as Conservation Lands cover 905,990 ha in the province. Conservation Lands include 32 Wildlife Management Areas (WMAs) covering 253,645 ha, 715 other administered lands covering 24,721 ha, and 291 non-administered lands covering 627,544 ha (Table 23). Habitat enhancement projects with Ducks Unlimited Canada outside those lands cover an additional 8,300 ha.

Table 23. Total number and area (ha) of Conservation Lands in each region

Region	Conservation Land type	N	Area (ha)	% Area
West Coast	Wildlife Management Areas	7	3,737.0	10.3
	other administered lands	85	2,537.2	1.8
	non-administered lands	38	11,396.2	1.5
South Coast	Wildlife Management Areas	11	35,306.8	12.1
	other administered lands	40	2,983.0	0.03
	non-administered lands	4	217.9	13.9
Thompson-Okanagan	Wildlife Management Areas	5	13,829.8	5.5
	other administered lands	70	2,391.8	9.7
	non-administered lands	85	36,202.4	5.8
Kootenay-Boundary	Wildlife Management Areas	5	76,631.3	30.2
	other administered lands	10	10,762.7	43.5
	non-administered lands	49	453,546.6	72.8
Skeena	Wildlife Management Areas	1	122,595.8	48.3
	other administered lands	10	303	1.2
	non-administered lands	7	4,599.3	0.73
Cariboo	Wildlife Management Areas	1	716.1	0.28
	other administered lands	24	2,783.7	11.3
	non-administered lands	23	6,496.6	1.0
Omineca	Wildlife Management Areas	2	828.3	0.33
	other administered lands	25	484.7	2.0
	non-administered lands	44	21,224.5	3.4
Northeast	Wildlife Management Areas	0	0	0
	other administered lands	21	2,475.1	10.0
	non-administered lands	40	93,860.3	15.0
Total	Wildlife Management Areas	32	253,645.1	28.0
	other administered lands	715	24,721.2	2.7
	non-administered lands	291	627,543.6	69.3
	Total	1038	905,909.9	

Figure 11 shows the distribution of Conservation Lands across the province.

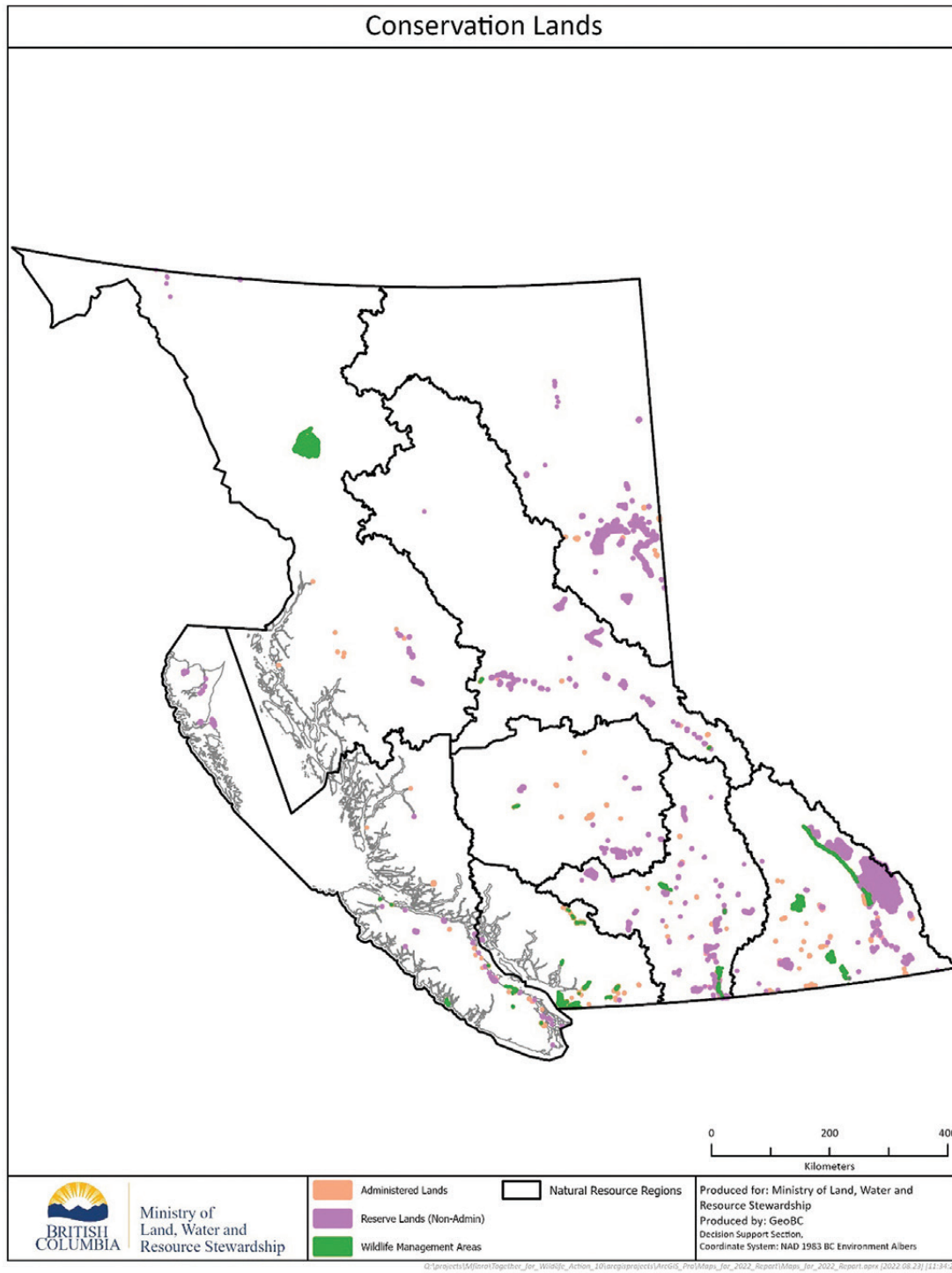


Figure 11. Distribution of Conservation Lands in British Columbia.

Disturbances in Conservation Lands

Provincially, over 60% of all Conservation Lands (CLs) have disturbance within their boundaries. Wildlife Management Areas (WMAs) are most affected by disturbance, with over 90% of all WMAs having some form of disturbance within their boundaries. Approximately 85.6% of all CLs are impacted by roads, with 80.6% of other administered lands, and 100% of non-administered lands and WMAs having impacts from roads. Approximately 20% of CLs have disturbance levels of >50%, while just over 60% of CLs have road disturbance of >50%. The mean disturbance within each CL is 23.2% and the mean road disturbance within each CL is approximately 60%. Overall, 1.8% of CLs have disturbance levels of >50%. The region with the highest mean disturbance in all CLs is the South Coast at 46.9%, while the West Coast and Thompson-Okanagan have the highest mean road disturbance at 71.6% and 81.0%, respectively (Table 24).

Most CLs have an overall disturbance level of <30% (Figure 12). After roads, urban and agriculture developments have the largest impact on Conservation Lands (Figures 13, 14, and 15).

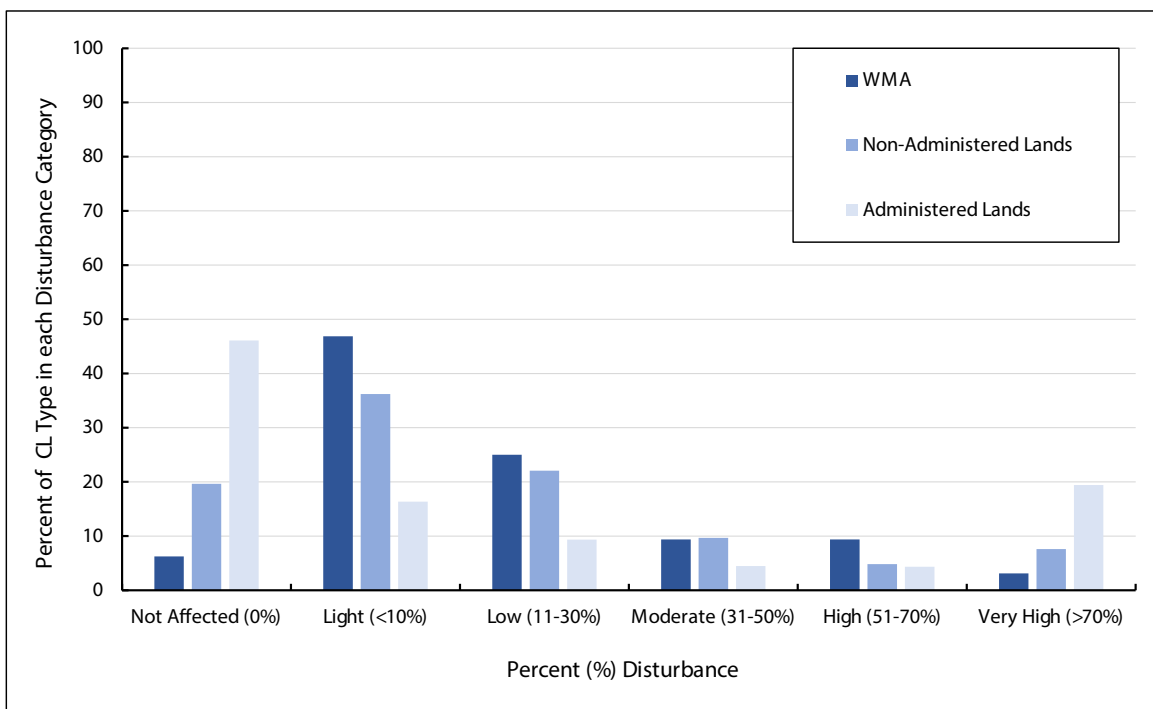


Figure 12. Percent of area affected by disturbance for Wildlife Management Areas (WMAs), other administered lands, and non-administered lands.

Table 24. Summary of disturbance from cumulative sources and roads on Conservation Lands in each region

Region	Conservation Land Type	% Of CLs Disturbed	% Of CLs with Road Disturbance	% Of CLs with >50% Disturbance	% Of CLs with >50% Road Disturbance	Mean Disturbance Within Each CL	Mean Disturbance from Roads Within Each CL
Cariboo	Administered Lands	87.5%	87.5%	12.5%	33.3%	24.7%	43.7%
	Non-Administered Lands	91.7%	100.0%	45.8%	50.0%	42.8%	51.5%
	Wildlife Management Area	100.0%	100.0%	100.0%	100.0%	52.8%	63.4%
	Total	89.6%	93.8%	31.3%	43.8%	34.0%	47.8%
Kootenay Boundary	Administered Lands	43.1%	74.8%	18.6%	60.1%	20.1%	56.4%
	Non-Administered Lands	79.6%	98.0%	10.2%	67.3%	20.0%	65.3%
	Wildlife Management Area	100.0%	100.0%	0.0%	0.0%	5.3%	24.1%
	Total	47.3%	77.4%	17.6%	60.2%	20.0%	56.9%
NorthEast	Administered Lands	81.0%	76.2%	38.1%	23.8%	36.8%	32.4%
	Non-Administered Lands	92.5%	97.5%	5.0%	20.0%	11.1%	36.9%
	Wildlife Management Area	NA	NA	NA	NA	NA	NA
	Total	88.5%	90.2%	16.4%	21.3%	20.0%	35.4%
Omenica	Administered Lands	56.0%	100.0%	8.0%	80.0%	10.8%	82.1%
	Non-Administered Lands	86.4%	88.0%	18.2%	64.0%	20.1%	40.9%
	Wildlife Management Area	100.0%	100.0%	0.0%	0.0%	26.9%	62.1%
	Total	76.1%	95.8%	14.1%	53.5%	17.0%	56.0%
Skeena	Administered Lands	50.0%	80.0%	30.0%	60.0%	32.7%	63.9%
	Non-Administered Lands	85.7%	100.0%	0.0%	42.9%	10.9%	49.6%
	Wildlife Management Area	100.0%	100.0%	0.0%	100.0%	11.3%	56.3%
	Total	66.7%	88.9%	16.7%	50.0%	22.4%	54.9%
South Coast	Administered Lands	72.5%	80.0%	47.5%	45.0%	46.1%	54.0%
	Non-Administered Lands	25.0%	75.0%	0.0%	0.0%	0.03%	16.7%
	Wildlife Management Area	100.0%	100.0%	18.2%	18.2%	23.5%	32.0%
	Total	74.5%	8.4%	38.2%	36.4%	38.2%	46.9%
Thompson-Okanagan	Administered Lands	82.9%	100.0%	38.6%	95.7%	40.8%	88.4%
	Non-Administered Lands	78.8%	100.0%	11.8%	81.2%	19.4%	76.9%
	Wildlife Management Area	100.0%	100.0%	20.0%	18.2%	25.8%	46.4%
	Total	81.3%	100.0%	23.8%	86.3%	29.0%	81.0%
West Coast	Administered Lands	61.2%	82.4%	29.4%	78.8%	29.4%	75.8%
	Non-Administered Lands	75.3%	98.8%	5.9%	52.9%	11.0%	64.5%
	Wildlife Management Area	100.0%	100.0%	0.0%	0.0%	7.0%	58.7%
	Total	62.3%	91.5%	20.0%	74.6%	22.8%	71.6%
Total	Administered Lands	53.8%	80.6%	23.6%	63.8%	25.2%	61.6%
	Non-Administered Lands	80.4%	100.0%	12.7%	57.4%	18.8%	58.8%
	Wildlife Management Area	93.8%	100.0%	12.5%	34.4%	17.8%	40.8%
	Total	62.5%	85.9%	20.2%	61.1%	23.2%	60.2%

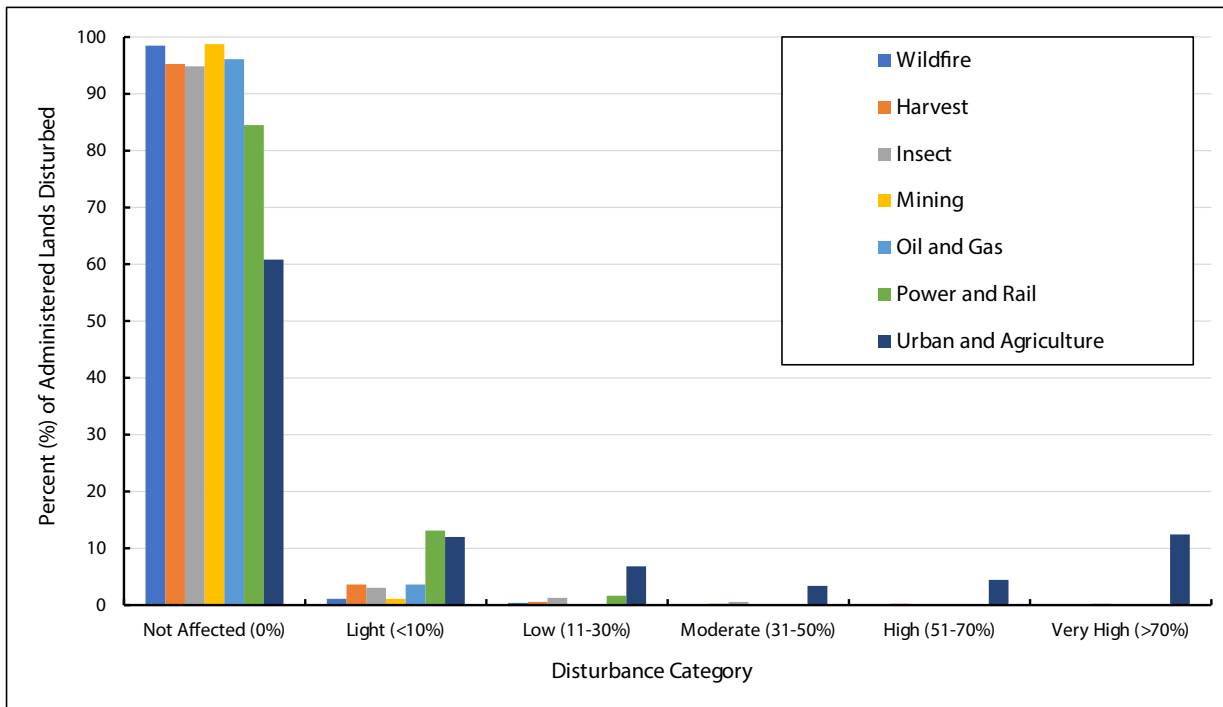


Figure 13. Percent area affected by different forms of land use or natural disturbance for all other administered lands.

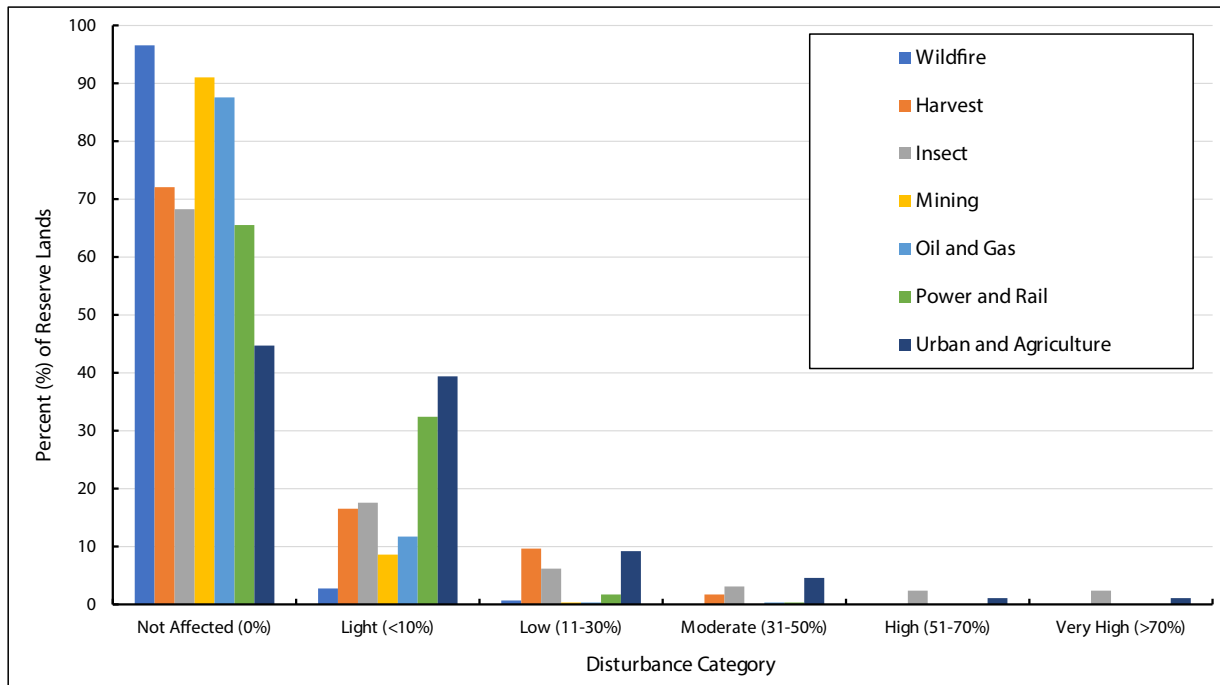


Figure 14. Percent area affected by different forms of land use or natural disturbance for all non-administered lands.

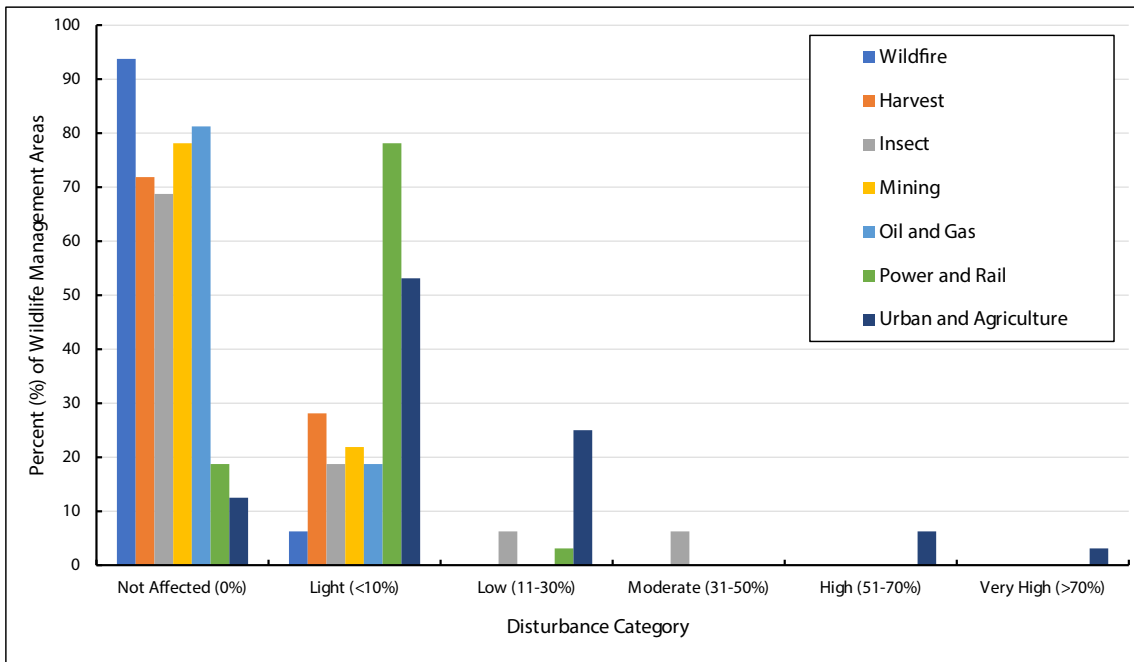


Figure 15. Percent area affected by different forms of land use or natural disturbance for all Wildlife Management Areas (WMAs).

Co-location of Conservation Lands and Old Growth Management Areas

Spatial overlap between Conservation Lands and legal and non-legal OGMA is limited to WMAs in two regions. One WMA in the Cariboo Region has approximately 92.6% area overlap with a legal OGMA covering 663 ha, while non-legal OGMA overlap amongst WMAs in the Kootenay-Boundary Region occurs on 10,606 ha or approximately 13.8% of WMAs in that region (Table 25).

Table 25. Summary of overlap between spatial legal and non-legal Old Growth Management Areas (OGMAs) and Wildlife Management Areas (WMAs) by natural resource region

Region name	Conservation land type	Cons. land area (ha)	No. cons. lands	Legal OGMA		Non-legal OGMA	
				Area of OGMA overlap (ha)	Percent OGMA overlap	Area of OGMA overlap (ha)	Percent OGMA overlap
Cariboo	WMA	716.1	1	663.1	92.6	0.0	0.0
Kootenay-Boundary	WMA	76,631.3	5	0.0	0.0	10,606.2	13.8

DISCUSSION

This report summarizes the impacts of various disturbance on three types of habitat designation in British Columbia: wildlife habitat areas, ungulate winter ranges and conservation lands. Impacts to these designations varied, with disturbance other than roads occurring within $\geq 25\%$ of the boundaries of these designations. The potential amount of disturbance from roads are greater, with $\geq 50\%$ of these designations having road disturbance.

The greatest source of disturbance for UWRs is insect-induced tree mortality, affecting habitat designations for caribou, mule deer, and moose. Roads also affect UWRs for a variety of ungulate species and may have an overall greater impact. The major sources of disturbance for WHAs are forest harvesting post-1995, insect-induced tree mortality, urban/agricultural, recreation development, and roads, with roads. Roads¹⁰ have a far greater impact on WHA units than other disturbances.

This analysis did not account for other potential disturbances adjacent or surrounding designations that may impact the effectiveness of these habitats. These adjacent disturbances can result in edge effects, impact movement corridors, and ultimately reduce the function and effectiveness of these designations. This is especially true for species such as spotted owls (Franklin and Gutierrez 2002, Dugger et al. 2015) and more common species such as Sitka deer (Kirchoff 1994). Species dependent on older forests for nesting or winter survival (e.g., snow interception canopy cover for ungulates) can be disproportionately impacted because habitat designations may be too small to meet species requirements for long-term survival because of increased predation, impacts from invasive species, reduced forage availability, and other edge-induced effects on the functioning of the designations. Ungulate Winter Ranges for black-tailed deer in the Chilliwack Natural Resource District are one example of how disturbance outside habitat designations can affect the functionality of these areas (Figure 16). While there is little forest harvest within these UWRs, harvesting has occurred outside of the winter ranges which may impact their functioning by reducing available habitat on the surrounding land base, especially if individual winter ranges are too small to function as snow interception and security cover and cannot meet the life requisites of the species.

Not all landscape disturbances have negative impacts on all wildlife. Conservation lands with contributing agricultural disturbances may have their boundaries purposefully established to include these agricultural activities in an effort to conserve particular species which benefit in agricultural habitats such as some species of wading birds (BC/NTBC Joint Conservation Land Management Program 2021). In addition, disturbances such as wildfire and forest harvesting create early seral vegetation, and benefits grizzly bears by increasing berry production, a critical high energy food source that correlates positive to bear densities (McLellan 2015).

There are limitations with the analysis that require consideration before applying the results:

- The disturbance analysis other than roads was only calculated within the boundaries of the designations. No analysis of cumulative disturbance was conducted on the landscape surrounding the designations. Disturbance adjacent to habitat designations can have substantial impacts on the functioning of the designations.
- Not all disturbances may influence habitat equally. For example, roads will have a different impact than insects on wildlife habitats, and the impacts of each disturbance type will not be equivalent across all species.
- This analysis was conducted at a provincial and regional scale and significant localized impacts on a watershed or individual designation scale may not be appropriately represented. Localized impacts may have disproportionate effects to habitat functionality for some species greater than the area disturbed in this broader analysis suggests.

¹⁰ The potential impact from roads is mostly from the buffering effect of 500m for highways and major roads, and 150m for resource roads.

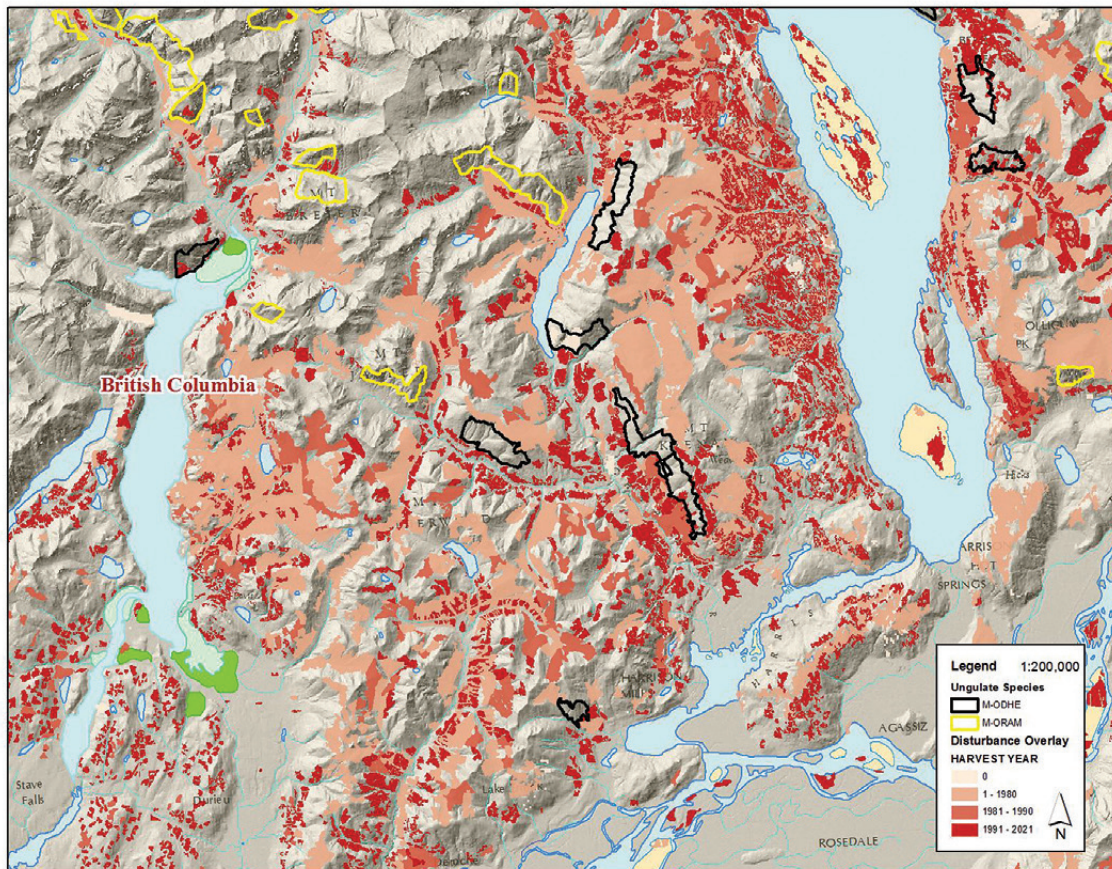


Figure 16. An example of forest harvest relative to black-tailed deer (black outline) and mountain goat winter ranges (yellow outline) in the Chilliwack Natural Resource District.

- This analysis is limited to data layers that reside in the BC Geographic Warehouse, and some disturbances (e.g., from trails and recreation) may not be mapped to the extent that they exist on the landscape and are thus not reflected in the results. The ecological impacts from invasive species, grazing, windthrow or untenured trail building, and recreation can significantly affect habitat functioning and are not reflected in the results.
- The analysis provides a coarse-scale examination of disturbance within the boundaries of the habitat designations assessed. In some cases, there were location errors, therefore a more detailed analysis is required at smaller spatial scales for evaluation and planning using a combination of higher resolution spatial layers (e.g., district road layers). Field verification of analytical results will be required in a subset of the habitat designations in the future.
- The disturbance analysis versus road analysis were calculated and reported separately. A problem arises where a designation could have the confounding and cumulative effects of adjacent roads along with disturbance within the boundary of the designation. This needs to be considered when conducting and designing on-the-ground effectiveness evaluations whereby the impacts from a given disturbance must also consider potential impacts from adjacent roads.
- Many wildlife habitat designations do not preclude disturbance, whether natural or anthropogenic, and thus some disturbances should be expected within some designations, and we did not assess the legality of anthropogenic disturbances within habitat designation.
- Assessing the effectiveness of those designations will require additional data and information on the intent of habitat designations with regards to managing disturbance, and on wildlife sensitivities to various disturbance types.

An impact rating was applied for the percent disturbance within habitat designations in an attempt to classify the impacts the disturbance has on a species' habitat. For example, many of the UWRs contain high-quality core winter habitat, and perturbations to these winter ranges, whether within or outside these designations, can have significant effects on the functioning of these areas. Nietvelt et al. (2018) examined mountain goat winter ranges that had been burned to varying degrees of severity and area. These authors found that when forest patch size declined (a surrogate for snow interception cover and forage), mountain goat abundance and use also declined significantly. These relationships, similar to the percent of the UWR or WHA area disturbed and how this relates to animal abundance and use, are critical for the management of these designations. Thresholds can then be established, as there will be a limit to the amount of disturbance (as a percent and remaining habitat) a WHA or UWR can withstand before it is no longer functional.

In summary, the analysis provides a coarse-scale examination of disturbance within the boundaries of the provincial habitat designations. The analysis supports some of the goals of Action 10 of the Together for Wildlife Strategy, however, more detailed analysis is required at smaller spatial scales for evaluation and planning purposes. Programs such as FREP, which outlines the provincial approach for examining the effectiveness of UWRs and WHAs can contribute to these additional goals. This includes specific integration of the priority FREP evaluation question, which is:

Do Ungulate Winter Ranges and Wildlife Habitat Areas maintain the habitats, structures and functions necessary to meet the goals of the area and is the amount, quality and distribution of these areas contributing effectively with the surrounding land base (including protected areas and managed land base) to ensure the survival of the species now and over time?

A discussion paper by Erikson et al. (2009) outlines steps for effectiveness evaluations for UWRs and WHAs under FRPA and is invaluable to support the province's goals. The integration of programs and strategies, along with other work being conducted by various organizations and indigenous partners will help refine the stewardship of wildlife habitat in the Province.

SUMMARY OF KEY FINDINGS

Ungulate Winter Ranges (UWRs)

- Ungulate Winter Ranges cover approximately 27,336,825 ha for eight species of ungulates.
- Approximately 12,870,000 ha of this UWR area is allocated to thinhorn sheep, a specified area to prevent disease transmission, which is nearly half (47.1%) of the total UWR area.
- With the specified area removed, the total area of UWRs managed for habitat is 14,466,055 ha.
- Not including the specified area for thinhorn sheep, Stone's sheep account for 25% of the UWR area, followed by boreal and northern caribou at 18.4% and 16.6% respectively, and mule deer at 11.6%. These contribute to 71.6% of the total UWR area in the province.
- The Cariboo Region has the highest amount of disturbance within UWRs (\bar{X} = 35.3%), while the Kootenay-Boundary Region has the highest level of road disturbance (\bar{X} = 56.9%).
- The greatest source of disturbance within UWRs is insect-induced tree mortality, affecting caribou, mule deer, and moose habitat. Roads were also noted as impacting a variety of ungulate species through both direct habitat alienation and secondary disturbance resulting from road use and associated ecological effects.

Wildlife Habitat Areas (WHAs)

- Wildlife Habitat Areas cover 4,949,669 ha for over 57 wildlife species.
- Approximately 46.5% of the total provincial WHAs are allocated to grizzly bear, 20% to northern caribou, 12.5% to data sensitive species, 8.9% to boreal caribou, 5.6% to mountain caribou, and 3.8% to Spotted Owl. These amounts total approximately 97% of the total area of WHAs in BC.
- For WHAs, the Cariboo Region has the highest mean disturbance at 33.1%, while the Thompson-Okanagan and Kootenay-Boundary have the highest mean road disturbance at 53.9% and 64.8%, respectively.
- The Cariboo Region also has the greatest percentage of WHAs with disturbance levels of >50%, with nearly a third (32.5%) of the WHAs having high levels of disturbance.
- The major sources of disturbance for WHAs are forest harvesting post-1995, insect-induced tree mortality, urban/agriculture/recreation development, and roads.
- Roads have a far greater impact on WHAs than other disturbances.

Conservation Lands (CLs)

- Conservation Lands include 32 Wildlife Management Areas covering 253,645 ha, 715 other administered lands covering 24,721 ha, and 291 non-administered lands covering 627,544 ha.
- Of the three types of CLs reported here, non-administered lands cover 69.3% of the total area, followed by Wildlife Management Areas at 28%, and other administered lands at 2.7%.
- The region with the highest mean disturbance in all CLs is the South Coast Region at 46.9%, while the West Coast and Thompson-Okanagan Regions have the highest mean road disturbance at 71.6% and 81.0%, respectively.
- After roads, urban and agriculture development have the largest impact on CLs.

Combined Summary

- Approximately 80.6% of UWRs and 59.0% of WHAs are subject to conditional harvesting (timber extraction).
- Approximately 29.5% of UWRs, 25% of WHAs, and 62.5% of CLs have disturbance other than roads within their boundaries.
- Approximately 16.0% of UWRs, 2.5% of WHAs, and 20.2% of CLs have disturbance levels (other than roads) of >50%.
- Potential disturbance from roads is greater than other forms of disturbance, with 63.9% of UWRs, 50.1% of WHAs, and 85.9% of CLs having disturbance from roads.
- Over half (54.6%) of UWRs, 20.5% of WHAs, and 61.1% of CLs have disturbance levels from roads of >50%.
- Mean disturbance (excluding roads) within the boundaries of these designations is 16.8% for UWRs, 38.9% for WHAs, and 23.2% for CLs.
- Mean levels of disturbance from roads is 54.2% for UWRs, 22.3% for WHAs, and 54.2% for CLs.

RECOMMENDED NEXT STEPS

The disturbance analysis identified areas that require further investigation and follow-up. These should inform priority setting for further detailed assessments. Based on the analysis results, the following next steps are suggested.

1. Confirm and refine an approach for completing a detailed assessment of habitat designations:

- Further assessments should focus on priority areas, designation types, and/or species.
- Disturbance assessments should include areas within specific habitat designations and the potential disturbance outside these designations.
- Prioritize establishing Provincial monitoring and assessment protocols for designations which incorporate various types of disturbance from all natural resource sectors. This will help provide consistent and measurable results and should align with work currently underway with Action 4 and 10 in the Together for Wildlife Strategy, FREP wildlife protocols, and RISC standards.

2. Identify tools to facilitate road management in wildlife habitat designations. Support the development of new tools where they are absent.

- Develop/assess opportunities for new legislative tools to support wildlife habitat management.
- Align priorities with emerging expectations for strengthening monitoring and assessment as part of the ministry restructuring.
- Update FREP wildlife evaluation guidance for UWRs and WHAs.

3. Communicate and apply results of the report to support planning initiatives and in developing policy tools to improve wildlife habitat stewardship:

- Periodically update disturbance analyses as improved disturbance data becomes available.
- Use results to inform current land-use planning discussions and forest landscape planning, and future establishment of habitat designations.
- Ensure appropriate linkages with the Government Action Plan from the Office of the Auditor General regarding the management of Conservation Lands.
- Extend results to ensure alignment with other provincial initiatives and policy development that involve identifying, conserving, and reporting areas for conservation.

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APPENDIX 1. CUMULATIVE EFFECTS FRAMEWORK DEVELOPMENT LAYER GROUPS AND SUBGROUPS

Group - SubGroup Rank	Disturbance Group	Sub Group	Human Disturbance Class
1-1	Mining_and_Extraction	Custom - North Area 2015	Current
1-2	Mining_and_Extraction	Baseline Thematic Mapping	Current
1-3	Mining_and_Extraction	VRI Mining	Current
1-4	Mining_and_Extraction	TRIM Enhanced Base Map	Current
2-1	Rail_and_Infrastructure	Railway BC	Current
2-2	Rail_and_Infrastructure	Railway NEBC	Current
2-3	Rail_and_Infrastructure	VRI Airports	Current
2-4	Rail_and_Infrastructure	TRIM Airfields	Current
3-1	OGC_Infrastructure	Surface Land Use - OGC	Current
4-1	Power	Dams	Current
4-2	Power	Transmission	Current
5-1	ROW	Surveyed ROW	Current
5-2	ROW	Crown ROW	Current
6-1	Urban	Baseline Thematic Mapping	Current
6-2	Urban	VRI Builtup	Current
6-3	Urban	TRIM Enhanced Base Map	Current
7-1	Recreation	BTM - Recreation	Current
8-1	OGC_Geophysical	Surface Land Use - Geophysical	Current
9-1	Cutblocks	Current - FAIB	Current
9-2	Cutblocks	Historic - FAIB	Historic (>20 yrs)
9-3	Cutblocks	Historic - BTM	Historic (>20 yrs)
10-1	Agriculture_and_Clearing	Baseline Thematic Mapping	Current
10-2	Agriculture_and_Clearing	VRI Clearing	Current
11-1	RESULTS_Reserves	RESULTS Reserves	Natural Landbase
12-1	BTM Natural Landbase - Range Lands	BTM - Range Lands	Natural Landbase
12-1	BTM Natural Landbase - Forest Land	BTM - Forest Land	Natural Landbase
12-1	BTM Natural Landbase - Shrubs	BTM - Shrubs	Natural Landbase
12-1	BTM Natural Landbase - Wetlands Estuaries	BTM - Wetlands Estuaries	Natural Landbase
12-1	BTM Natural Landbase - Fresh Water	BTM - Fresh Water	Natural Landbase
12-1	BTM Natural Landbase - Salt Water	BTM - Salt Water	Natural Landbase
12-1	BTM Natural Landbase - Alpine SubAlpine Barren	BTM - Alpine SubAlpine Barren	Natural Landbase
12-1	BTM Natural Landbase - Glaciers and Snow	BTM - Glaciers and Snow	Natural Landbase



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