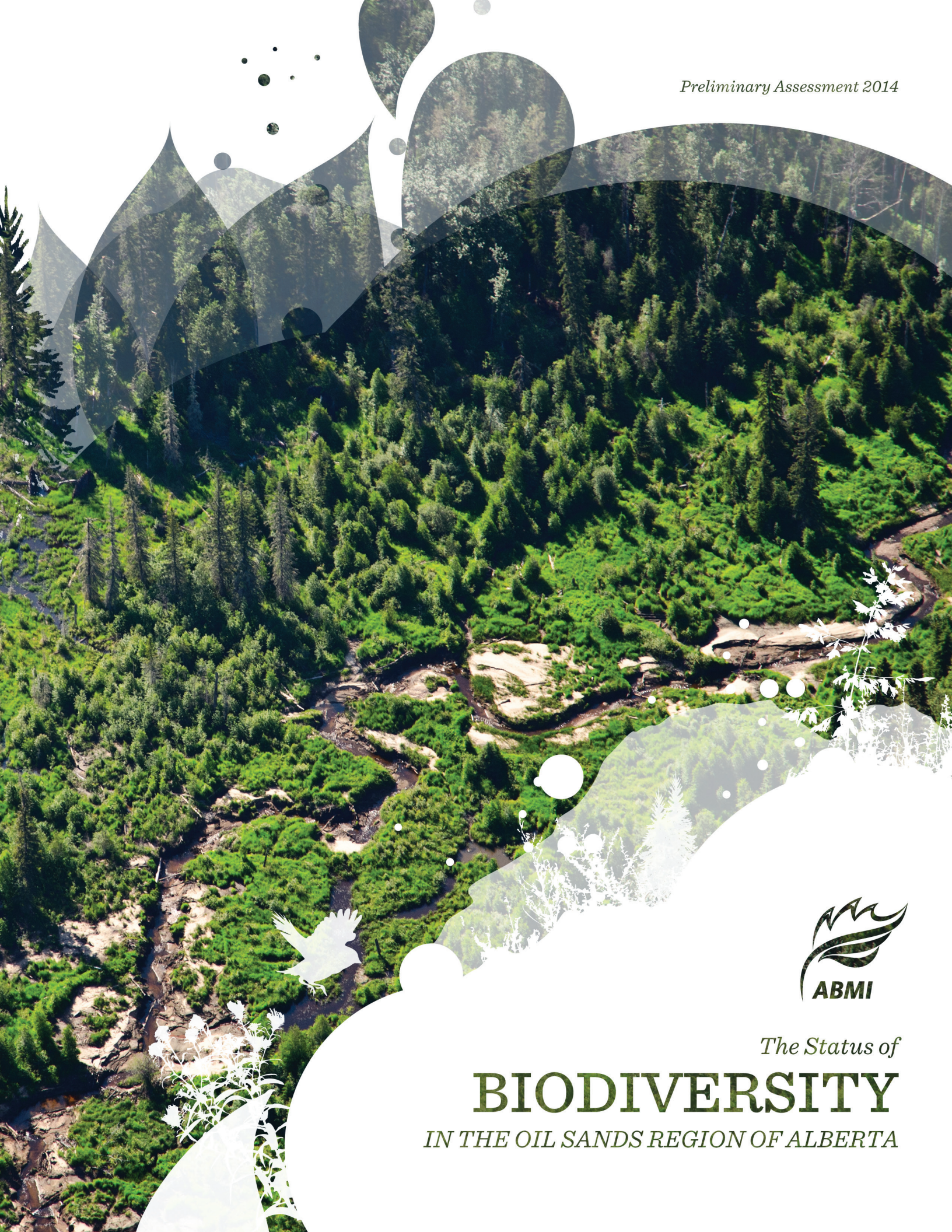
Preliminary Assessment 2014



ABMI

The Status of

BIODIVERSITY

IN THE OIL SANDS REGION OF ALBERTA

THIS REPORT DESCRIBES THE STATUS OF BIODIVERSITY AND HUMAN FOOTPRINT IN THE OIL SANDS REGION OF ALBERTA

In partnership with:

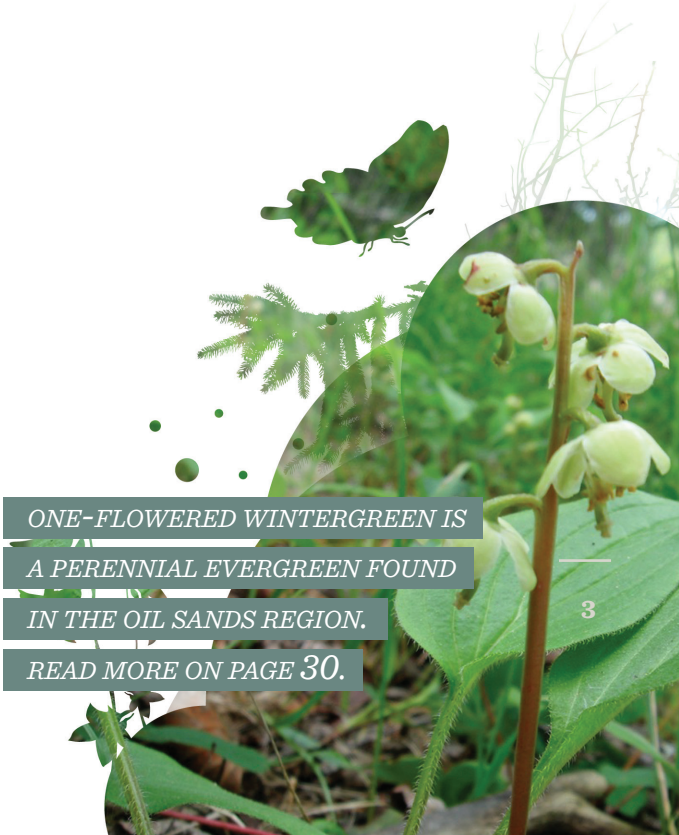
Alberta Innovates

Royal Alberta Museum

University of Alberta

University of Calgary

Contents



ONE-FLOWERED WINTERGREEN IS A PERENNIAL EVERGREEN FOUND IN THE OIL SANDS REGION.
READ MORE ON PAGE 30.

About the ABMI

The Alberta Biodiversity Monitoring Institute (ABMI) is an arm's-length, not-for-profit scientific organization. The business of the ABMI is to monitor and report on the status (current condition) and trends of Alberta's species, habitat, and human footprint.* The goal of the ABMI is to provide relevant scientific information on the state of Alberta's biodiversity to support natural resource and land-use decision making in the province.

The ABMI is jointly delivered by Alberta Innovates - Technology Futures, the Royal Alberta Museum, the University of Alberta, and the University of Calgary. The ABMI Board of Directors includes representatives from the Government of Alberta; environmental non-governmental organizations; the forest, energy, and agriculture sectors; and the research community.

The ABMI reports on a range of biodiversity indicators that act as a guide for establishing biodiversity-related management goals and tracking performance against those goals. Notwithstanding, the ABMI is not a management agency and does not make management recommendations. The ABMI generates value-neutral, independent, and publicly accessible data.

The ABMI is guided by a core set of principles—we are independent, objective, credible, accessible, transparent, and relevant.

*The ABMI defines "human footprint" as the visible conversion of native ecosystems to temporary or permanent residential, recreational, agricultural, or industrial landscapes.

Report Summary

The Alberta Biodiversity Monitoring Institute (ABMI) measures and reports on the state of biodiversity and human footprint across the province. This report presents data on several indicators of environmental health for the Oil Sands Region (OSR) of Alberta, an aggregate of three provincially recognized oil sands administrative units: Athabasca Oil Sands Area, Cold Lake Oil Sands Area, and Peace River Oil Sands Area.

The OSR makes up 21% of Alberta's land area and is similar in size to the State of New York and two times larger than the province of New Brunswick. Multiple ice ages have shaped the topography of the OSR, creating a hilly landscape dotted with numerous shallow lakes and wetlands connected by meandering streams and large rivers. This predominantly forested region is naturally regulated by disturbances like fire and insect outbreaks, which results in a patchy mixture of young and old forest across the landscape. Some areas of the OSR are also covered by the boreal-grassland transition zone known as Aspen parkland. Aspen parkland is a mixture of Aspen and White Spruce groves interspersed with prairie grasslands. Much of the land in the Aspen parkland has been converted to agricultural use.

The ABMI has 350 permanent monitoring sites in the OSR. Between 2003 and 2012, we conducted field surveys at 186 of these sites. At each location, ABMI technicians recorded the species present and measured a variety of habitat characteristics. Between 1999 and 2012, the ABMI also completed a detailed assessment of human footprint for all 350 sites by surveying a 3 x 7 km area around each site using satellite imagery. Finally, a broad characterization of human footprint for the entire region was conducted through the creation of a wall-to-wall human footprint map circa 2007 and 2010 using a variety of data sources.

As of 2012, the total human footprint across the OSR was 13.8%. Covering 7.4% of the OSR, agriculture was the largest human footprint and 2.5 times larger than forestry footprint, which covered 2.9% of the OSR. Energy footprint covered 2.2% of the OSR.

The total area of human footprint in the OSR increased from 11.3% to 13.8% between 1999 and 2012; this represents a 20% change in human footprint over this time. More than half of this increase was driven by the creation of forestry footprint, which increased from 1.8% in 1999 to 3.1% in 2012. Energy footprint increased from 1.6% to 2.3%. Agricultural footprint remained virtually unchanged between 1999 and 2012.

Overall, 86% of the OSR has no direct human footprint, and a total of 6.2% of the OSR is managed as protected areas.

The ABMI assessed the status (current condition) of 425 species in the OSR and found the Biodiversity Intactness Index* to be, on average, 88%. Biodiversity intactness for each species group was:

- *80% for native birds*
- *91% for winter-active mammals*
- *90% for armoured mites*
- *88% for native vascular plants*
- *91% for mosses and liverworts*

Areas of active mining in the Surface Mineable Area north of Fort McMurray have biodiversity intactness values near 0%. Regional biodiversity intactness values are much higher than 0% because the active oil sands mines represent a small portion of the entire OSR.

At present, the biggest ecological changes are associated with the higher abundance of species that thrive in areas with human development, such as the Coyote and Black-billed Magpie.

Additional results of note include:

- Species that prefer old-forest habitat, like Marten and Fisher, Black-throated Green Warbler, and Spreading Woodfern were less abundant than expected.
- A total of 57 non-native vascular plant species were detected in the OSR. Non-native species were detected at 46% of the sites surveyed. At sites where they were found, there were an average of 3.8 non-native species present.
- There are at least 88 species at risk[†] in the OSR. The ABMI detected 74 species at risk, 27 of which occurred with enough frequency to enable the calculation of biodiversity intactness. Of the assessed species, the majority were less abundant than expected.
- Woodland Caribou has the highest public profile of all the species at risk; there are seven caribou populations whose ranges overlap with the OSR. The abundance of Woodland Caribou declined in five of the ranges between 1991 and 2011. Two ranges have insufficient data to assess population trends. In 2010, the total human footprint ranged from a low of less than 1% in the Richardson range to a high of over 7% in the Nipisi population range.
- Living trees and snags (standing dead trees) in the OSR were found to be 88% intact. With the exception of large lowland conifer trees, all categories of living trees and snags were less abundant than expected.
- Downed woody material was 95% intact.

This report describes regional ecological baseline conditions for several components of biodiversity. These findings can be used as a foundation for planning and for evaluating future outcomes of resource management in the OSR. Over the next few years, the ABMI will broaden the assessment of biodiversity in the OSR to include status and trend reporting for lichens and wetlands, and trends for all groups. A detailed assessment of biodiversity is currently available for the Athabasca Oil Sands Area. Detailed assessments will also be available for the Peace River and Cold Lake Oil Sands Areas in the near future.

[*] *The ABMI's Biodiversity Intactness Index is used to report on the status of biodiversity, including birds, winter-active mammals, armoured mites, vascular plants, and mosses and liverworts, within Alberta. The index ranges from 100% intact to 0% intact. An area with little evidence of human impact is nearly 100% intact, whereas a parking lot surrounded by big box stores is nearly 0% intact. The Biodiversity Intactness Index is a measure of how much more or less common a species is relative to its abundance if there were no human footprint present.*

[†] *Threat categories for species at risk as identified by the Government of Canada and/or the Government of Alberta. This assessment includes species identified by Canada's Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered, Threatened, Special Concern, or Data Deficient; Canada's Species at Risk Act (SARA) as Endangered, Threatened, or Special Concern; Alberta's Ministry of Environment and Sustainable Resource Development (ESRD) as May Be at Risk, At Risk, Sensitive, or Undetermined; Alberta's Endangered Species Conservation Committee (AB ESCC) as Endangered, Threatened, Special Concern, Data Deficient, or In Process.*

Introduction

Canada has the third-largest volume of proven oil reserves in the world. Ninety-seven percent of these reserves are found in three oil sands deposits located primarily in Alberta. They are the Peace River deposit, the Athabasca deposit, and the Cold Lake deposit, all overlaid by administrative boundaries, or Oil Sands Areas, of the same name (Figure 01). These areas contain an estimated 1.84 trillion barrels of crude bitumen (see inset for definition), of which approximately 9% (or 168 billion barrels) can be recovered using current technology. In the Oil Sands Region (OSR), there were 127 operating oil sands projects as of January 2013, with production expected to more than double in the next 10 years.[1]

> *"Oil sands" is a term used to describe geological deposits composed of a mixture of sand and clay saturated with bitumen. Bitumen is a thick, sticky form of crude oil that is similar in consistency to molasses when at room temperature.*

The oil sands industry is a critical component of Alberta's and Canada's economy, and there are several well-publicized environmental concerns related to the development of this resource (e.g., pipeline development and greenhouse gas emissions). But energy development is not the only land-use activity in the OSR. This area also has a robust forest industry, with much of the region managed for timber production. The conventional natural gas industry has also developed alongside the oil sands industry, while agriculture is the dominant land use in some areas. Managing the cumulative effects of all land-use activities is a key management challenge in the OSR.

The Government of Alberta has recently initiated an Integrated Resource Management System to understand and manage the cumulative effects of economic growth.[2] Under this approach, targeted outcomes must be defined and achieved for environmental as well as social and economic values. Two government initiatives figure prominently in the management of environmental values under this Integrated Resource Management System—regional planning through the Land-use Framework and environmental monitoring. The ABMI falls under the umbrella of environmental monitoring. However, the ABMI also supports the Land-use Framework planning process by providing monitoring information and services necessary to report on the performance of regional plans, tracking progress toward environmental outcomes, and ensuring that regional plans are performing as expected.[3]

In this report, we describe the status of species, habitat, and human footprint in the OSR, an aggregate of three administrative units (Figure 01): the Athabasca Oil Sands Area, the Cold Lake Oil Sands Area, and the Peace River Oil Sands Area. We examine the status of hundreds of species and highlight those that show the most sensitivity to human development. Information from this report can be used as a foundation for evaluating the sustainability of resource development in the region.

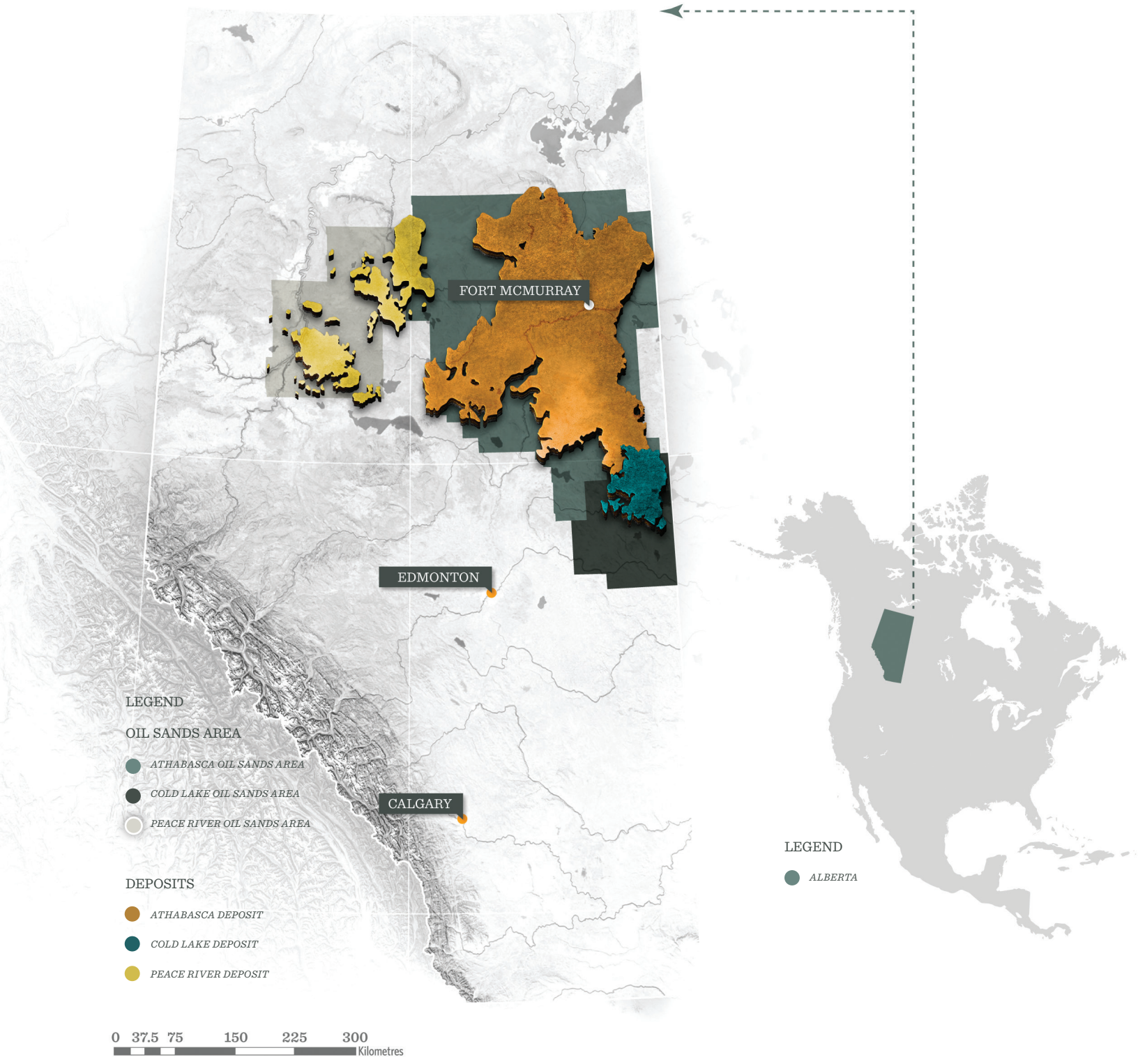


FIGURE 01

THE OSR IN ALBERTA INCLUDES THREE OIL SANDS DEPOSITS OVERLAID BY THREE ADMINISTRATIVE UNITS: PEACE RIVER DEPOSIT OVERLAID BY THE PEACE RIVER OIL SANDS AREA, ATHABASCA DEPOSIT OVERLAID BY THE ATHABASCA OIL SANDS AREA, AND COLD LAKE DEPOSIT OVERLAID BY THE COLD LAKE OIL SANDS AREA.

Why Biodiversity Matters

Biodiversity is the variety of life on Earth—from the multitude of species that live in a drop of water to the vast wildlife that depends on the world's largest ecosystems. While it is not always immediately evident, biodiversity is critical to human health and well-being, providing us with a number of benefits that we often take for granted.

For example, ensuring healthy aquatic ecosystems in our environment is the most cost-effective way of providing a clean and reliable source of drinking water.[4] Productive forest ecosystems grow trees that not only supply our sawmills and pulp mills, but also act as an important storehouse of carbon, which helps to mitigate climate change. Approximately one-third of the fruits and vegetables we buy at the grocery store require pollination by the many insect species that are an important part of biodiversity. In addition, the products we find in our medicine cabinets are often derived from plants. In fact, approximately 25% of the world's bestselling prescription medications are derived from plant-based biodiversity products.[5] And finally, natural areas provide opportunities for hiking, hunting, fishing, and berry picking. Biodiversity is all around us every day, and it plays an enormous role in supporting our way of life.

ABMI Measures Biodiversity

From the boreal forest in the north to the grasslands in the south, the ABMI monitors the state of Alberta's biodiversity. To do this, the ABMI employs a systematic grid of 1,656 site locations, spaced 20 km apart, to collect biodiversity information on terrestrial and wetland sites (Figure 02).

At each location, ABMI technicians record the species that are present, and measure a variety of habitat characteristics. For species that cannot be identified in the field (e.g., mites and lichens), ABMI taxonomists at the Royal Alberta Museum sort, identify, and archive samples to complete the Institute's species-level dataset. Through our field and laboratory efforts, the ABMI tracks over 2,000 species.

The ABMI also monitors the state of Alberta's human footprint and habitat using fine-resolution aerial photography and satellite imagery. Our Geospatial Unit conducts analyses of human footprint at two spatial scales:

For a 3 × 7 km area around each ABMI site location, detailed inventories of human footprint are created using satellite imagery.

At the provincial scale, existing satellite imagery is used to create a wall-to-wall human footprint map of the entire province. This Geographic Information System (GIS) Inventory of Provincial Human Footprint is a compilation of externally sourced information about provincial human footprint, supplemented with ABMI remote sensing data that has undergone ABMI quality-control procedures.

These mapped products are updated at regular intervals to track changes in human footprint and habitat over time.

The ABMI's dataset is used to identify relationships between human land use, habitat, and species abundance. The scale and depth of the ABMI's monitoring program makes us a unique program nationally, and a leader internationally. The ABMI's scientific design and implementation is informed by periodic review by an international Science Advisory Committee consisting of Dr. Reed Noss (University of Central Florida), Dr. Jeremy Kerr (University of Ottawa), Dr. John Reynolds (Simon Fraser University), and Dr. Jari Kouki (University of Eastern Finland).

FIGURE 02

THE ABMI HAS 350 OF OUR 1,656 SURVEY SITES DIRECTLY IN THE THREE OIL SANDS AREAS, INCLUDING 235 SITES IN THE ATHABASCA OIL SANDS AREA, 43 SITES IN THE COLD LAKE OIL SANDS AREA, AND 72 SITES IN THE PEACE RIVER OIL SANDS AREA. HOWEVER, DATA FROM ACROSS THE BOREAL FOREST IS USED TO STRENGTHEN ANALYSIS.

Biodiversity Indicators in This Report

Habitat loss is a major driver of biodiversity decline on the planet.[6] In the OSR, habitat is being modified or lost to the forest industry, energy industry, agriculture industry, and to urban expansion. Responsible development of this region depends on understanding the complex interactions between human footprint, species, and habitat. The ABMI assesses indicators of human footprint, species, and habitat in the following ways.

Species and Habitat Elements

To assess the status of species and habitat elements, the ABMI collects and analyzes data on breeding birds, winter-active mammals, armoured mites, vascular plants, mosses and liverworts, and habitat elements (including trees, snags, and downed woody material). To report on the status of species and habitat elements, the ABMI has developed the Biodiversity Intactness Index. The index ranges from 0% to 100% and is interpreted as follows (see Figure 03 for a visual guide):

If a species or habitat element is 100% intact in a given area, the abundance of the species or habitat element is equal to the abundance one would expect in an area without any human footprint (although natural disturbances still occur).

As the index declines, it reflects one of two possible scenarios. In the first, the species or habitat element abundance is lower relative to an undisturbed area. In other words, the species or habitat element has become more rare. In the second scenario, the species or habitat element is more abundant than expected. In both instances the abundance of the species or element has deviated from an "intact reference condition."

While the ABMI collects data on over 2,000 species throughout the province, intactness can only be calculated for species with at least 20 records in our dataset. In this report, we are able to report on intactness for 425 species. This number will increase as the ABMI surveys more sites in the OSR.

Native Habitat

To assess the status of native habitat, the ABMI uses the GIS Inventory of Provincial Human Footprint. To report on the status of native habitat, we present the per cent area of land cover that has no human footprint, as well as the per cent area that is designated as protected in a region.

Human Footprint

To assess the status of human footprint, the ABMI uses GIS to calculate the percentage of land directly altered by human activities, which is interpreted as follows:

- 0% means there is no visible human footprint.
- 100% means the landscape has been completely modified by human footprint.

In general, cities and cultivated fields have high human footprint, while protected and undeveloped areas have low human footprint. Information related to the entire OSR is based on the detailed 3 × 7 km human footprint data. Data for Caribou populations is calculated using the GIS Inventory of Provincial Human Footprint circa 2007 and 2010.

See the OSR Data Supplement (available at www.abmi.ca) for further details.

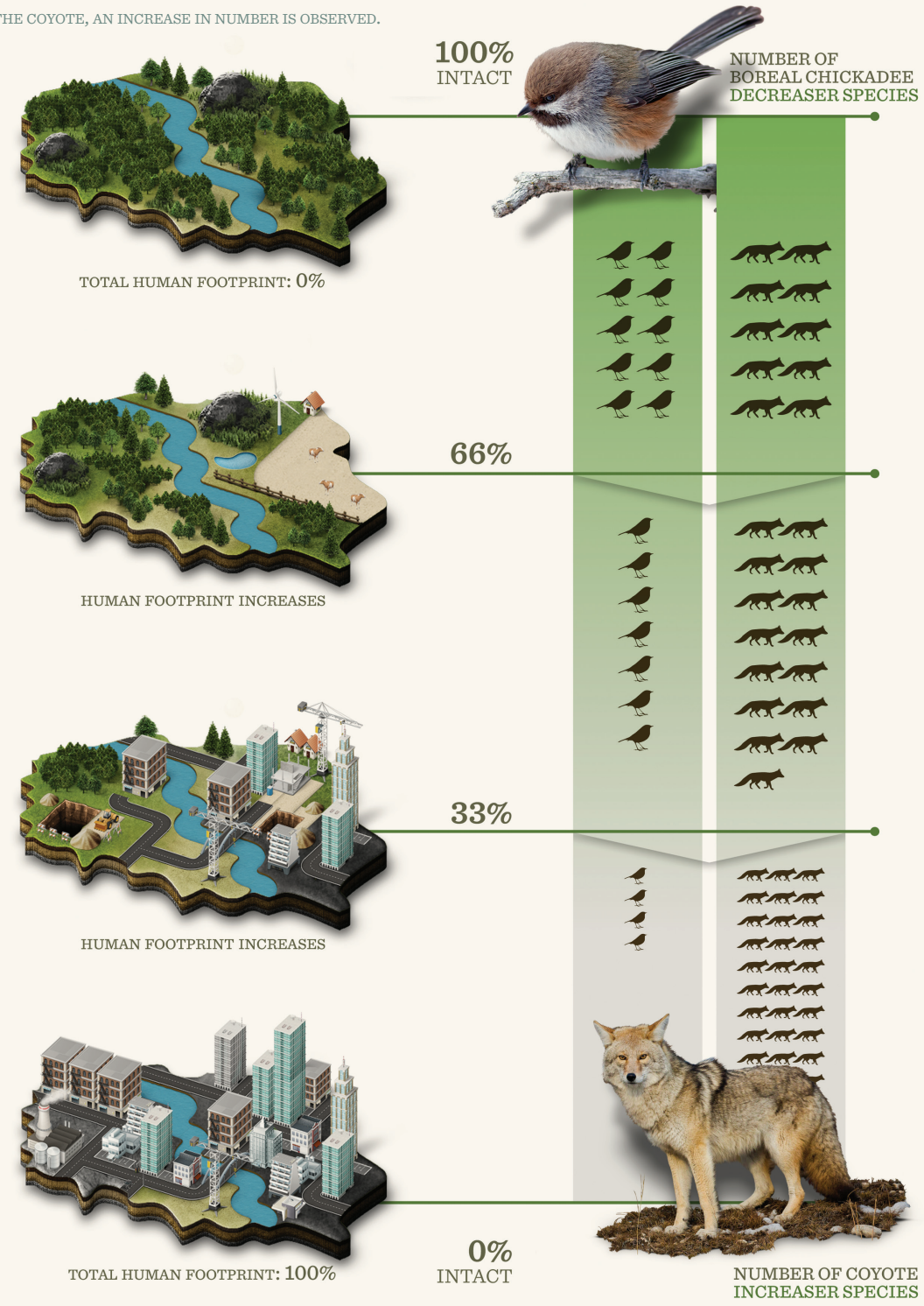
FIGURE 03 THE ABMI BIODIVERSITY INTACTNESS INDEX

THE ABMI USES THE BIODIVERSITY INTACTNESS INDEX TO REPORT ON THE HEALTH OF A SPECIES IN A REGION. IN THIS FIGURE, WE ILLUSTRATE HOW THE INDEX CHANGES FOR:

- A "DECREASER" SPECIES, THE BOREAL CHICKADEE
- AN "INCREASER" SPECIES, THE COYOTE

THE INTACTNESS INDEX RANGES FROM 0% TO 100%. AT 100% INTACT, THE ABUNDANCE OF BOTH SPECIES IS EQUAL TO THE ABUNDANCE EXPECTED IN AN UNDISTURBED AREA—ONE WITH 0% HUMAN FOOTPRINT. AS THE INTACTNESS INDEX DECLINES TOWARD 0%, IT REFLECTS A CHANGE IN THE ABUNDANCE OF A SPECIES IN RESPONSE TO HUMAN FOOTPRINT:

- FOR THE CHICKADEE, A DECREASE IN NUMBER IS OBSERVED.
- FOR THE COYOTE, AN INCREASE IN NUMBER IS OBSERVED.



Reporting Area – Oil Sands Region

The status of biodiversity, habitat, and human footprint in the OSR is the focus of this report. Alberta's OSR is defined as the aggregate of three recognized administrative units that together represent 21% of the province's land area (Figure 04):

- The Athabasca Oil Sands Area
- The Cold Lake Oil Sands Area
- The Peace River Oil Sand Area

MUCH OF THE OSR IS MANAGED FOR TIMBER PRODUCTION. THERE ARE SEVEN FOREST MANAGEMENT AGREEMENT AREAS THAT OVERLAP WITH THE OSR.

Ecology of the Oil Sands Region

The OSR is situated mainly within the Boreal Forest Natural Region with small areas of the Parkland, Foothills, and Canadian Shield Natural Regions. The boreal forest is characterized by a mosaic of upland forests composed of Trembling Aspen, White Spruce, Lodgepole Pine, and Jack Pine, and lowland forests composed of Black Spruce and Larch. These forests experience frequent natural disturbance like fire and insect outbreaks, which results in a mosaic of stands of different ages from young forests to forests more than 150 years old.

Peace River Oil Sands Area covers approximately 29,000 km², or 4% of Alberta.

The boreal-grassland transition zone, known as Aspen parkland, also covers large areas of the OSR, particularly in the Peace River and Cold Lake Oil Sands Areas. Aspen parkland is a mixture of Aspen and White Spruce groves interspersed with prairie grasslands. Much of the grasslands have been converted to agricultural use.

AGRICULTURE IS THE PREDOMINANT LAND-USE ACTIVITY IN THE PEACE RIVER AND COLD LAKE OIL SANDS AREAS.

FIGURE 04

THE OSR, A 140,213 KM^2 AREA IN NORTHEASTERN ALBERTA, IS THE FOCUS OF THIS REPORT.

Athabasca Oil Sands Area covers approximately 93,000 km², or 14% of Alberta.

SURFACE MINING IS THE MOST RECOGNIZABLE FORM OF BITUMEN EXTRACTION AND ONLY OCCURS IN THE MINEABLE REGION IN THE ATHABASCA OIL SANDS AREA; LARGE SHOVELS ARE USED TO EXCAVATE THE OIL SANDS DEPOSITS LOCATED CLOSE TO THE EARTH'S SURFACE.

FORT MCMURRAY

EDMONTON

WITH THE PROVINCE'S HIGHEST DENSITY OF HIGH-QUALITY RECREATIONAL LAKES, THIS AREA, KNOWN AS LAKELAND COUNTRY, OFFERS TREMENDOUS RECREATION POTENTIAL.

Cold Lake Oil Sands Area covers almost 18,000 km², or 3% of Alberta.

LEGEND

NATURAL REGION

- *BOREAL*
- *CANADIAN SHEILD*
- *FOOTHILLS*
- *PARKLAND*
- *OIL SANDS AREAS*
- *MINABLE OIL SANDS REGION*

0 37.5 75 150 225 300 Kilometers

IN SITU EXTRACTION IS USED TO EXTRACT THE MAJORITY OF BITUMEN DEPOSITS THAT ARE LOCATED DEEP (> 75 M) UNDERGROUND. THE TERM "IN SITU" LITERALLY MEANS THE BITUMEN IS RECOVERED "IN PLACE" AS IT IS HEATED AND SEPARATED FROM SAND UNDERGROUND AND THEN PUMPED TO THE SURFACE. IN-SITU EXTRACTION IS USED IN ALL THREE OIL SANDS AREAS.

Human Footprint

Human footprint data, including footprint type and amount, provide the context for interpreting the Biodiversity Intactness Index.

The ABMI defines human footprint as the visible conversion of native ecosystems to temporary or permanent residential, recreational, agricultural, or industrial landscapes. This includes activities that support the energy, forest, and agriculture industries, residential settlement, and transportation infrastructure. At present, however, the measure of human footprint does not account for the recovery of biodiversity in forests that are regenerating following temporary disturbances such as logging or energy exploration (i.e., seismic lines). In other words, a regenerated cutblock or seismic line is treated the same as a more recent disturbance of the same type. The ABMI is currently advancing the science necessary to account for this regeneration so that recovering areas can make a reduced contribution to the estimate of total human footprint.

As of 2012, the total human footprint across the OSR was 13.8% (Figure 05, 06A).

Covering 7.4% of the OSR, agriculture footprint (Figure 06B) was the largest human footprint and 2.5 times larger than forestry footprint (Figure 06C), which covered 2.9% of the OSR. Energy footprint (Figure 06D) covered 2.2% of the region.

The total amount of human footprint in the OSR increased from 11.3% to 13.8% between 1999 and 2012, which represents a 20% increase over this time period (Figure 05). This increase was largely driven by forestry footprint, which increased from 1.8% to 3.1%. Energy footprint increased from 1.6% to 2.3%. Agriculture footprint remained virtually unchanged over the 13-year period we examined.

The type and amount of human footprint provide context for interpreting the status of biodiversity in this report. As the amount of human footprint increases, the risks to biodiversity in a region also increase. These risks are initially small and can go unnoticed. However, as the area of human footprint increases, it becomes more likely that biodiversity will be impacted. Some species thrive in landscapes with high human footprint and increase in abundance, while other species decrease in abundance and become uncommon as a result of development.

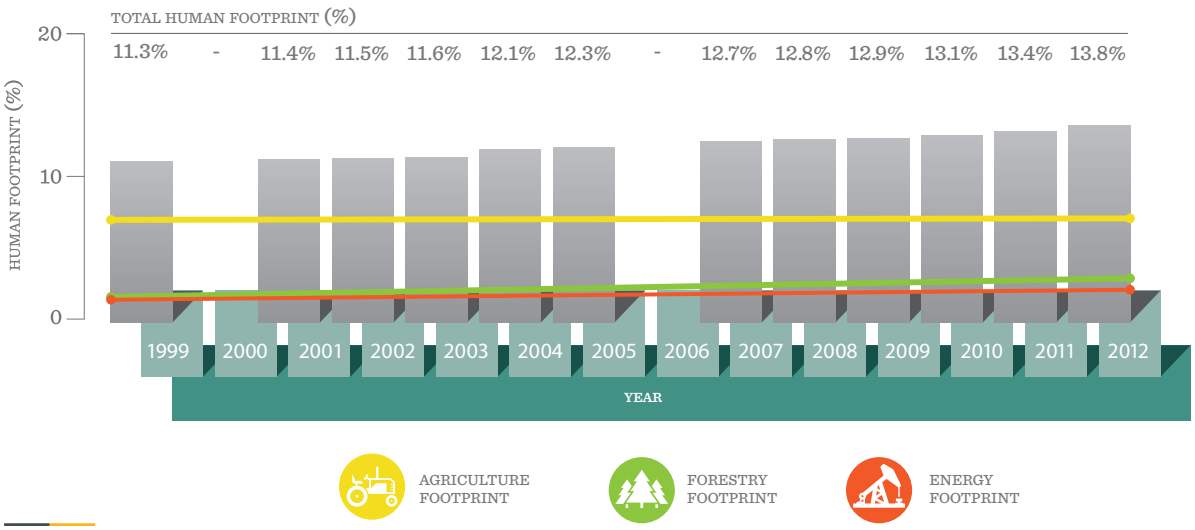


FIGURE 05

TREND IN THE PERCENTAGE OF TOTAL HUMAN FOOTPRINT AND ITS PRIMARY COMPONENTS: AGRICULTURE INDUSTRY, ENERGY INDUSTRY, AND FOREST INDUSTRY FOOTPRINT IN THE OSR FROM 1999 TO 2012.

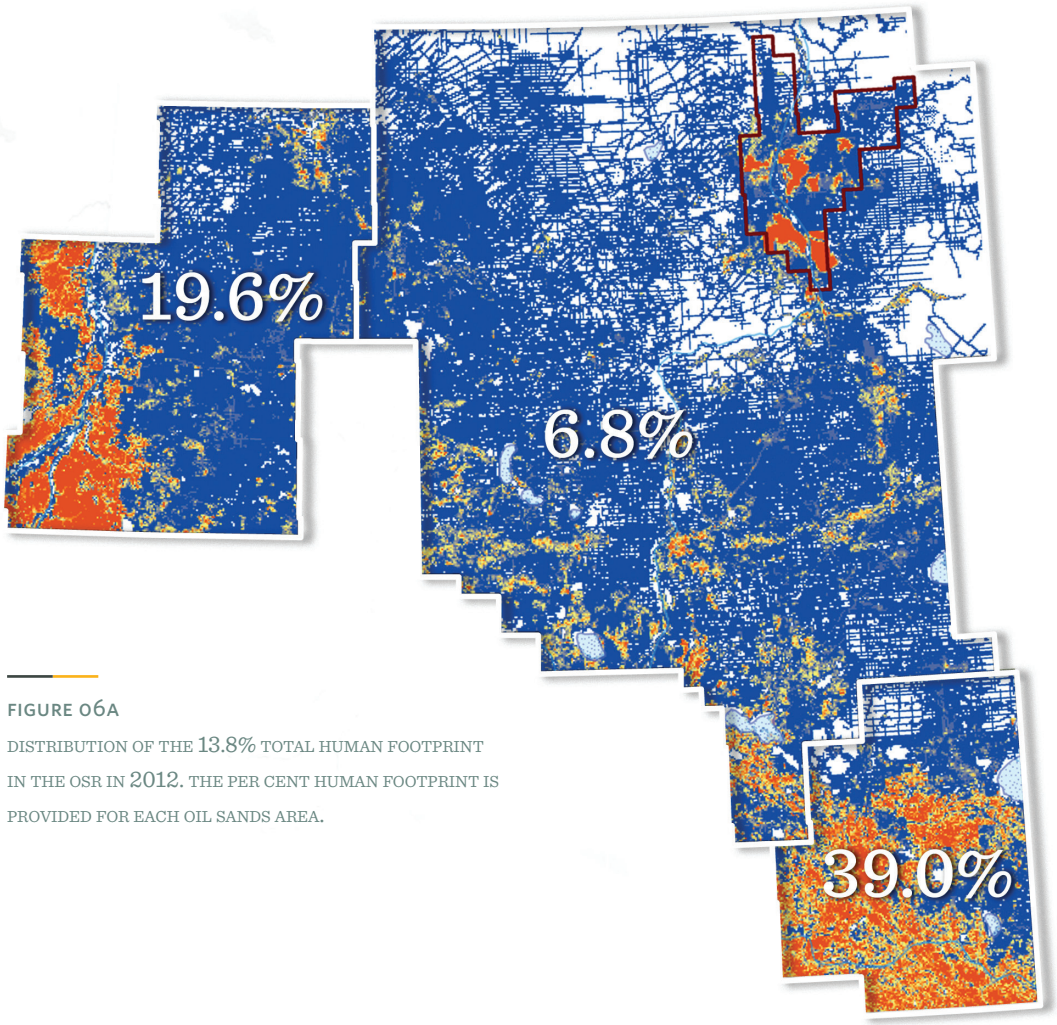
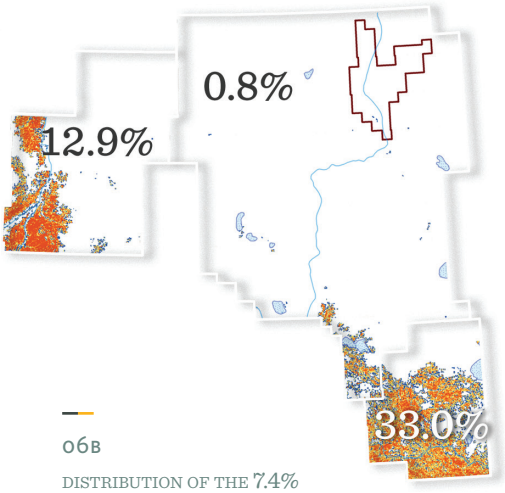


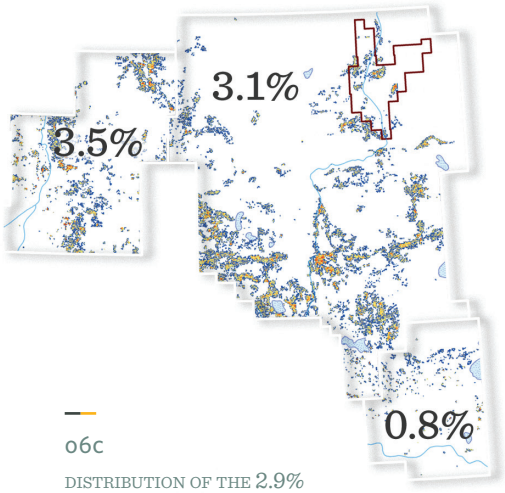
FIGURE 06A

DISTRIBUTION OF THE 13.8% TOTAL HUMAN FOOTPRINT IN THE OSR IN 2012. THE PER CENT HUMAN FOOTPRINT IS PROVIDED FOR EACH OIL SANDS AREA.



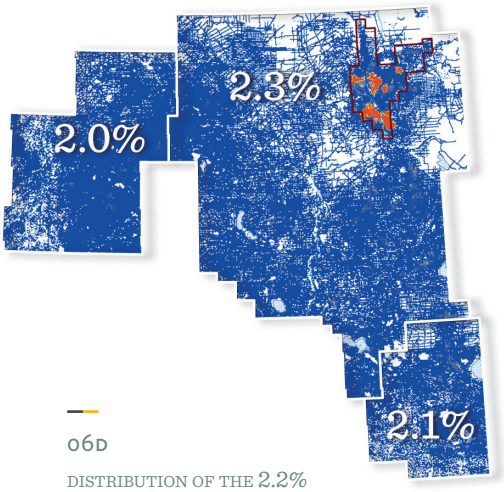
06B

DISTRIBUTION OF THE 7.4% AGRICULTURE FOOTPRINT IN THE OSR. THE PERCENTAGE AGRICULTURE FOOTPRINT IS PROVIDED FOR EACH OIL SANDS AREA.



06C

DISTRIBUTION OF THE 2.9% FORESTRY FOOTPRINT IN THE OSR. THE PERCENTAGE FORESTRY FOOTPRINT IS PROVIDED FOR EACH OIL SANDS AREA.



06D

DISTRIBUTION OF THE 2.2% ENERGY FOOTPRINT IN THE OSR. THE PERCENTAGE ENERGY FOOTPRINT IS PROVIDED FOR EACH OIL SANDS AREA.

Habitat and Protected Areas

Native Habitat

People's perception of wilderness often includes undisturbed expanses of forest, river, and lake ecosystems. The ABMI uses the phrase and concept of "native habitat" to identify undisturbed areas in Alberta, including in the OSR, that have not been visibly disturbed by humans, although natural disturbances, such as wildfire and insect outbreaks, and indirect effects of humans, like pollution, still occur. While native habitat can be defined in different ways, the ABMI defines it as "undeveloped habitat that is distant enough from human footprint that it meets a particular management objective."

Native habitat can be affected by nearby human footprint. For example, some species can effectively use habitat that is adjacent to human footprint while others require habitat that is more distant. Therefore, we measure native habitat using four different buffer distances: 0 m, > 50 m, > 200 m, and > 2 km away from footprint. These distances delimit the amount of native habitat available with a given "buffer" from human footprint. For example, at 0 m from human footprint, all native habitat in the region is included. However, at > 50 m, only native habitat that is at least 50 m away from human footprint is included. These numbers are valuable because species respond differently to human activity, with some requiring more distance from footprint.

Overall, 86% of the OSR is composed of native habitat with a 0 m buffer from human footprint while 3% of native habitat is at least 2 km away from development (Figure 07).

As a note of caution, our summary of native habitat does not yet account for some forms of human land use (e.g., livestock grazing or hunting). Successional recovery to habitat in cutblocks and seismic lines is also not yet accounted for in these summaries.

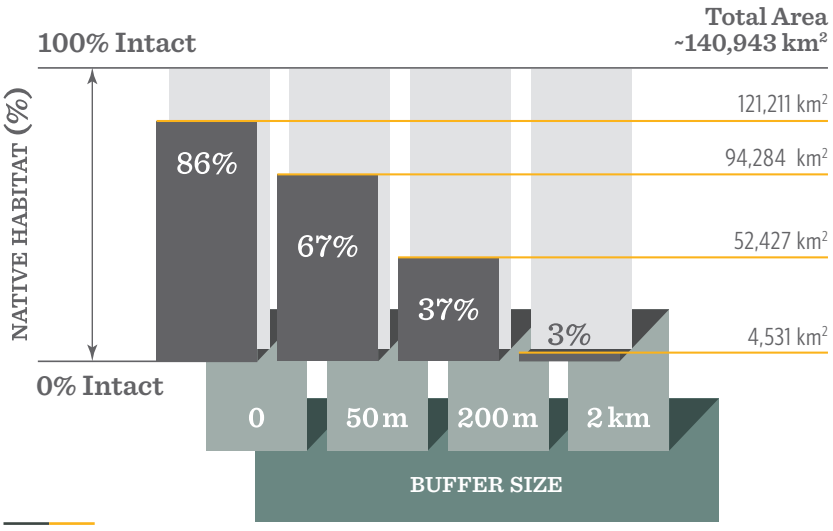


FIGURE 07

TOTAL AREA AND PERCENTAGE OF NATIVE HABITAT IN THE OSR EXPRESSED USING FOUR BUFFERS.

Protected Areas

Protected areas are an important landscape-level management tool to conserve biodiversity. Resource managers and conservationists are often interested in protecting native ecosystems with little to no human footprint to maintain the biodiversity within these naturally functioning systems.[7]

Overall, 6.2% (or 8,710 km^2) of the OSR is managed as protected areas (Figure 08); most of this area is located along the northern and northeastern perimeter of the OSR. Wood Buffalo National Park is located just to the north of the region.

The ABMI's definition of protected areas in the OSR includes Alberta's parks and protected areas network, national parks, and National Wildlife Areas. This analysis also includes the Birch River Conservation Area (a quarter of the protected area total) located in the north side of the OSR, which is classified as a Public Land-use Conservation Area within the Lower Athabasca Regional Plan 2012–22. Unlike in other protected areas, resource management plans for the Birch River Conservation Area may allow for forest harvesting.

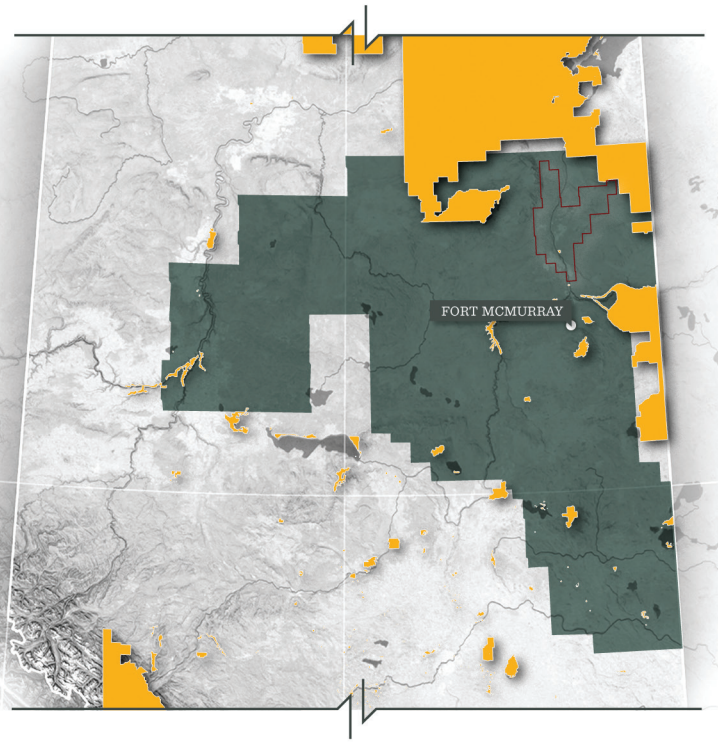


FIGURE 08

DISTRIBUTION OF PROTECTED AREAS IN OSR OF ALBERTA. OVERALL, 6.2% OF THIS REGION IS MANAGED AS PROTECTED AREAS.

Intactness of Biodiversity

Thousands of animal and plant species live in the OSR. Native birds, mammals, armoured mites, vascular plants, and moss represent a small but diverse subset of all species in the region.

The ABMI assessed the status of 425 common native species in the OSR using the Biodiversity Intactness Index and found them to be 88% intact (Table 01).

At 80% intact, native birds showed the greatest deviation from reference conditions while both mammals and mosses, at 91% intact, showed the least. See Appendix 1 for a summary of biodiversity intactness for each of the three OSAs, including Athabasca Oil Sands Area, Cold Lake Oil Sands Area, and Peace River Oil Sands Area.

It is important to note that the intactness results in this report are averages for the entire OSR. As with most landscapes in Alberta, specific locations within this region are nearly 0% intact (e.g., active industrial sites), and other sites are 100% intact (e.g., undeveloped forest and wetland habitat). See Figure 09 for an explanation of how the Biodiversity Intactness Index changes depending on the area of focus.

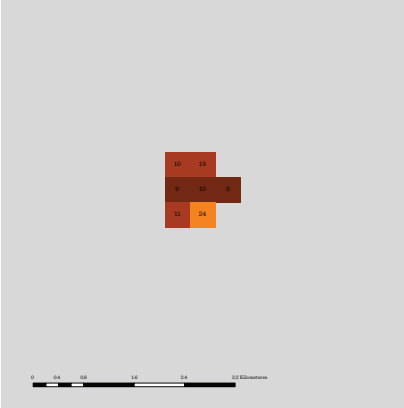
TABLE 01.

INTACTNESS* FOR DIFFERENT COMPONENTS OF BIODIVERSITY IN THE OSR IN ALBERTA.

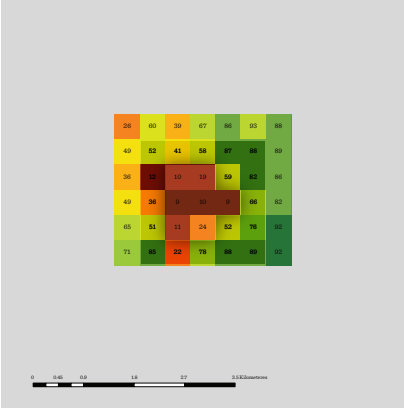
Biodiversity Component	Number of Species	Intactness
Native birds	80	80 %
Winter-active mammals	10	91 %
Armoured mites	62	90 %
Native vascular plants	183	88 %
Moss and liverworts	90	91 %
Overall intactness	425	88 %

*overall intactness is calculated as the average of the five biodiversity components as opposed to the average of individual species intactness values.

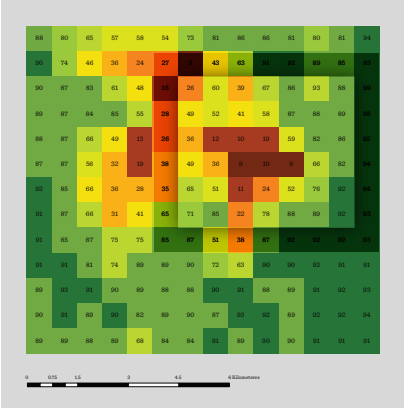
For Biodiversity Intactness, Context Matters†



A. 7 QUARTER SECTIONS WITH INTENSE HUMAN DEVELOPMENT
AVERAGE INTACTNESS: 13%



B. 42 QUARTER SECTIONS WITH LOW TO INTENSE HUMAN DEVELOPMENT
AVERAGE INTACTNESS: 56%



C. 182 QUARTER SECTIONS WITH MINIMAL TO INTENSE HUMAN DEVELOPMENT
AVERAGE INTACTNESS: 72%

FIGURE 09

ESTIMATED BIODIVERSITY INTACTNESS MAPS‡ WITH BIODIVERSITY INTACTNESS INDEX VALUES FOR EACH QUARTER SECTION (QS) OF LAND WITHIN A GIVEN AREA. SHADING REPRESENTS BIODIVERSITY INTACTNESS FROM LOW (RED BRICK SQUARE: 0%–10%) TO HIGH (DARK GREEN SQUARE: 91%–100%). A. INTACTNESS VALUES (9%–24%) FOR SEVEN QS. B. INTACTNESS VALUES (9%–93%) FOR 42 QS, INCLUDING THE 7 PRESENTED IN A. C. INTACTNESS VALUES (9%–99%) FOR 182 QS, INCLUDING THE 42 PRESENTED IN B.

Using our data, the ABMI estimates Biodiversity Intactness Index values for each quarter section (QS) in Alberta. Based on these, the average intactness for a given area can be calculated.

The example above, however, illustrates that average intactness depends on the area of focus. If we focus exclusively on an area of intense industrial development, such as the area in Figure 09A, average intactness will be very low. By contrast, if we consider areas with a range of industrial development from minimal to intense, such as those shown in Figures 09B and 09C, average intactness will increase accordingly.

The context dependence of the Biodiversity Intactness Index must be considered when interpreting data contained in this report.

‡ *Please refer to page 22 of the report for an explanation of how estimated biodiversity intactness maps are interpreted.*

Estimated Intactness of Biodiversity

Based on data collected throughout the boreal forest, the ABMI has developed statistical models that describe the relationship between the relative abundance of individual species, habitat, and human footprint. These statistical models are used to calculate the Biodiversity Intactness Index for each species in the OSR that has sufficient data. The models can also be used to estimate the Biodiversity Intactness Index for each species for every quarter section of land in the OSR—in other words, for locations where the ABMI is not directly monitoring. Using the ABMI's Inventory of Human Footprint (circa 2010) and data on the native habitat, the average intactness of over 400 species in the OSR has been estimated and mapped to generate an overall picture of biodiversity in the region (Figure 10).

Since the estimated intactness map provides a visual representation of biodiversity intactness across the region, it illustrates how the average biodiversity intactness value for the entire OSR is calculated at 88%. Clearly, the map shows that large areas of the region have little to no human footprint, and correspondingly higher biodiversity intactness (shown as dark green in Figure 10). On the other hand, agricultural areas near Peace River and Cold Lake have lower biodiversity intactness as do areas of active mining in the Surface Mineable Area north of Fort McMurray (e.g., < 20%, shown as red in Figure 10). Regional biodiversity intactness is higher because of large areas in the OSR that have little to no human footprint.

Any interpretations of estimated biodiversity intactness maps must take the following into account:

- *The information in the estimated intactness map is preliminary and will change as analyses are refined and as more data are gathered.*
- *There may be considerable uncertainty in the intactness value for any particular quarter section. (i.e., variance in the quarter section predictions is not yet reported by the ABMI).*
- *ABMI estimated biodiversity intactness maps are intended to show broad patterns of intactness, not exact values for each quarter section.*

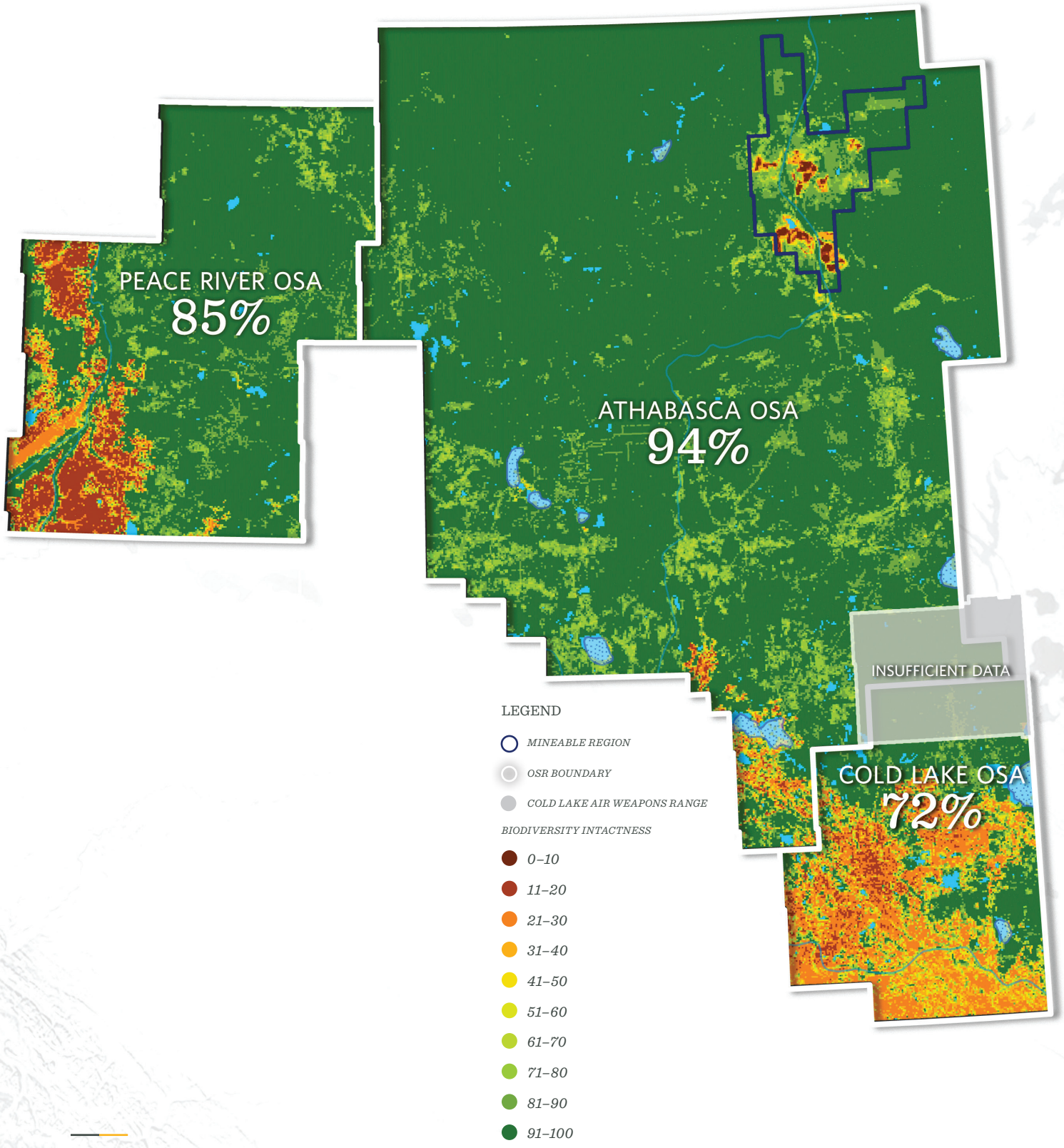


FIGURE 10

THE AVERAGE ESTIMATED INTACTNESS FOR 425 SPECIES IN THE OSR IS 88%. AVERAGE BIODIVERSITY INTACTNESS IS ALSO INDIVIDUALLY INCLUDED FOR THE PEACE RIVER OIL SANDS AREA, THE ATHABASCA OIL SANDS AREA, AND THE COLD LAKE OIL SANDS AREA. DARK RED IDENTIFIES THOSE QS THAT ARE PREDICTED TO HAVE THE LOWEST AVERAGE BIODIVERSITY INTACTNESS, AND DARK GREEN IDENTIFIES QS WITH THE HIGHEST INTACTNESS.

FOR EACH BIODIVERSITY COMPONENT ADDRESSED IN THIS SECTION OF THE REPORT, WE PROFILE RESULTS FOR SPECIES THAT SHOWED THE BIGGEST DIFFERENCE FROM REFERENCE CONDITIONS, INCLUDING SPECIES THAT WERE MORE AND LESS ABUNDANT THAN EXPECTED. WE ALSO PROFILE NON-NATIVE PLANTS AND SPECIES AT RISK WITHIN THE OSR. BECAUSE WOODLAND CARIBOU HAVE A HIGH PUBLIC PROFILE IN THE OSR, WE PROVIDE A SPOTLIGHT ON THE STATUS OF THIS SPECIES. COMPREHENSIVE DETAIL ON ALL SPECIES IS INCLUDED IN SUPPLEMENTAL MATERIAL ASSOCIATED WITH THIS REPORT (AVAILABLE AT WWW.ABMI.CA).

Birds

The OSR, at the heart of the boreal forest in Alberta, is characterized by a mosaic of upland forests interspersed with shallow lakes, streams, and wetlands. This landscape provides a diversity of habitats that support over 200 bird species during their spring and summer breeding season. In fact, Canada's boreal forest, of which the OSR is a part, is considered the "bird nursery" of North America, with millions of birds breeding here each year. From ducks and shorebirds to warblers and sparrows, the array of bird species that take advantage of the abundant food and the diverse habitat during the breeding season is impressive. For example, many warbler species, such as the Bay-breasted Warbler and Canada Warbler, are almost entirely reliant on the boreal forest during the breeding season. Breeding birds in the boreal forest are so successful that populations approximately double by the end of the summer with the addition of new young.

The ABMI assessed the status of 80 birds in the OSR and found them to be, on average, 80% intact.

We present results for 20 of the 80 bird species analyzed for this report. The 20 species shown here were selected because they showed the largest departures from intact reference conditions, including 10 species that were less abundant than expected and 10 species that were more abundant than expected (Figure 11). Details on all 80 species can be found in supplemental material supporting this report.

Of the 10 species that were less abundant than expected, 8 are considered old-forest specialists; these specialists require old-forest habitat for nesting and feeding. Most notable is the Black-throated Green Warbler, which was approximately 50% less abundant than expected. Only the Ruffed Grouse and Palm Warbler are not old-forest specialists but instead use younger forest habitat.

The 10 species that were more abundant than expected are human-associated, meaning that these species benefit from some types of human land use. Eight of these species were at least two-times more abundant than expected. Human-associated species, such as the American Crow and Black-billed Magpie do well in landscapes where there is widespread human activity such as agriculture, forestry, and urbanization.

Overall, the most immediate changes to biodiversity seem to be associated with strong positive changes in the abundance of human-associated species.

MORE THAN 80% OF THE BAY-BREASTED WARBLER BREEDING POPULATION IN THE WESTERN HEMISPHERE CAN BE FOUND IN THE BOREAL FOREST DURING THE BREEDING SEASON. THIS SPECIES IS A SPRUCE BUDWORM SPECIALIST AND INCREASES IN ABUNDANCE DURING BUDWORM OUTBREAKS. THE BAY-BREASTED WARBLER OCCURRED AT 15% OF SITES IN THE OSR AND IS 98% INTACT.

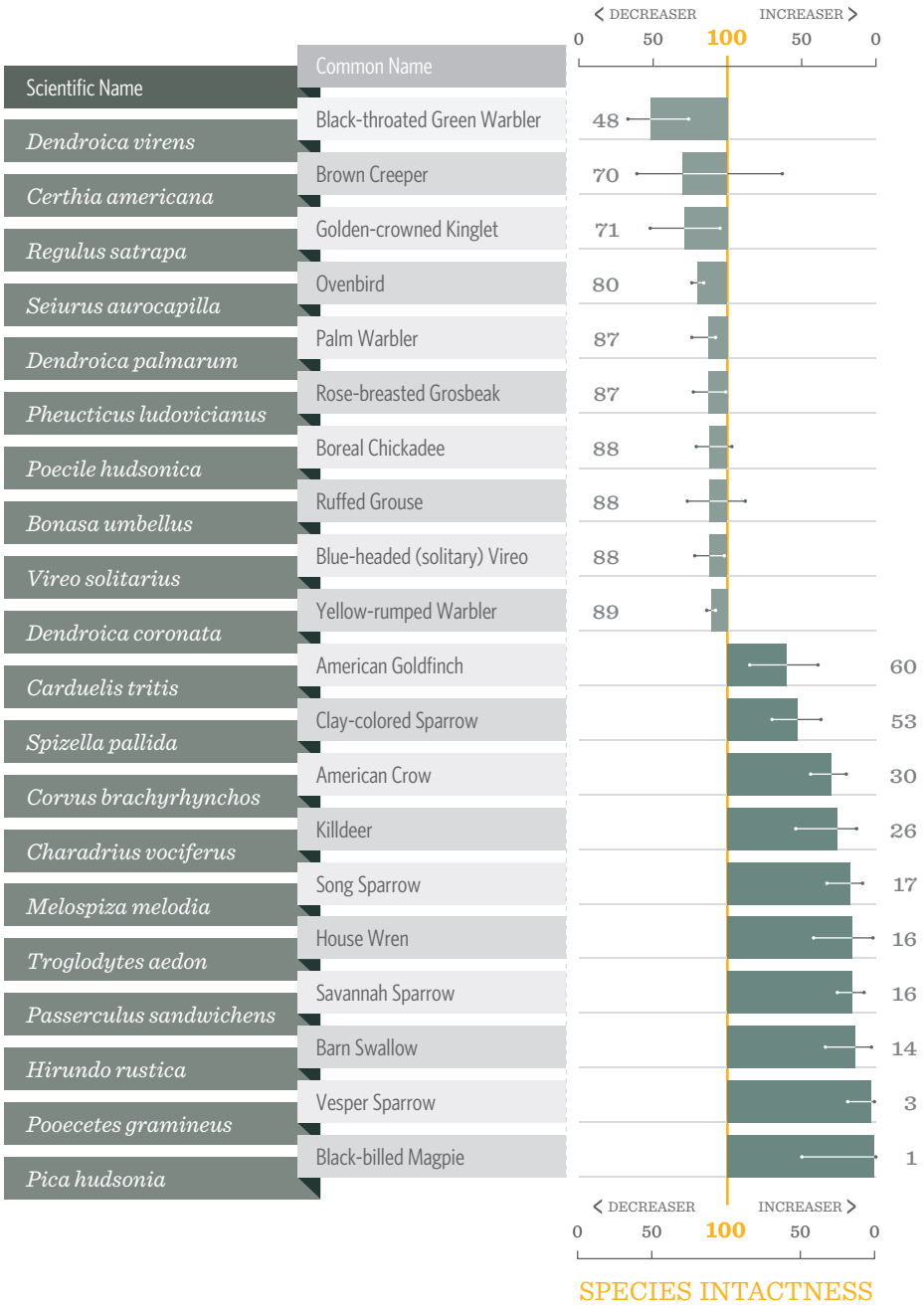


FIGURE 11

INTACTNESS (WITH 90% CONFIDENCE INTERVALS) FOR THE 20 BIRD SPECIES IN THE OSR (INCLUDES THE ATHABASCA OIL SANDS AREA, THE PEACE RIVER OIL SANDS AREA, AND THE COLD LAKE OIL SANDS AREA) THAT SHOWED THE LARGEST DEPARTURE FROM INTACT REFERENCE CONDITIONS; WE SHOW 10 SPECIES THAT WERE LESS ABUNDANT THAN EXPECTED AND 10 SPECIES THAT WERE MORE ABUNDANT THAN EXPECTED.

NOTE: BARS FOR EACH SPECIES INDICATE DIFFERENCE FROM INTACT REFERENCE CONDITIONS; SPECIES INTACTNESS IS PRESENTED BY THE NUMERICAL VALUE ADJACENT TO THE BAR.

Winter-active Mammals

The OSR is home to nearly 50 mammal species. Some of these are fur-bearing mammals that play an important role in northern Alberta ecosystems by filling the role as top predators (e.g, Gray Wolf), while others provide hunting and trapping opportunities for Aboriginal and local people.

While mammal populations in the OSR have long been affected by hunting, trapping, and agricultural settlement, more recent human activities, like forestry and energy development, are also having an impact on their populations. Some species, like the Coyote and White-tailed Deer, benefit from many forms of human development, while other species become less common as human land use intensifies. The process of subdividing contiguous tracts of boreal forest into smaller patches impacts species that require large undisturbed areas, such as the Wolverine and Woodland Caribou, as well as smaller forest-dwelling mammals, like the Fisher and Marten.

The ABMI assessed the status of 10 winter-active mammal species or groups of species in the OSR and found them to be, on average, 91% intact (Figure 12).

The Coyote differed the most from what we expected under intact reference conditions; at 69% intact, it was more abundant than expected. Coyotes are habitat generalists and readily adapt to human-dominated landscapes.

Marten and Fisher, and Red Squirrel, were less abundant than expected if there were no human footprint. These species are associated with mature coniferous forest.

The ABMI does not yet have enough data to determine intactness for uncommon species such as Wolverine.

CANADA LYNX IS A SPECIALIST PREDATOR OF SNOWSHOE HARE; LYNX POPULATIONS FLUCTUATE WITH THE HARE POPULATION CYCLE. CANADA LYNX HAVE LONG BEEN TRAPPED IN NORTHERN ALBERTA FOR THEIR COMMERCIALLY VALUABLE FUR. AT 93% INTACT, THE CANADA LYNX WAS LESS ABUNDANT THAN EXPECTED IF THERE WERE NO HUMAN FOOTPRINT.

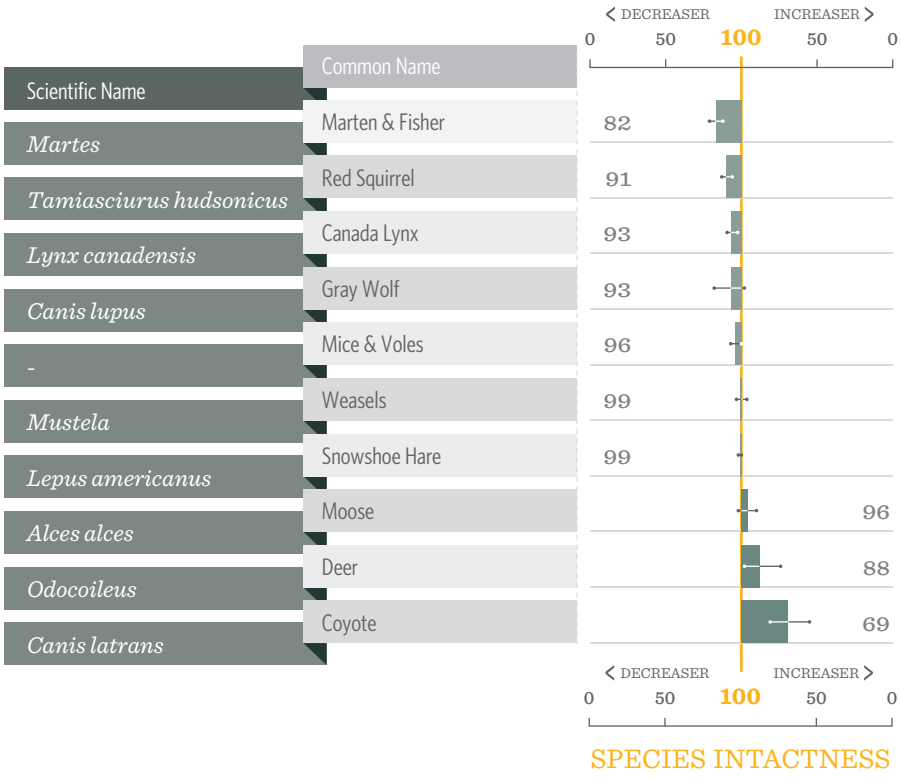


FIGURE 12

INTACTNESS (WITH 90% CONFIDENCE INTERVALS) FOR 10 MAMMAL SPECIES OR SPECIES GROUPS IN THE OSR (INCLUDES THE ATHABASCA OIL SANDS AREA, THE PEACE RIVER OIL SANDS AREA, AND THE COLD LAKE OIL SANDS AREA).

NOTE: BARS FOR EACH SPECIES INDICATE DIFFERENCE FROM INTACT REFERENCE CONDITIONS; SPECIES INTACTNESS IS PRESENTED BY THE NUMERICAL VALUE ADJACENT TO THE BAR.

Armoured Mites

Armoured mites (also known as oribatid mites) are a critical component of Alberta's soil biodiversity. No larger than the tip of a ballpoint pen, several hundred thousand armoured mites can be found in a cubic metre of healthy topsoil. Of the 10,000 armoured mite species known to exist on the planet, at least 344 occur in our province, and more are being discovered each year.

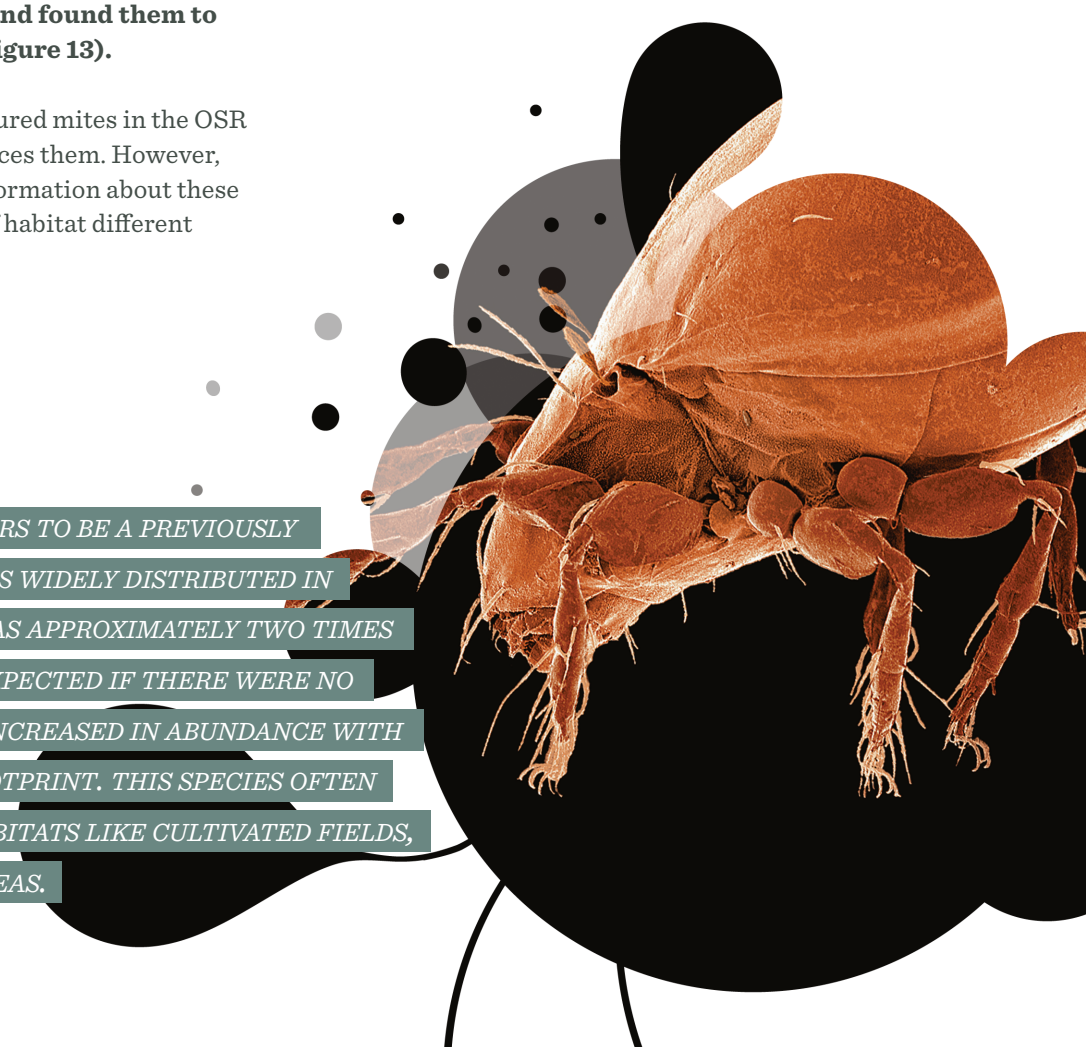
Like mammals and birds, some species of armoured mites are carnivores and some are herbivores. However, the majority of mites live off the remains of plants, animals, and fungi, playing a critical role in the formation and maintenance of soil structure. Armoured mites also serve as food for many small arthropods such as beetles, ants, and spiders, and for some small frogs and birds. As a result, these tiny unseen species are vital to the maintenance of healthy ecosystems in our province.

The ABMI assessed the status of 62 species of armoured mites in the OSR and found them to be, on average, 90% intact (Figure 13).

Not much is known about armoured mites in the OSR or how human footprint influences them. However, ABMI data is providing new information about these species, including what types of habitat different species like to live in, and how human footprint might influence them. The ABMI provides baseline data that forms the foundation for understanding how mite populations change as we continue to develop oil sands resources.

For example, the Ornate Hatless Mite was 25% less abundant than expected if there were no human footprint. The abundance of this species was highest in older spruce forests and declined with increased forestry footprint as well as agriculture and energy footprint.

Of the species that were more abundant than expected if there were no human footprint, several species increased in abundance with agriculture footprint, including the Six-dimpled Northern Mite (54% intact) and the Field Roamer (57% intact).



THE FIELD ROAMER APPEARS TO BE A PREVIOUSLY UNKNOWN SPECIES THAT IS WIDELY DISTRIBUTED IN ALBERTA. THIS SPECIES WAS APPROXIMATELY TWO TIMES MORE ABUNDANT THAN EXPECTED IF THERE WERE NO HUMAN FOOTPRINT AND INCREASED IN ABUNDANCE WITH AGRICULTURE HUMAN FOOTPRINT. THIS SPECIES OFTEN OCCURS IN DISTURBED HABITATS LIKE CULTIVATED FIELDS, PASTURES, AND URBAN AREAS.

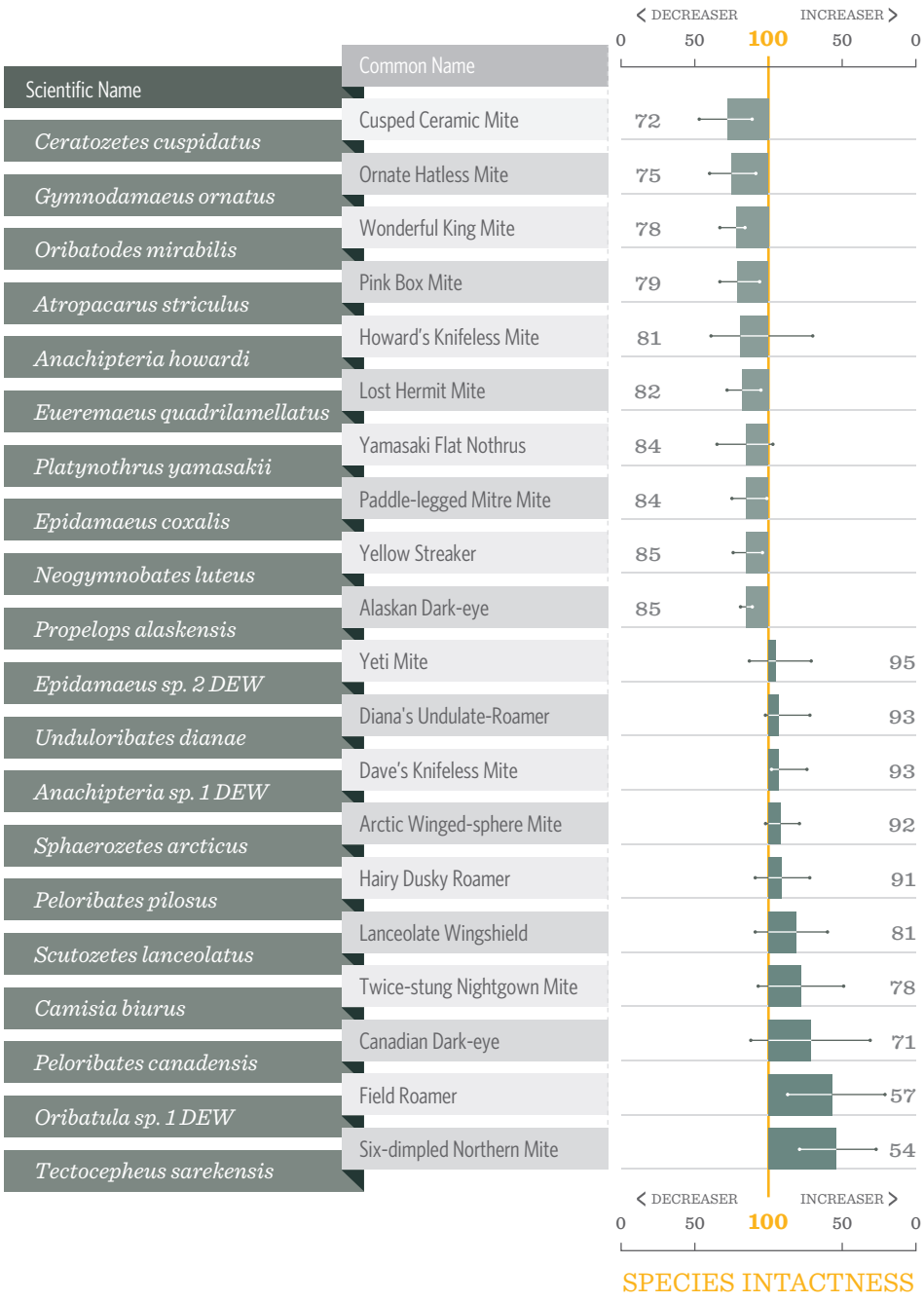


FIGURE 13

INTACTNESS (WITH 90% CONFIDENCE INTERVALS) FOR THE 20 MITE SPECIES IN THE OSR (INCLUDES THE ATHABASCA OIL SANDS AREA, THE PEACE RIVER OIL SANDS AREA, AND THE COLD LAKE OIL SANDS AREA) THAT SHOWED THE LARGEST DEPARTURE FROM INTACT REFERENCE CONDITIONS; WE SHOW 10 SPECIES THAT WERE LESS ABUNDANT THAN EXPECTED AND 10 SPECIES THAT WERE MORE ABUNDANT THAN EXPECTED.

NOTE: BARS FOR EACH SPECIES INDICATE DIFFERENCE FROM INTACT REFERENCE CONDITIONS; SPECIES INTACTNESS IS PRESENTED BY THE NUMERICAL VALUE ADJACENT TO THE BAR.

Native Vascular Plants

Vascular plants represent one of the most diverse and important components of biodiversity in the OSR. Well over 500 species of vascular plants have adapted to the diverse environmental conditions found in the boreal forest and its major ecosystem types, including deciduous forest, mixedwood forest, coniferous forest, and wetland ecosystems. Species like the Wild Red Currant and Prickly Rose thrive under the high light conditions, warmer temperatures, and nutrient-rich soils that characterize deciduous forests. In coniferous forests, shade-tolerant evergreen species, like the Twinflower and Greenish Flowered Wintergreen, are dominant. One common type of wetland in the boreal forest, known as peatlands, provides a unique set of ecological conditions (limited oxygen, low nutrient availability, acidic soil), which supports a distinctive set of flora. This includes many species of wild orchids, like the Northern Green Bog Orchid, and carnivorous plants, like the Round-leaved Sundew.

FOXTAIL BARLEY GROWS IN A VARIETY OF HABITATS THROUGHOUT ALBERTA, AND THRIVES IN NEWLY DISTURBED HABITATS. THIS SPECIES IS OFTEN USED TO RECLAIM DISTURBED AREAS. AT 58% INTACT, FOXTAIL BARLEY WAS MORE ABUNDANT THAN EXPECTED IN THE OSR.

Overall, plant communities in the boreal forest are an important part of biodiversity, providing vital food resources and habitat for wildlife in the region, and supporting the development of healthy forests and soil. Planning for a future rich in biodiversity requires management of these different ecosystem types and the plant communities found within them.

The ABMI assessed the status of 183 vascular plants in the OSR and found them to be, on average, 88% intact (Figure 14).

The 10 vascular plant species that showed the greatest negative difference compared to reference conditions ranged from 56% to 78% intact (Figure 14). These species have a range of habitat requirements. For example, Beaked Hazelnut can be a dominant shrub in the understorey of young deciduous forests, while the One-flowered Wintergreen and the Spreading Woodfern are more common in older coniferous forests.

Seven of the 10 plant species that were more abundant than expected if there were no human footprint are grasses and sedges (Figure 14). These species are often considered "pioneer" species as they are among the first species to colonize recently disturbed areas. A prime example of a pioneer species is the Red Fescue, which can produce new shoots from rhizomes, or laterally creeping roots. This species thrives in open areas and is often abundant in newly disturbed habitats, such as recent clear-cuts or burns, and it is sometimes used to revegetate disturbed areas. Red Fescue, at 29% intact, was at least three times more abundant than expected.

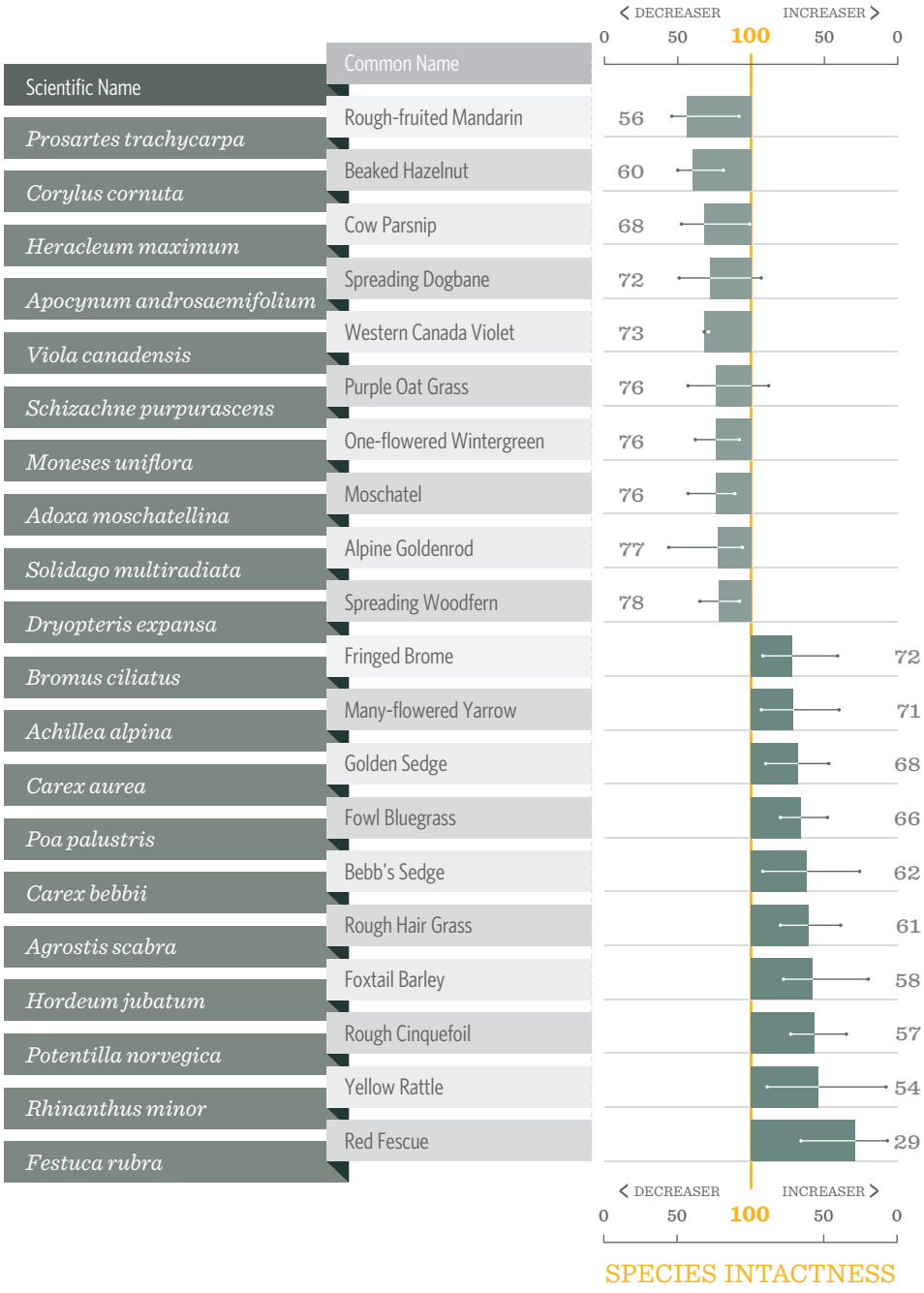


FIGURE 14

INTACTNESS (WITH 90% CONFIDENCE INTERVALS) FOR 20 VASCULAR PLANTS IN THE OSR THAT SHOWED THE LARGEST DEPARTURES FROM INTACT REFERENCE CONDITIONS; WE SHOW 10 SPECIES THAT WERE LESS ABUNDANT THAN EXPECTED AND 10 SPECIES THAT WERE MORE ABUNDANT THAN EXPECTED.
NOTE: BARS FOR EACH SPECIES INDICATE DIFFERENCE FROM INTACT REFERENCE CONDITIONS; SPECIES INTACTNESS IS PRESENTED BY THE NUMERICAL VALUE ADJACENT TO THE BAR.

Non-native Plants

Non-native plants are those species that have been introduced, intentionally or otherwise, into new areas beyond their natural habitat. While not all non-native species represent a threat to biodiversity, given the right conditions, non-native species can become a major ecological concern.

Early action is the most effective way of managing non-native species before serious impacts have occurred. The ABMI's monitoring data are a means to assess the current distribution and detect trends in distribution through time, serving as an early warning signal of potential risks to native biodiversity.

The ABMI found 57 species of non-native plants in the OSR (see supplemental material available at www.abmi.ca for a complete list). Combined, non-native plants were detected across 46% of the OSR. Many of the non-native plants occurred very infrequently in the region, at less than 5% of ABMI sites. At sites where non-native plants were found, an average of 3.8 species were detected. For each quarter section in the OSR, the predicted number of non-native species per 1 ha plot ranged from 0 to 30 species (Figure 15).

Common Dandelion was the most abundant non-native plant, occurring at 30% of ABMI sites surveyed, followed by Kentucky Bluegrass, which occurred at 18% of sites, and Alsike Clover, which was present at 14% of sites. Four of the species detected are listed under the Alberta Weed Control Act, including Creeping Thistle **(6%)**, Perennial Sow-thistle **(3%)**, Tall Buttercup **(2%)**, and Scentless Chamomile **(< 1%)**.

ABMI data can be used by managers to set regional targets for non-native plant management and to measure progress toward achieving those targets.

PERENNIAL SOW THISTLE IS IDENTIFIED AS A NOXIOUS WEED UNDER ALBERTA'S WEED CONTROL ACT (2010); IT WAS DETECTED AT 3% OF ABMI SITES IN THE OSR.

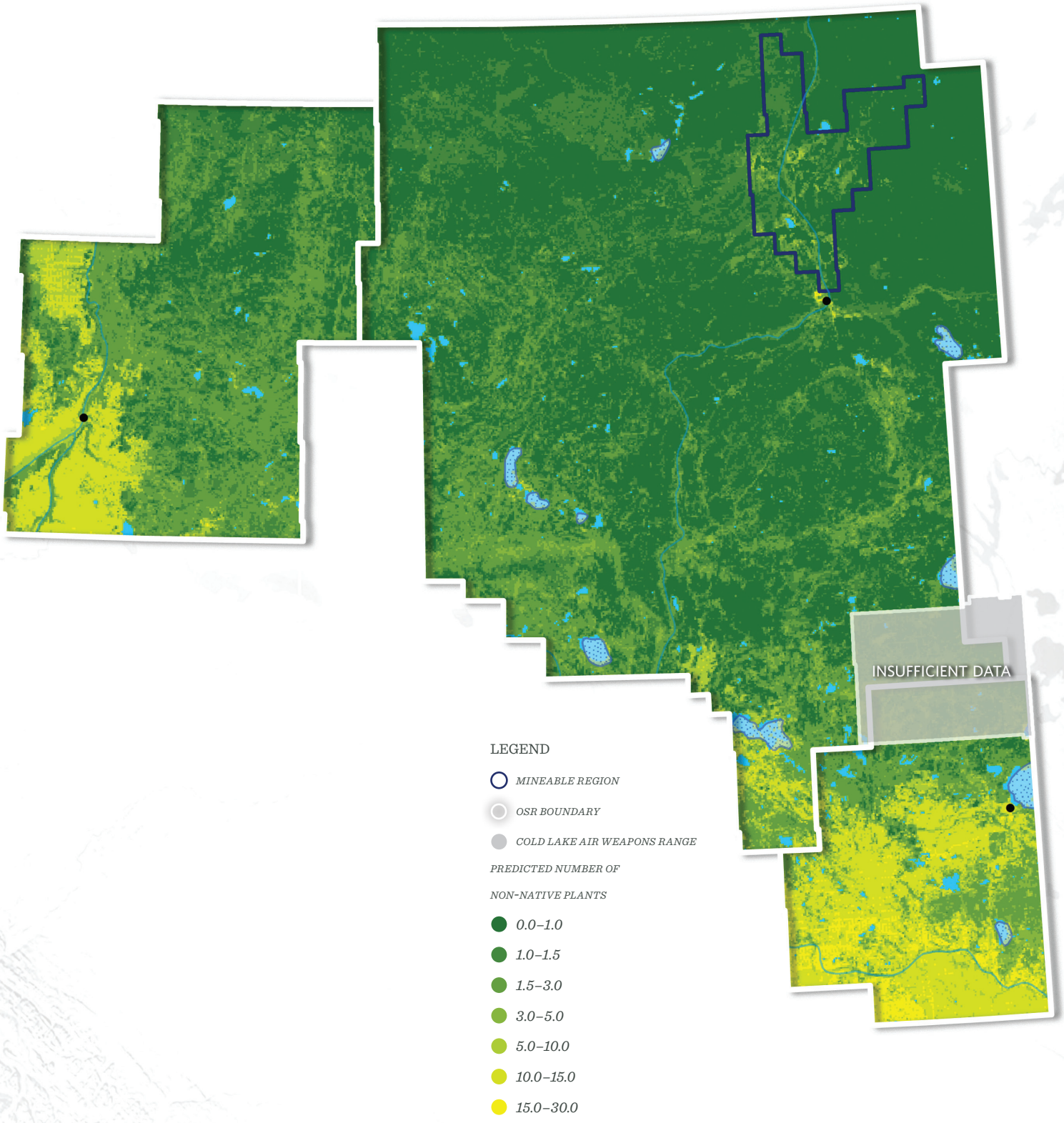


FIGURE 15

PREDICTED NUMBER OF NON-NATIVE PLANT SPECIES PER 1 HA PLOT IN EACH QUARTER SECTION OF THE OSR. DARK GREEN INDICATES VERY LOW NUMBERS OF NON-NATIVE PLANT SPECIES WHILE YELLOW INDICATES HIGH NUMBERS OF NON-NATIVE SPECIES.

Mosses and Liverworts

Mosses often carpet the forest floor in boreal ecosystems. For example, the ground cover in Black Spruce forests is made up almost entirely of mosses and liverworts (along with lichens). Mosses provide a number of important functions in these northern ecosystems.[8] For example, a blanket of moss provides a layer of insulation keeping the soil moist and cool during the summer, and "warm" during the winter, protecting overwintering micro-organisms. Mosses intercept the majority of incoming nutrients, such as nitrogen, and make these nutrients available to other plants. These moss beds can also limit the establishment of understorey plants as well as tree seedlings, thereby directly affecting the boreal plant community.[9] And mosses are home to a diverse community of micro-organisms, such as fungi, bacteria, and mites, that play critical roles in decomposing plant material and maintaining healthy soil.

But mosses aren't restricted to forest ecosystems. Peaty wetlands are common across the boreal landscape, and the creation of these wetlands is strongly influenced by a particular group of mosses known as sphagnum mosses. In a process known as paludification, boreal forests growing on mineral soil are slowly converted to treed peatlands as dead vegetative material (peat) accumulates on the forest floor and the water table rises. Sphagnum mosses become established on this peat substrate, and these mosses slowly accumulate and expand in area over thousands of years. The unique ecological conditions of peatlands, such as limited oxygen, low nutrient availability, and acidic soil provide habitat for a distinctive set of flora that are rarely found elsewhere in the boreal forest. And boreal peatlands are a vast storehouse of carbon.

Mosses are ubiquitous throughout the boreal forest, influencing water, nutrient, and carbon cycles, providing microhabitat for microscopic organisms, and affecting the natural development of forests.

The ABMI assessed the status of 85 moss species in the OSR and found them to be, on average, 91% intact (Figure 16).

The 10 mosses and liverworts most sensitive to human development that were less abundant than expected ranged from 74% to 84% intact (Figure 16). Long-forked Moss, at 74% intact, was the most sensitive to human footprint. This species is one of a number of species that play an important role in peatland formation.

The species that were more abundant than expected ranged from 62% to 94% intact (Figure 16). Several of these species, including the Cord Moss (62% intact), Common Liverwort (84% intact), and Bristly Haircap Moss (90% intact), thrive in disturbed areas such as recent burns, pastures, abandoned fields, roadsides, and ditches.

LONG-FORKED MOSS, AT 74% INTACT, WAS LESS ABUNDANT THAN EXPECTED. THIS SPECIES THRIVES IN BOGS AND FENS, AND PLAYS AN IMPORTANT ROLE IN PEATLAND FORMATION.

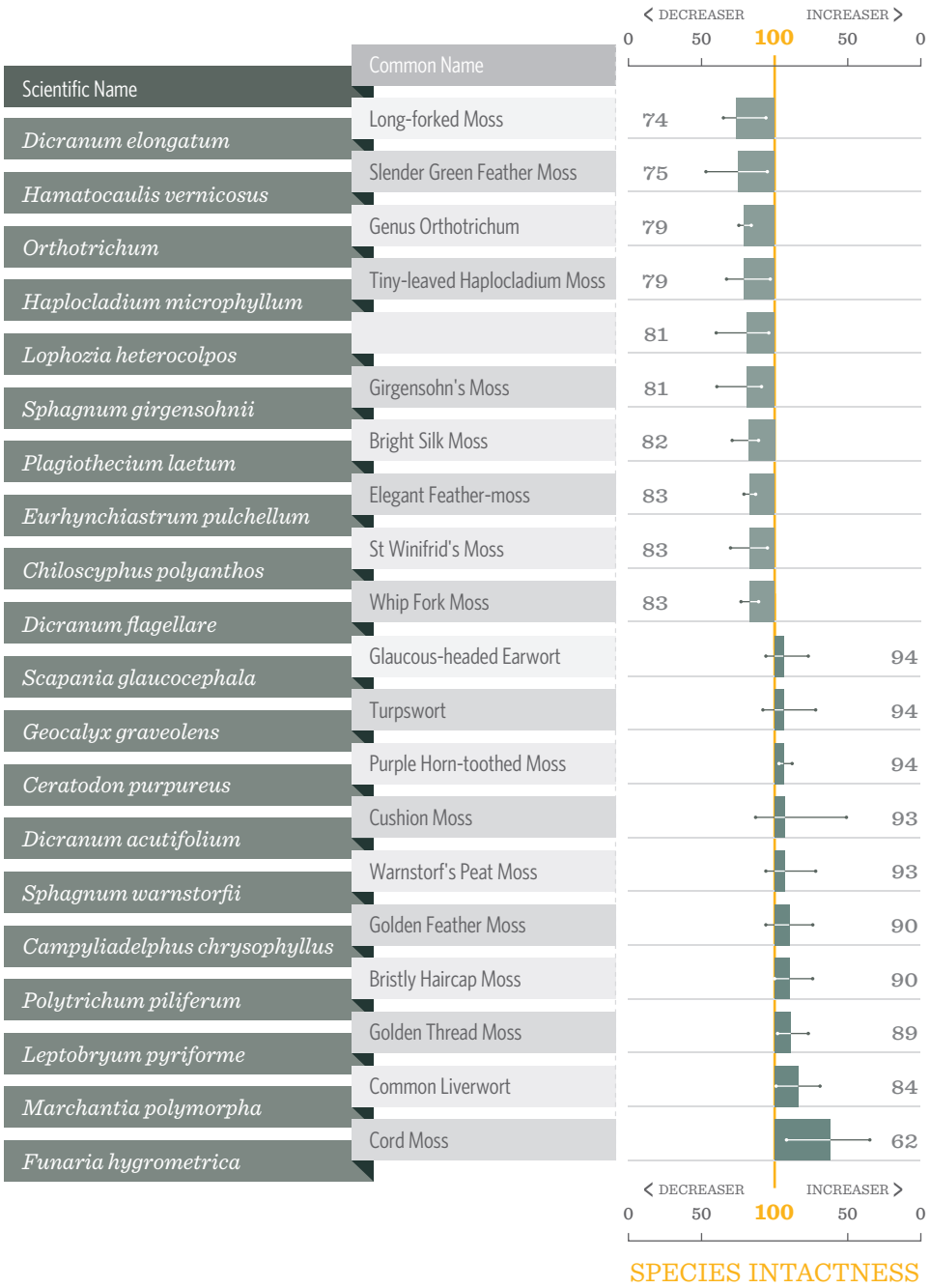


FIGURE 16

INTACTNESS (WITH 90% CONFIDENCE INTERVALS) FOR 20 MOSSES AND LIVERWORTS IN THE OSR THAT SHOWED THE LARGEST DEPARTURES FROM INTACT REFERENCE CONDITIONS; WE SHOW 10 SPECIES THAT WERE LESS ABUNDANT THAN EXPECTED AND 10 SPECIES THAT WERE MORE ABUNDANT THAN EXPECTED. NOTE: BARS FOR EACH SPECIES INDICATE DIFFERENCE FROM INTACT REFERENCE CONDITIONS; SPECIES INTACTNESS IS PRESENTED BY THE NUMERICAL VALUE ADJACENT TO THE BAR.

Species at Risk

The health of biodiversity in a region includes an assessment of species that are naturally rare or that have demonstrated a significant decline in abundance. These rare species are generally referred to as "species at risk" because future declines in abundance may result in the loss of the species from an area.

There are at least 88 species at risk in the OSR; the ABMI detected 74 of these species (see the supplemental report available at www.abmi.ca for a complete list). Twenty-seven of these species occurred with enough frequency to enable the calculation of the ABMI's intactness index, including five species that are listed as threatened or of special concern by the Government of Canada and/or by the Government of Alberta (Table 02). Intactness ranged from 14% intact to 96% intact for increaser species. Intactness ranged from 48% intact to 98% intact for decreaser species. No species occurring in the OSR are listed as endangered.

The two species that differed the most from intact reference conditions were the Barn Swallow and the Black-throated Green Warbler. The Barn Swallow, at 14% intact, was more abundant than expected if there were no human footprint in the OSR. This species is considered a habitat generalist, nesting in or on artificial structures like barns, bridges, and culverts and foraging in open, human-modified landscapes. While the Barn Swallow has experienced declines across parts of Canada over the past 30 years, causes of the declines are unknown. In the OSR, the Barn Swallow is more abundant in areas with agriculture and urban/residential development and is virtually absent from areas without human footprint. Some types of human footprint in the OSR may be creating suitable habitat for the Barn Swallow.

In contrast to the Barn Swallow, the Black-throated Green Warbler, at 48% intact, was half as abundant as expected if there were no human footprint in the OSR. The Black-throated Green Warbler is most often found in older coniferous or mixedwood forests, especially if there are large White Spruce trees present. White Spruce trees are preferred foraging sites.

The ABMI is partnering with the Ecological Monitoring Committee for the Lower Athabasca (EMCLA)* to improve monitoring of rare plants and animals in some parts of the OSR, specifically the Lower Athabasca Planning Region which includes much of the Athabasca Oil Sands Area. The ABMI is providing scientific and operational support to the EMCLA to develop new monitoring protocols for rare species, including listed species like the Canadian Toad and Yellow Rail that are not currently monitored by the ABMI.

THE CANADA WARBLER IS LISTED AS THREATENED BY CANADA'S COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA (COSEWIC) AND SPECIES AT RISK ACT (SARA). IN ALBERTA, CANADA WARBLERS ARE MOST OFTEN FOUND IN OLDER DECIDUOUS AND MIXEDWOOD FORESTS. THE ABMI FOUND THE CANADA WARBLER TO BE LESS ABUNDANT THAN EXPECTED, AT 89% INTACT

*The EMCLA is a joint industry-government group tasked with improving the quality of regulatory wildlife and biodiversity monitoring in the Lower Athabasca Planning Region.

TABLE 02

SUMMARY OF SPECIES AT RISK† IN THE OSR FOR WHICH ABMI COULD CALCULATE AN INTACTNESS INDEX.

	Common Name	Species Scientific Name	Federal or Provincial Designation	% of ABMI Sites Where Detected	ABMI Assessment in the OSR
BIRDS	Barn Swallow	*Hirundo rustica*	ESRD - Sensitive | AB ESCC 2010 Sensitive COSEWIC - Threatened | SARA - Eligible for listing	4	14 (ABOVE)
BIRDS	Bay-breasted Warbler	*Dendroica casanea*	ESRD - Sensitive | AB ESCC 2010 - In Process	15	98 (BELOW)
BIRDS	Black-throated Green Warbler	*Dendroica virens*	ESRD - Sensitive | AB ESCC 2010 - Species of Special Concern	4	48 (BELOW)
BIRDS	Brown Creeper	*Certhia americana*	ESRD - Sensitive	10	70 (BELOW)
BIRDS	Canada Warbler	*Wilsonia canadensis*	ESRD - Sensitive | COSEWIC - Threatened SARA - Threatened	10	89 (BELOW)
BIRDS	Cape May Warbler	*Dendroica tigrina*	ESRD - Sensitive | AB ESCC 2010 - In Process	26	90 (BELOW)
BIRDS	Common Yellowthroat	*Geothlypis trichas*	ESRD - Sensitive	36	98 (BELOW)
BIRDS	Least Flycatcher	*Empidonax minimus*	ESRD - Sensitive	44	94 (BELOW)
BIRDS	Olive-sided Flycatcher	*Contopus cooperi*	ESRD - May Be at Risk | COSEWIC - Threatened SARA - Threatened	17	95 (BELOW)
BIRDS	Pileated Woodpecker	*Dryocopus pileatus*	ESRD - Sensitive	22	92 (ABOVE)
BIRDS	Rusty Blackbird	*Euphagus carolinus*	ESRD - Sensitive | COSEWIC - Special Concern SARA - Special Concern	6	90 (ABOVE)
BIRDS	Sora	*Porzana carolina*	ESRD - Sensitive	11	78 (ABOVE)
BIRDS	Western Tanager	*Piranga ludoviciana*	ESRD - Sensitive	36	90 (BELOW)
BIRDS	Western Wood Pewee	*Contopus sordidulus*	ESRD - Sensitive	14	80 (ABOVE)
BIRDS	Yellow-bellied Flycatcher	*Empidonax flaviventris*	ESRD - Undetermined	10	90 (ABOVE)
MAMMALS	Canada Lynx	*Lynx canadensis*	AB ESCC - Sensitive | COSEWIC - Not at Risk	64	93 (BELOW)
MAMMALS	Marten & Fisher	*Martes*	AB ESCC - Sensitive	35	82 (BELOW)
NATIVE VASCULAR PLANTS	Short Sedge	*Carex canescens*	ESRD - Undetermined	19	96 (ABOVE)
NATIVE VASCULAR PLANTS	Hay Sedge	*Carex siccata*	ESRD - Undetermined	15	78 (ABOVE)
NATIVE VASCULAR PLANTS	Spreading Woodfern	*Dryopteris expansa*	ESRD - Sensitive	4	78 (BELOW)
NATIVE VASCULAR PLANTS	Purple Peavine	*Lathyrus venosus*	ESRD - Sensitive	19	96 (BELOW)
NATIVE VASCULAR PLANTS	Groundpine	*Lycopodium dendroideum*	ESRD - Undetermined	26	92 (BELOW)
NATIVE VASCULAR PLANTS	Canada Goldenrod	*Solidago canadensis*	ESRD - Undetermined	10	72 (ABOVE)
MOSSES	Cushion Moss	*Dicranum acutifolium*	ESRD - Undetermined	5	93 (ABOVE)
MOSSES	Flat Stump Moss	*Herzogiella turfacea*	ESRD - Undetermined	6	95 (BELOW)
MOSSES	Drummond's Leafy Moss	*Plagiomnium drummondii*	ESRD - Undetermined	29	90 (BELOW)
MOSSES	Flat-brocade Moss	*Platygyrium repens*	ESRD - Sensitive	14	93 (BELOW)

†Threat categories for species at risk as identified by the Government of Canada and/or the Government of Alberta. This assessment includes species and sub-species identified by Canada's Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered, Threatened, Special Concern, or Data Deficient; listed under Canada's Species at Risk Act (SARA) as Endangered, Threatened, or Special Concern; recognized by Alberta's Ministry of Environment and Sustainable Resource Development (ESRD) as May Be at Risk, At Risk, Sensitive, or Undetermined; and/or identified by Alberta's Endangered Species Conservation Committee (AB ESCC) as Endangered, Threatened, Special Concern, Data Deficient, or In Process.

Species Spotlight: Woodland Caribou

The Woodland Caribou has the highest public profile of any species at risk in the OSR. While the ABMI does not detect this species often enough to assess its status, comprehensive monitoring by the Alberta Caribou Committee, and now the Ministry of Environment and Sustainable Resource Development (ESRD), has been in place for many populations since 1993. The Government of Alberta has published the results of this monitoring activity as recently as 2010.[10]

In Alberta, there are a total of 16 caribou populations that have recently been grouped into two recognized conservation units (termed "Designatable Units" by COSEWIC 2011)[11]: Central Mountain and Boreal. The Boreal Caribou is predominantly located in the OSR, with six populations occurring in and around this region (Figure 17):

- *Cold Lake*
- *East-side Athabasca*
- *Nipisi*
- *Red Earth*
- *Richardson*
- *West-side Athabasca*

The Chinchaga population slightly overlaps the OSR along its western boundary.

Although the exact number of caribou in each of these seven populations remains uncertain, the best available scientific evidence indicates that the populations have been declining over the past 20 years. During that time period, the estimated annual rates of decline for the populations range from -4.6% to -15.2% per year (Figure 17).

Recent genetic science suggests that six of the seven populations in the OSR are indistinguishable from one another.[12] However, these six populations are genetically distinct from other Boreal Caribou populations north and west of the Peace River, including the Chinchaga population, and from those located in west-central Alberta.

It is therefore unlikely that populations in the OSR will gain new members from caribou populations in other parts of the province.

Human Footprint in Woodland Caribou Populations

Tracking the amount of human footprint and habitat is important for the effective management of Woodland Caribou in the OSR. Managing the rate of human land-use development and recovery is an important component of caribou recovery. The ABMI provides scientific information on status and trend of human footprint for the province of Alberta, including the seven population ranges that overlap with the OSR.

In 2010, the total amount of human footprint in each of the seven Woodland Caribou population ranges varied from a low of less than 1% in the Richardson range to a high of over 7% in the Nipisi range (Table 03). The greatest net change in human footprint from 2007 to 2010 occurred in the Nipisi range with an increase of 1.3% total footprint.

TABLE 03

CHANGES IN HUMAN FOOTPRINT CIRCA 2007 AND 2010 FOR SEVEN CARIBOU POPULATIONS THAT AT LEAST PARTIALLY OVERLAP WITH THE OSR.

Range/Population	Total Area of Range (km^2)	2007 Total Human Footprint	2010 Total Human Footprint	Net Change in Human Footprint (2007 to 2010; %)	Rate of Change in Human Footprint (2007 to 2010; %)
Chinchaga	17,644	5.3	5.8	0.5	9.4
Cold Lake	6,726	2.8	3.3	0.5	17.9
East-side Athabasca (ESAR)	13,154	4.8	5.3	0.5	10.4
Nipisi	2,104	6.0	7.2	1.3	20.0
Red Earth	24,702	2.8	2.8	0.1	2.1
Richardson	7,074	0.8	0.9	0.1	12.5
West-side Athabasca (WSAR)	15,707	2.1	2.4	0.3	14.3

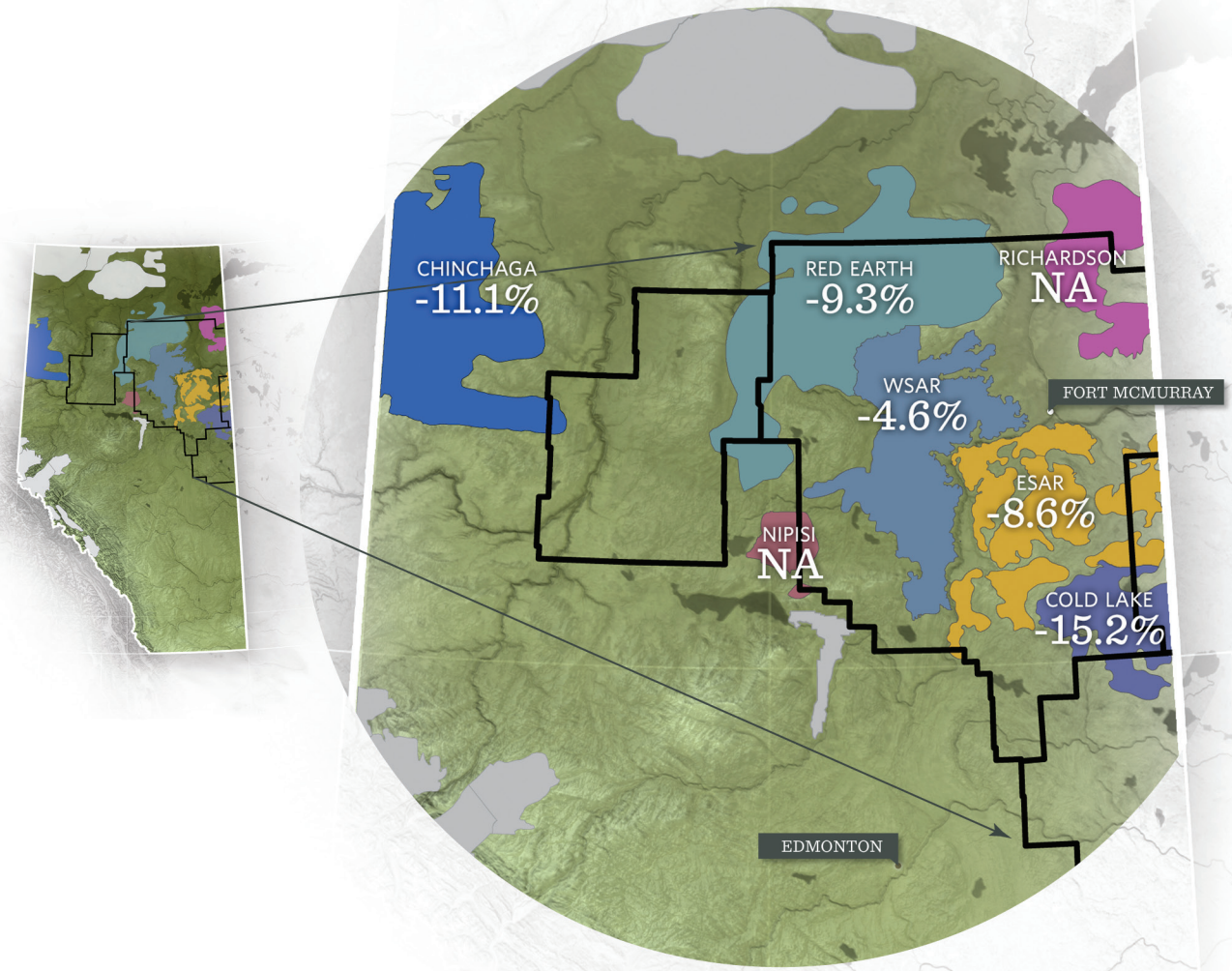


FIGURE 17

AVERAGE ESTIMATED ANNUAL RATE OF POPULATION CHANGE (OVER THE PAST TWO DECADES) FOR SEVEN WOODLAND CARIBOU POPULATIONS THAT OVERLAP WITH THE OSR. THE BOREAL DESIGNATABLE UNIT IS PREDOMINANTLY LOCATED IN NORTH-EASTERN ALBERTA.

Habitat

Habitat Elements

Resource managers do not often manage for individual species but instead manage habitat. There are several key habitat elements that are important to many species that live in the boreal forest, including large trees, snags (or standing dead trees), and downed woody material (or fallen dead trees). For example, many birds, such as chickadees and woodpeckers, are associated with large trees and snags for nesting and foraging; these birds are known to be sensitive to a reduction in these forest habitat elements. Mammal species, like Fisher and Marten, also use large snags and fallen trees as den sites; fallen trees are also important for these species during the winter, providing them with access routes under the snow as they hunt for prey. Fallen trees have a number of other important functions in the boreal forest, such as improving soil fertility and health by storing organic matter, moisture, carbon, and nutrients; serving as seed or spore germination sites, particularly for some mosses; and supporting diverse communities of invertebrates, such as oribatid mites, that are unlike communities found on the forest floor.

Overall, many components of biodiversity are linked to large trees, snags, and fallen trees. Because these habitat elements are generally more abundant in older forests, they can be challenging to maintain in landscapes managed for the production of timber, energy, or agricultural commodities.

Through the use of ground-based sampling, the ABMI assessed the status of living trees and snags in the OSR and found them to be 88% intact.

With the exception of large lowland conifer trees, all categories of living trees and snags were below what we expected to find under intact reference conditions (Table 04). Large deciduous trees and large snags differed the most from what we expected; they were 27% less abundant and 19% less abundant, respectively.

Through the use of ground-based sampling, the ABMI assessed the status of downed woody material in the OSR and found it to be 95% intact (Table 05).

CAVITY-NESTING SPECIES, LIKE THE PILEATED WOODPECKER, RELY ON DEAD AND DYING TREES FOR FORAGING AND NESTING.

TABLE 04

THE INTACTNESS AND BASAL AREA OF LIVING TREES AND SNAGS IN THE OSR.

Habitat Variable	Mean Basal Area* per Hectare (m^2/ha)	Intactness	Above or Below Reference Conditions
All Deciduous Trees	9.2	85 %	BELOW
Large Deciduous Trees	3.6	73 %	BELOW
All Upland Conifer Trees	2.7	94 %	BELOW
Large Upland Conifer Trees	0.8	89 %	BELOW
All Lowland Conifer Trees	13.0	99 %	BELOW
Large Lowland Conifer Trees	0.5	100 %	
All Snags	4.1	85 %	BELOW
Large Snags	1.0	81 %	BELOW

basal area is a common term used to describe the cross-sectional area occupied by all tree stems and/or snags, standardized to m^2/hectares in this case.

TABLE 05

THE INTACTNESS AND VOLUME OF DOWNED WOODY MATERIAL IN THE OSR.

Habitat Element	Mean Volume-per Hectare (m^3/ha)	Intactness	Above or Below Reference Conditions
All Downed Woody Material	32.1	92 %	BELOW
Large Downed Woody Material	14.4	98 %	BELOW

Reclamation in the OSR

Reclamation is a critical part of sustainable oil sands development. It is the process of returning a developed site to a natural or semi-natural condition (termed "equivalent land capability"[13] by the Government of Alberta). Industry is legally required to reclaim developed sites following the extraction of energy resources; reclamation is the final step in the life cycle of energy development in the oil sands.

Land reclamation is currently not keeping pace with development. In 2011, the active footprint of oil sands mining activities covered just over 76,000 ha.[14] Of this footprint, 104 ha (0.14%) has been certified as reclaimed and returned to the Crown as public land; a further 4,700 ha (6.2%) has been permanently reclaimed, but ongoing monitoring of ecological recovery of this land is required before an application for reclamation certification can be made.[14]

In areas where surface mining has occurred, reclaiming an area that has been stripped of soil, wetlands, forests, and all associated biodiversity poses many challenges. Reclamation of energy development sites outside of the mineable region, which is nearly 30 times larger, is technically less challenging, but no less important.

Clearly, successful reclamation of the surface mines and the in situ footprint is an important part of the long-term environmental sustainability of Alberta's oil sands regions. Currently, however, there are differing ideas about what constitutes successful reclamation; furthermore, there's a great deal of uncertainty around which ecosystems can be completely reclaimed.[e.g., 15] The science of reclamation continues to develop. Monitoring reclamation efforts and applying corrective measures using ecologically appropriate knowledge increases the probability that sites will be successfully reclaimed.

The ABMI is currently working to advance the science of reclamation monitoring to track the long-term ecological recovery of Alberta's reclaimed upstream oil and gas facilities.

Conclusion

Sustainable development of oil sands resources requires a clear understanding of not only the environmental costs linked to the continued expansion of energy infrastructure, but the opportunities to preserve environmental values. The biodiversity indicators set out in this report establish the current conditions that will be used to help judge environmental outcomes in the future.

In this report we describe the current status of human footprint and biodiversity in the OSR. We found:

- *As of 2012, the total human footprint across the OSR was 13.8%. Covering 7.4% of the OSR, agriculture was the largest human footprint, followed by forestry, which covered 2.9% of the OSR, and energy footprint, which covered 2.2% of the region.*
- *Overall, 86% of the OSR is composed of native habitat with a 0 m buffer from human footprint, while 3% of native habitat is at least 2 km away from any development.*
- *Biodiversity intactness for the OSR is 88%. The biggest ecological changes in the OSR are associated with higher-than-expected relative abundances of species that thrive in areas with human development, such as the Coyote and Black-billed Magpie. Species that prefer old-forest habitat, like Marten and Fisher, and the Black-throated Green Warbler, were often less abundant than would be expected if there were no human footprint, as were old-forest elements, like large trees and snags.*

Results from this report set the stage for openly addressing key questions such as:

- *What components of biodiversity are the most sensitive to energy development, and what might be done to minimize impacts?*
- *What are the cumulative effects of resource development on biodiversity, and how effective are efforts to manage regional cumulative effects?*
- *What is the impact of energy development on biodiversity as compared to other land uses, such as agriculture and forestry?*

With the OSR at 88% intact today, there is significant opportunity for land and resource managers to make informed and deliberate choices about its future. As development continues to unfold in the region, the ABMI will continue to measure and report on the changing state of biodiversity.

Next Steps

The ABMI will continue to work with federal and provincial agencies to implement scientifically credible monitoring systems for the OSR and for the province as a whole. Among the highest priorities for the ABMI will be to ensure integration between monitoring and land-use planning activities and to support the coordination of biodiversity monitoring with water and air monitoring initiatives.

The analyses in this report are preliminary as not all ABMI sites in the OSR have been sampled. As monitoring information for the region accumulates and our analysis methods continually improve, the ABMI will report on more species and habitats. A biodiversity status report is currently available for the Athabasca Oil Sands Area; in the coming years, similar reports will be available for the Peace River Oil Sands Area and the Cold Lake Oil Sands Area. Future reports will also report on biodiversity trends—the primary purpose of the ABMI. We look forward to providing updates to this report on a regular schedule.

General Terms

Limitations

The ABMI is designed primarily as a proactive tool used to identify the status, trends, and correlative relationships among common species, habitats, and human footprint. While the status and trends of some rare species and species at risk can be evaluated using the ABMI monitoring program, the monitoring program cannot directly evaluate all rare and endangered species.

The ABMI indices are based on the establishment of current, intact reference conditions that are statistical predictions designed to account for human footprint. These reference conditions and subsequent ABMI analyses and reporting do not account for historical changes in the overall abundance of a species (i.e., the ABMI cannot account for any change in a species that occurred before 2003). ABMI reference conditions have statistical uncertainty for individual species. This uncertainty will decrease as the ABMI surveys more sites in the OSR.

Looking Forward

The ABMI has made considerable strides in supporting biodiversity management in Alberta; however, we are just beginning. The ABMI continues to build momentum and is committed to:

- *Ensuring the effective delivery of relevant, timely, and scientific biodiversity information*
- *Improving biodiversity management by contributing knowledge to decision-making systems*
- *Supporting governments and industries in meeting their domestic and international reporting obligations*
- *Eliminating duplication and redundancy in provincial biodiversity monitoring*
- *Facilitating the transfer of information to government, industry, the research community, and the public*

SCIENTIFIC INTEGRITY

The ABMI is committed to the responsible analysis and evaluation of data. The ABMI holds itself to the highest ethical standards, including operational transparency, honesty, conscientiousness, and integrity. The ABMI strongly encourages the responsible and ethical evaluation and interpretation of the knowledge contained in this report. For a complete discussion of the ethical behaviour endorsed by the ABMI, please see Honor in Science, published by Sigma Xi (1997), available at www.sigmaxi.org/programs/ethics/Honor-in-Science.pdf. A broader discussion about the use of ABMI data and information can be found in Scope and Application of the ABMI's Data and Information (00048), Version 2008-01-04, Alberta Biodiversity Monitoring Institute, Alberta, Canada. This report is also available at www.abmi.ca under "Reports/Core Reports."

Disclosure

Data used in the preparation of this report are available on the ABMI's website and include species, habitat, and remotely sensed data collected between 2003 and 2012. The scientific methods used in analyses of data for this report are described in the following documents:

1. Alberta Biodiversity Monitoring Institute. 2011. Manual for Estimating Species and Habitat Structure Intactness (20029), Version 2011-07-07. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Available at www.abmi.ca under "Reports/Intactness Analyses."

2. Alberta Biodiversity Monitoring Institute. 2012. Manual for Reporting Human Footprint (20030), Version 2013-03-26. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Available at www.abmi.ca under "Reports/Standards and Protocols/Landscape Mapping Protocols."

Principal authors of this report are listed alphabetically: Jim Herbers, Dave Huggard, Katherine Maxcy, Tara Narwani, and Rob Serrouya. Joan Fang and Daiyuan Pan analyzed and helped interpret the data. Jim Schieck, David Walter, and Colleen Scott provided technical and editorial insight on various aspects of the report.

TERMS AND CONDITIONS OF REPORT

Preparation

In 2013, Canada's Oil Sands Innovation Alliance (COSIA) requested that the ABMI produce a custom biodiversity status report specific to Alberta's Oil Sands Region. COSIA funded the creation of this report. The following terms were applied as a condition of the ABMI preparing this report:

1. The ABMI reports on a standardized list of biodiversity indicators that are relevant to regional planning, policy, and management. Developed by the ABMI, these indicators were consistently applied.

2. The ABMI maintains full control over all language and messaging in this report.

3. This biodiversity status report encompasses the OSR and cannot be localized to smaller landscapes within the OSR unless already specified in this report.

4. This biodiversity status report uses data collected between 2003 and 2012.

5. The report was released publicly in a timely manner.

Image Credits

p.1: boreal landscape, credit: Michel Rapinski / p. 3: One-flowered Wintergreen, credit: Amy Nixon / pp. 4-5: bird recorder crew, credit: Chris Kolaczan / pp. 4-5: wetland monitoring, credit: Caitlin Willier / pp. 4-5: monitoring near industry, credit: Caitlin Willier / p. 10.: bee on Alsike Clover, credit: Marek Velechovsky / p. 10: boreal wetland, credit: Nils Anderson / p. 14: boreal landscape, credit: Nils Anderson / p. 15: agriculture, credit: Trevor Reeves / p. 15: Christina Lake, credit Julia Shonfield / p. 15: forestry, credit: Heiko Kueverlin / p.15: surface mining, credit:

Pembina Institute / p. 15: in situ site, credit: Monica Kohler / p. 19: Gregoire Lake, credit Sara Venskaitis / p. 24: Bay-breasted Warbler, credit: Gerald A. DeBoer / p. 26: Canada Lynx, credit: Dennis Donohue / p. 28: Oribatula, credit: Royal Alberta Museum / p. 30: Foxtail Barley, credit: Kirstan Tereschyn / p. 32: Perennial Sow Thistle, credit: Ruud Morijn / p. 34: Long-forked Moss, credit: Michael Lüth / p. 36: Canada Warbler, credit: Gerald A. DeBoer / p. 38: Caribou, credit: Nancy S. / p. 40: Pileated Woodpecker, credit: Brandon Smith / p. 41: mossy log, credit: Jason Johnston

Preferred Citation

The Alberta Biodiversity Monitoring Institute. 2014. The Status of Biodiversity in the Oil Sands Region of Alberta: Preliminary Assessment. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Report available at www.abmi.ca.

References

1. Ministry of Energy. 2013. About Oil Sands: Facts and Statistics. Available at www.energy.alberta.ca/OilSands/791.asp.
2. Government of Alberta. 2010. Describing the Integrated Land Management Approach. Available at www.srd.alberta.ca/LandsForests/IntegratedLandManagement/default.aspx.
3. Government of Alberta. 2012. Lower Athabasca Regional Plan. Available at www.landuse.alberta.ca.
4. Stanton, T. et al. 2010. State of Watershed Payments: An Emerging Marketplace. Available at www.forest-trends.org/documents/files/doc_2438.pdf.
5. Balunas, M.J. and A.D. Kinghorn. 2005. Life Sciences 78(5): 431-441.
6. Brook, B.W. et al. 2008. Trends in Ecology and Evolution 23(8):453-460.
7. Andrew, M.E. et al. 2012. Biological Conservation 146(1):97-107.
8. Turestsky, M.R. et al. 2012. New Phytologist 196: 49-67.
9. Sanderson, L.A. et al. 2012. Forestry 85: 329-339.
10. Status of the Woodland Caribou (Rangifer tarandus caribou) in Alberta: Update 2010. Available at www.srd.alberta.ca/Fishwildlife/SpeciesAtRisk/.
11. COSEWIC. 2011. Designatable Units for Caribou *(Rangifer tarandus)* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 88 pp.
12. Serrouya, R. et al. 2012. Molecular Ecology 21:2588–2601.
13. Government of Alberta. 1993. Environmental Protection and Enhancement Act: Conservation and Reclamation Regulation. Alberta Regulation 115/1993.
14. Government of Alberta. 2013. Oil Sands Reclamation. Available at www.oilsands.alberta.ca/FactSheets.
15. Rooney, R.C. et al. 2012. Proceedings of the National Academy of Sciences 109:4933-4937.

Appendix 1

Summary of Biodiversity Intactness for the Athabasca Oil Sands Area

The ABMI assessed the status of 386 species in the Athabasca Oil Sands Area and found them to be, on average, 94% intact (Table A1). Please see the report The Status of Biodiversity in the Athabasca Oil Sands Area (available at www.abmi.ca) for a full description of results.

Summary of Biodiversity Intactness for the Cold Lake Oil Sands Area

The ABMI assessed the status of 415 species in the Cold Lake Oil Sands Area and found them to be, on average, 72% intact (Table A1).

Summary of Biodiversity Intactness for the Peace River Oil Sands Area

The ABMI assessed the status of 415 species in the Peace River Oil Sands Area and found them to be, on average, 85% intact (Table A1).

TABLE A1.

INTACTNESS* FOR DIFFERENT COMPONENTS OF BIODIVERSITY IN THE ATHABASCA OIL SANDS AREA, THE COLD LAKE OIL SANDS AREA, AND THE PEACE RIVER OIL SANDS AREA.

	Athabasca Oil Sands Area		Cold Lake Oil Sands Area		Peace River Oil Sands Area	
Biodiversity Component	No. of Species	Intactness	No. of Species	Intactness	No. of Species	Intactness
Native birds	71	90 %	80	62 %	80	76 %
Winter-active mammals	13	95 %	10	77 %	10	88 %
Armoured mites	62	95 %	57	76 %	57	88 %
Native plants	165	93 %	183	73 %	183	85 %
Moss	75	96 %	85	71 %	85	87 %
Overall Intactness	386	94%	415	72%	415	85%

Note: For intactness for the whole OSR, total reference and current abundances of a species are predicted for the whole region. These are used to calculate intactness for the whole region for each species, and these intactness values are then averaged for the overall intactness.

Alberta Biodiversity
Monitoring Institute

Edmonton Office
Alberta Biodiversity Monitoring Institute
CW 405 Biological Sciences Centre
University of Alberta
Edmonton, Alberta
Canada, T6G 2E9

Vegreville Office
Alberta Biodiversity Monitoring Institute
c/o Alberta Innovates – Technology Futures
Bag 4000, Vegreville, Alberta
Canada, T9C 1T4
www.abmi.ca

Alberta Biodiversity Monitoring Institute
@ABbiodiversity