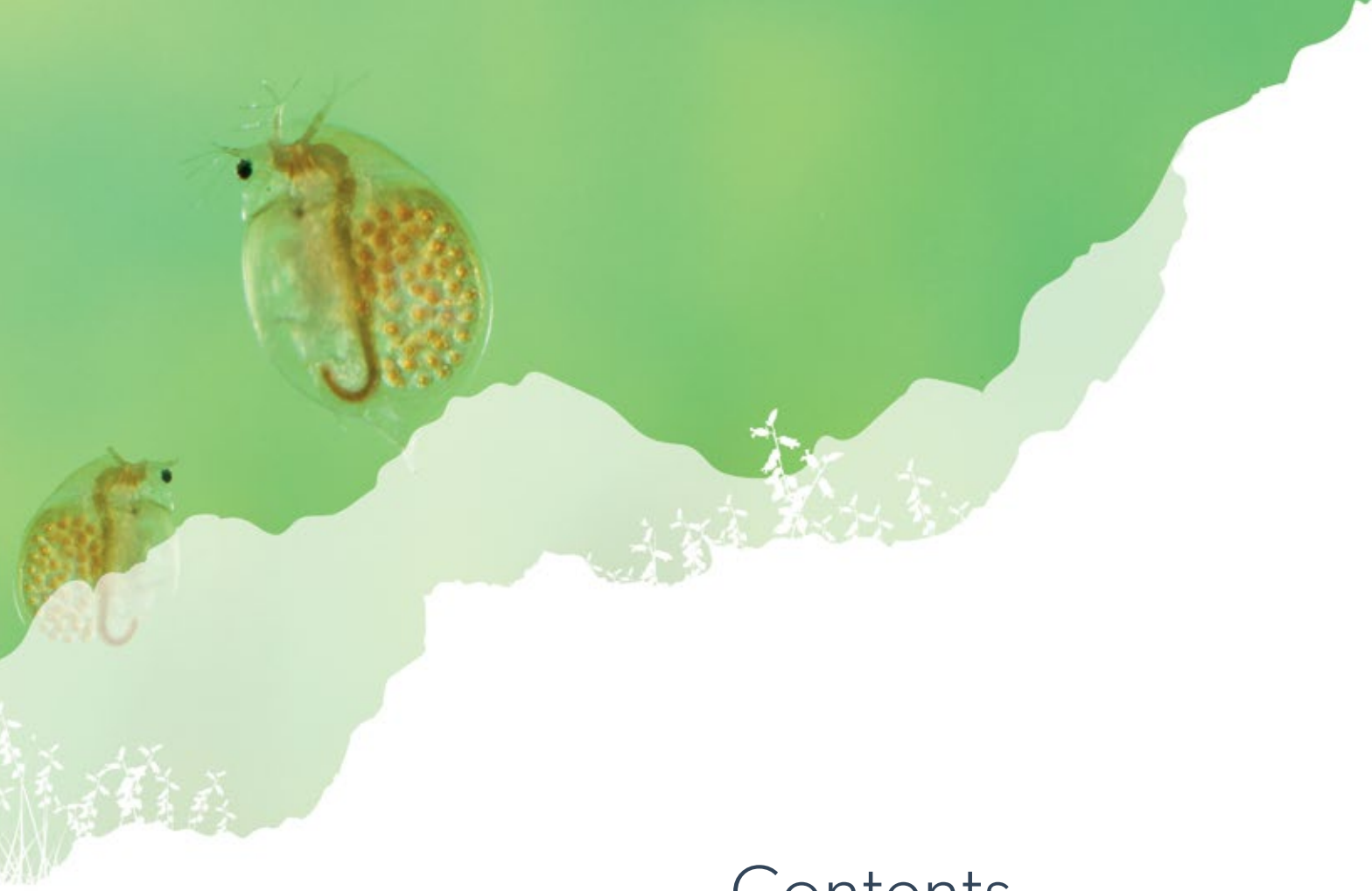
ALBERTA
BIODIVERSITY
MONITORING
INSTITUTE

Alberta Biodiversity Monitoring Institute

ANNUAL REPORT | 22–23



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Message from the Executive Director

I am delighted to present the annual report of the Alberta Biodiversity Monitoring Institute (ABMI) for 2022–23, which highlights our efforts in monitoring Alberta's wildlife and habitats using a range of tools and technologies, from satellites in space to species observations under the microscope.

Biodiversity serves as a vital indicator of ecosystem health and resilience. By monitoring and reporting on biodiversity, we're able to gain insights into how Alberta's changing landscapes are affecting our ecosystems. By making biodiversity knowledge accessible, we look to empower decision-makers with high-quality scientific information.

Highlights from 2022–23 can be found throughout this report and range from new taxonomic records in the province to the use of satellite imagery to monitor unwanted algal blooms in lakes. Front and centre in these achievements is the steadfast support provided by our collaborators, partners, and the entire ABMI team. Their dedication helps to fuel our mission and pushes the science of environmental monitoring forward, both within Alberta and beyond its borders.

I am pleased to introduce the establishment of our Geospatial Foundations Unit, which harnesses advanced technologies such as lidar and photogrammetric data to enhance habitat monitoring capabilities—and will empower us to glean insights on landscapes like never before.

Furthermore, I am delighted to introduce Biodiversity Pathways, an ABMI subsidiary committed to strengthening relationships with stakeholders and partners across Western Canada. Through Biodiversity Pathways, we aim to develop, support, and implement science-based monitoring programs with our neighbouring provinces and territories.

As we journey forward, we remain steadfast in our dedication to monitoring Alberta's biodiversity through the application of satellite and microscopic technology—and so much in between. We also recognize the growing significance of environmental social governance and sustainability reporting in today's world. We are hopeful that the breadth of our data, tools, and products will assist in guiding good stewardship for generations to come.

On behalf of the ABMI Management Team, I again would like to thank our Members, Board of Directors, delivery partners, funders, and collaborators for their continued support and shared commitment to building this strong foundation of biodiversity knowledge.

Jim Herbers
Executive Director,
Alberta Biodiversity
Monitoring Institute

Acknowledgements

The ABMI respectfully acknowledges that our work takes place on the territories of Treaties 6, 7, and 8, traditional and ancestral lands of First Nations and Métis peoples, whose histories, languages, and cultures are directly connected to the biodiversity that we monitor. We acknowledge the traditional teachings of the lands that we work on, and that reciprocal, meaningful, and respectful relationships with Indigenous peoples make our work possible. We are committed to supporting Indigenous-led monitoring programs, and learning Indigenous ways of knowing, being, and doing.

Thanks to our Partners and Sponsors

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Forest Resource Improvement Association of Alberta (FRIAA)

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Oil Sands Monitoring Program

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Tourism Fernie

Town of High Level (NWSAR)

Town of Okotoks

University of Alberta*

University of British Columbia

University of Calgary*

Wildlife Infometrics Inc.

* *The ABMI values the strong support provided from our delivery partners*

at InnoTech Alberta, the University of Alberta (UofA), and the University of Calgary (UofC). Without their invaluable contributions, many of the achievements we showcase in this report would not have been possible. Learn more about how our delivery partners support us here.

Thanks to our 2022–2023 Board of Directors

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Monitoring Alberta's Landscapes and Biodiversity

From satellite-based remote sensing to species identification through the microscope, the ABMI employs a diverse range of methods to monitor Alberta's biodiversity and land base across various scales.

As part of our Ecosystem Health Program, we conduct biodiversity surveys throughout Alberta, collecting data on Alberta's species and their habitats in both upland and wetland locations. Leveraging advanced remote sensing technologies and collaborations with the Government of Alberta, our geospatial work includes the Human Footprint Inventory (HFI) as well as habitat mapping and monitoring efforts. Through these initiatives, we have generated map products, datasets, and protocols that contribute to our understanding of Alberta's landscapes.

Our involvement in the Oil Sands Monitoring (OSM) program enhances our monitoring activities in Alberta's Oil Sands Region, and encompasses a range of terrestrial, geospatial, and wetland monitoring programs. Through targeted monitoring efforts and various collaborations, we are accumulating stratified datasets that aid in understanding how oil sands stressors are changing biological endpoints.

We are grateful for the support, collaboration and partnership of numerous organizations, as well as the invaluable contributions of our collaborators. Moreover, we extend our gratitude to the landholders across the province who generously grant us access to their land, enabling us to carry out our monitoring activities.

ECOSYSTEM HEALTH PROGRAM 2022–23

The ABMI's Monitoring Centre recruited 28 seasonal staff to support the 2022 field program. Field data are used to describe the status (distribution, abundance, and associations with land cover) and trend (change over time) of species throughout Alberta. Data collection involved

over 40 distinct protocols for both terrestrial and wetland sample locations. We collected information on nine different taxonomic groups and multiple habitat elements through our large-scale field campaign across the province. In 2022, we were able to collect Ecosystem Health Program data at 27 wetland and 56 terrestrial sites. Sampling effort was distributed across the province, including the Boreal Forest, Foothills, Rocky Mountain, Parkland, and Grassland natural regions. This program continues to evolve through the development of ABMI's Study Design 2.0. Field testing and planning are ongoing to support this initiative.

In addition to our Monitoring Centre's core field data collection activities, we also support ongoing methods development and testing. In 2022, the Monitoring Centre implemented simultaneous deployments of multiple camera models to ensure continuity and comparison over time. We also deployed a camera height comparison program at a subset of locations to evaluate the impact on detectability for different species at different camera deployment heights. Ongoing field evaluation of the aquatic invertebrate program also continues, with a methods comparison using the traditional ABMI protocol (composite transect approach) and the Canadian Aquatic Biomonitoring Network (CABIN: traveling sweep-net transect approach) protocol. We are working towards this duplicate sampling across natural regions to ensure comparability under these two protocols at a provincial scale.

INTRODUCING STUDY DESIGN 2.0

As part of our ongoing efforts to refine and adapt our core Ecosystem Health Monitoring Program, we made significant advancements in the development of a terrestrial monitoring "Study Design 2.0". These efforts included a refinement in our baseline program that enables completion within the next three years; design and site selection for our short-term change detection program, which will facilitate more rapid monitoring of biodiversity change; and research and scoping to support future development of biodiversity and climate change monitoring.

Sampling effort was distributed across the province, including the Boreal Forest, Foothills, Rocky Mountain, Parkland, and Grassland natural regions.

SUPPORTING THE OIL SANDS MONITORING PROGRAM

The ABMI supports the delivery of the OSM program—a regional monitoring effort designed to detect environmental change as a result of oil sands stressors. We supported several program areas for OSM in 2022–23. First, we continued our work with an integrated team of collaborators to monitor how the terrestrial environment is changing, as part of the Terrestrial Biological Monitoring (TBM) program. This included the second year of bird and mammal monitoring and the first year of vascular plant monitoring under a before-after dose-response (BADR) design—a large-scale, stratified monitoring program designed to improve understanding of how biodiversity is responding to oil sands activities. We also completed several technical reports and publications with these collaborators, with an emphasis on preliminary analysis of year 1 BADR data. Second, we supported the delivery of a wetlands surveillance program, working closely with Alberta Environment and Protected Areas (EPA) science leads. Our role in this program was focused heavily on data collection through field and lab work to support vegetation monitoring in wetlands. Finally, we initiated a habitat regeneration project focused on the use of large-scale light detection and ranging (lidar) to monitor the regeneration of vegetation on oil sands disturbances. This multi-year initiative will provide broad-scale coverage on the status of vegetation regrowth.

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GEOSPATIAL PROGRAMS

Earth Observations Insights

The ABMI's geospatial program creates products that help monitor Alberta's wetlands and lakes, uplands, human footprint, and vegetation recovery on human footprint features. In 2022–23, we continued to conduct wetland class and form mapping in Alberta's Grassland, Parkland, and Boreal Forest natural regions through collaboration with EPA and Ducks Unlimited Canada (DUC). Through an ongoing collaboration with the Uof A, Alberta Health, the Alberta Lake Management Society, and EPA, we used satellite imagery to monitor harmful algal blooms in Pigeon Lake, Wabamun Lake, and Lac la Biche. In early 2023, we received an Alberta Innovates Water Innovation Program grant for continued research and monitoring expanding to other large lakes in Alberta. Upland land cover classification maps were also produced for a pilot area (37,500 km^2) in the Boreal Forest Natural Region.

Human Footprint

In addition, the 2020 Human Footprint Inventory (HFI) for Alberta delineates surficial human disturbances that are visible from SPOT6 satellite, and is available to view on the ABMI's mapping portal and to download.

Geospatial Foundations

More detailed information on human footprint and land cover using lidar and photogrammetric data are produced by the Geospatial Foundations team for the Vegetation Regeneration Mapping program. In 2022–23, ABMI acquired over 30,000 km^2 of new wide-area lidar data (12 points per m^2) and high resolution RGBN aerial imagery in the boreal forest and Porcupine Hills. These are used

in conjunction with additional data from the forestry industry, to map the regeneration of vegetation on human footprint features in Alberta's Woodland Caribou ranges. From the imagery we photogrammetrically derived training and validation datasets on vegetation density, height, and species. From the lidar data we produced digital elevation models and canopy height models, among other derivatives. Together these provide the key inputs for new machine learning models that classify vegetation on human footprint features, including seismic lines, and can be used to inform the prioritization and planning of reclamation treatments.

CAPTURING ALBERTA'S BIODIVERSITY THROUGH ENVIRONMENTAL SENSORS

As part of the 2022–23 Ecosystem Health Program, 194 autonomous recording units (ARUs) and 215 remote cameras were deployed, with ongoing data processing. In total, 49 wildlife species were documented from the processed camera data. Of the acoustic data collected, 1,196 recordings totalling 1,892 minutes were processed, and 158 wildlife species including amphibians, birds, and mammals were documented.

As part of the 2022–23 OSM program, 197 ARUs and 210 remote cameras were deployed. Uploading and processing of the data are in progress. After processing, the data will undergo a quality assurance/quality control (QA/QC) process before being publicly released.

Once complete, the ARU and remote camera datasets will be available for download through the "Data Downloads" portal of WildTrax.

Photo of *Pterochthonius angelus* (Angel-winged soil mite)

Spotlight
Open Data

A cornerstone of our operations, Open Data is the philosophy and practice of making data freely available, easy-to-access, and easy-to-use by anyone. Open Data is increasingly recognized world-wide as a valuable way to increase efficiency, transparency, and participation in data-driven initiatives. Specific to the world of wildlife monitoring, Open Data can help address scientific questions by connecting people, facilitating cooperation and collaboration, and bringing together complementary datasets. We're committed to ongoing improvements in our ability to make data open, and proud of the many examples of these efforts you'll find throughout this annual report.

Science Innovation

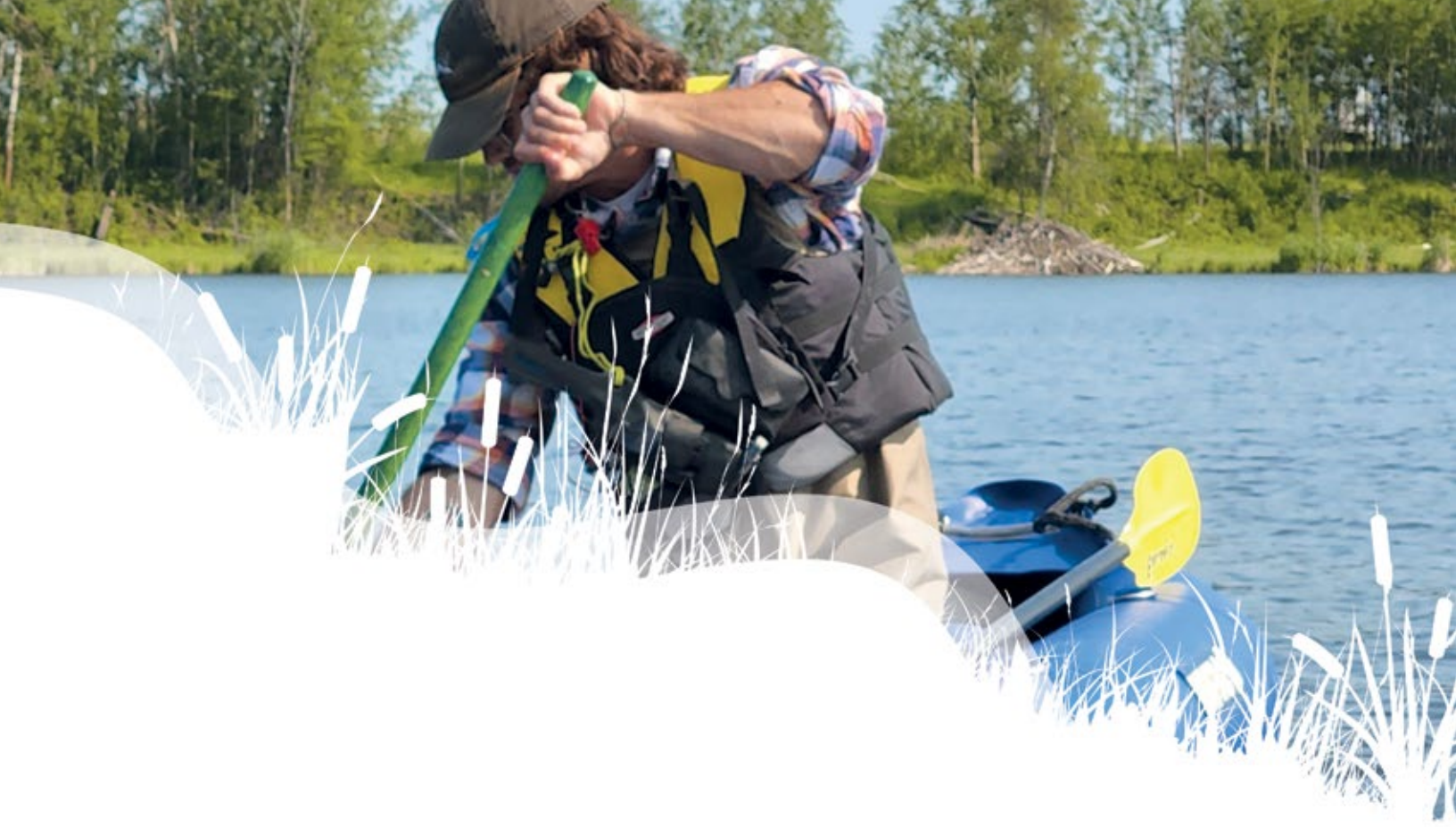
We believe that regular evaluation and improvement of our monitoring applications is critical to maintaining scientific rigour, relevance, and credibility. In 2022–23, we continued to advance our taxonomic expertise, as well as the science behind our monitoring designs, field protocols, and analytical methods. In addition to the highlights listed below, in 2022–23, the ABMI's Science Centre initiated a multi-year review of its modelling framework to assess whether our current modelling products effectively meet the needs of our partners and stakeholders. We anticipate this review will involve progressive rollouts of new approaches and products and we look forward to future engagement with stakeholders on this process.

For a complete overview of our scientific work and collaborations, including ongoing projects not highlighted here, please visit abmi.ca.

INNOVATING AND IMPROVING PROTOCOLS

As part of ongoing efforts to innovate and improve the way we monitor biodiversity, the ABMI implemented a number of new protocols in 2022–23. First, we continued testing and operationalization of our "small-plot" protocol for vascular plants, which is designed to capture changes in vascular plant abundance over shorter revisit periods. We reviewed and advanced species lists used in this protocol, and implemented data collection at a number of Ecosystem Health sites. This protocol is being finalized for large-scale roll out as part of our short-term change detection program. Second, we continued to evaluate different factors affecting detection rates of remote cameras used in wildlife monitoring. This work included both a literature review and field testing to increase our understanding of detectability trade-offs of working with remote cameras. Factors explored included camera deployment height, camera model, lure use, and placement of cameras on game trails.

We continued to evaluate different factors affecting detection rates of remote cameras used in wildlife monitoring.



HUMAN FOOTPRINT INNOVATION

Human land use, i.e., human footprint (HF), is a key driver of biodiversity change. In the Oil Sands Region we completed an enhanced Human Footprint Inventory (HFIe) for 2020. The enhancements included attributes by sector (including exploration vs. production disturbances for the oil and gas sector), status of vegetated cover, age attribution, light, and noise. Age attribution (i.e., year of origin) was completed for select feature types including reservoirs, borrow pits, railways, canals, mine sites, industrial sites, well sites, landfills, confined animal feeding operations, and harvest areas. We continue to work on "aging" the remaining sublayers using a variety of information sources including seismic line databases through our new agreement with Pulse Seismic.

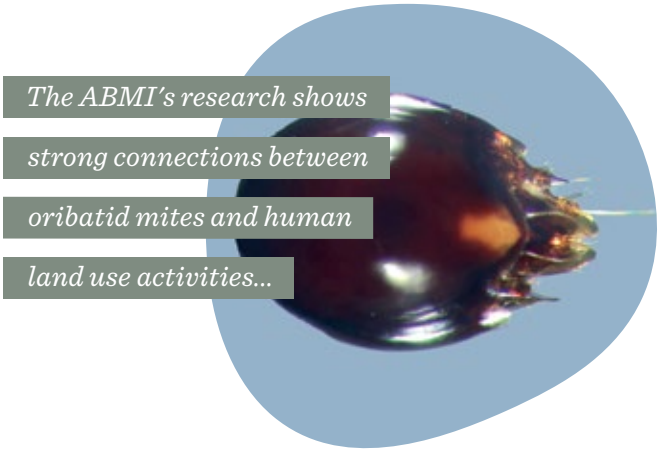
Artificial light and light pollution can modify ecosystem functioning at large scales. For well sites, industrial, and residential feature types, we incorporated nighttime light radiance values into the HFIe from monthly satellite image composites from the Visible Infrared Imaging Radiometer Suite sensor's Day/Night Band. The data have a spatial resolution of approximately 460m and are filtered to exclude impacts from lightning and lunar illumination, but have not been filtered to screen out light from fires or the aurora borealis. Only the months of October through March were used, to minimize the impacts of longer hours of daylight experienced in Alberta during the summer months.

Noise pollution also impacts biodiversity. Anthropogenic noise levels were modelled using boosted regression tree machine learning algorithms and acoustic sound recordings distributed across the region, as a function of the location's distance to potential HF-related noise sources. Working with researchers at the UofA, background noise levels were modelled from recordings lacking distinguishable anthropogenic noise and subtracted from overall noise levels. Mean noise levels for HF features were extracted using zonal statistics.

DARING MITE-Y THINGS: EXPLORING ALBERTA'S BIODIVERSITY THROUGH TAXONOMIC RESEARCH

Taxonomy continues to be a vital component of the ABMI's effort. ABMI researchers continue to find new taxonomic records for the province, including an oribatid soil mite, *Eremaeus occidentalis*, Behan-Pelletier, 1993, first discovered in Alberta from ABMI's 2022 soil collections in southwestern Alberta.

Taxonomy was also integral in assessing how land use and spatial-climatic factors influence oribatid mite communities in the Oil Sands Region of Alberta. In 2022, ABMI completed an analysis covering 13 years of soil monitoring, by examining a dataset resulting from detailed taxonomic analyses of more than 29,000 oribatid mites (201 species). In general, the study showed strong connections between oribatid mites and human land use activities that impact soil integrity (e.g., mines, cultivation), highlighting the utility of this taxonomic group as an indicator for assessing soil health over broad spatial scales, and the influence of a wide range of ecological factors and environmental stressors.



AQUATIC INVERTEBRATE COLLECTION METHODS COMPARISON STUDY

Since 2007, the ABMI has used a composite transect approach (CTA) to collect aquatic invertebrate samples from over 2000 wetlands across Alberta. A key feature of the CTA approach is that the method can be applied at any wetland regardless of depth or bottom composition. A more recently developed rapid assessment method, the traveling sweep-net approach (TSA), has been adopted by other organizations for sampling shallow, wadeable wetlands in Alberta. The TSA

method is much quicker to implement in the field and could result in cost savings for the ABMI while allowing for data integration with other organizations.

In 2018, the ABMI conducted a preliminary study to assess both methods in a side-by-side comparison to determine whether the TSA method could be adapted to a broader array of wetland types, and if TSA data would be comparable to the ABMI's historical CTA-generated data. With the results of the 2018 study being inconclusive, the ABMI initiated a three-year plan to better assess the two sampling methods. The first year of sample collection was completed in the summer of 2022 in conjunction with the ABMI's Ecosystem Health Program. A similar sampling regime will be used in 2023, with final specimen identification and data analysis expected to be complete by the summer of 2024.

USING MACHINE LEARNING AND RECOGNIZERS TO ENHANCE SPECIES IDENTIFICATION AND DATA PROCESSING

As the prevalence of environmental sensors such as ARUs and remote cameras continues to increase, the capacity of humans to process all of the collected data is becoming increasingly limited. The ABMI and the Uof A have been working to improve the use of machine learning to create recognizers that automatically identify species in recordings and images. This year we initiated the integration of Microsoft's new MegaDetector version 5 application into our WildTrax platform, for release in 2023-24, and continue to support Cornell's BirdNET for audio recordings. Testing of these tools is ongoing to determine what types of ecological questions can and cannot rely on computer-based processing. We have also developed tools to assess the loudness of birds on audio recordings, as an indication of proximity to the sensor, and are currently developing automated methods to assess the loudness of other captured sounds. This technique will dramatically increase our ability to estimate the density of vocalizing animals.

Working Collaboratively

We take pride in collaboration, in supporting the needs of partners, stakeholders, and Indigenous communities, and in sharing our work for broader benefit. The data and expertise we accumulate represent a continuously expanding wealth of accessible information, serving the interests of Albertans, as well as researchers and land managers across Canada and beyond.

Below, we spotlight several examples of where and how the ABMI is working collaboratively to further the goals and outcomes of biodiversity monitoring in Alberta and beyond. For more information, visit abmi.ca.

COLLABORATIONS WITH ALBERTA ENVIRONMENT AND PROTECTED AREAS

We were involved in a number of collaborative initiatives with EPA to ensure joint development of program areas and relevance of ABMI data and products. These collaborations spanned multiple topics, including, for example, i) indicator development to support land-use planning; ii) the development of metadata and protocol standards for the use of remote cameras for wildlife monitoring; iii) the establishment of a North American Bat Hub for Alberta and communal bat data storage system; iv) advancing data and approaches for caribou habitat tracking; and v) collaboration on the delivery of the Alberta Human Footprint Monitoring Program. EPA representatives were also involved on the ABMI's Board, Management Team, and Operations Team.

REMOTE CAMERA STEERING COMMITTEE

The ABMI continues to support the work of the Alberta Remote Camera Steering Committee (RCSC). In collaboration with Wildlife Camera for Adaptive Management (WildCAM—a remote camera network based in British Columbia), the RCSC aims to foster collaboration, enable science, and improve data management among remote camera users in western Canada.

In 2022–23, we supported EPA in developing version 2 of the provincial metadata standards, Remote Camera Metadata Standards: Standards for Alberta (RCSC 2023) which provides guidance on the types of data that should be collected and documented when using remote cameras. The ABMI worked actively with the RCSC, WildCAM, and EPA to complete the companion document, the Remote Camera Survey Guidelines (RCSC et al. 2023) in support of EPA's initiative to update the provincial Sensitive Species Inventory Guidelines. These guidelines offer recommendations on appropriate survey design,

camera deployment methods, and data management (for novice to advanced users). Both of these documents are available in the resources section of WildTrax. The ABMI continues to support outreach efforts alongside WildCAM through the provincial coordinator. Our provincial coordinator supported data amalgamation for the Regional Industrial Caribou Collaboration, and participated in other collaborative projects, including one at the UofA focused on feral horses and "Cameras and ARUs in the Foothills." In doing so, we have begun to unravel the complexities of large-scale and/or multi-method datasets, and furthered an existing initiative, which is to create bias correction factors for remote camera data.

ISOTOPES ANALYSIS: DEVELOPING INSIGHTS INTO THE HYDROLOGY OF ALBERTA'S WETLANDS

The ABMI has been working with InnoTech Alberta on the collection and analysis of water samples using isotopes since 2009. The initial focus of this work is to use isotopic tracer data (oxygen-18 and deuterium—specific types of oxygen and hydrogen molecules) to better understand the hydrology of wetlands. Isotope amounts vary in response to natural processes and so can tell us about important measures such as evaporation, runoff, and groundwater input. The unique and large sample set (1,022 samples!) provided by the ABMI resulted in an ability to understand broad regional trends in the Oil Sands Region and beyond. This work has identified the importance of groundwater in maintaining open water wetlands in the Oil Sands Region, and the potential geology driving those connections. This modelling will be used to support the prioritization of monitoring and understanding of potential impacts of development on wetland systems. The ABMI will continue to work with InnoTech Alberta to further enhance this highly valuable dataset and to use the model to support understanding of biodiversity consequences of differences in sources and drivers of inflow and outflow of water.

For more information read: Isotope-based water balance assessment of open water wetlands across Alberta: Regional trends with emphasis on the oil sands region.

The unique and large sample set (1,022 samples!) provided by the ABMI resulted in an ability to understand broad regional trends in the Oil Sands Region and beyond.

COLLABORATION WITH DUCKS UNLIMITED CANADA

Under a memorandum of understanding, the ABMI and DUC have developed a relationship that supports continued understanding of Alberta's wetland systems, and promotes the use of strong science in wetland stewardship, and collaboration on habitat mapping initiatives. In 2022–23, the organizations worked together closely and were successful in receiving funding for joint work towards these goals.

WETLAND GENOMICS COLLABORATION

Advances in the field of environmental genomics offer some exciting new opportunities for the future of biodiversity monitoring. In collaboration with InnoTech Alberta and DUC, the ABMI successfully led a funding proposal to the Alberta Innovates Water Innovation Program in 2022/23 to examine the effects of agriculture and climate change on aquatic invertebrates and waterfowl in prairie pothole wetlands. Fieldwork was initiated this spring, and over the next four years this project will help to expand the ABMI's understanding of the cumulative effects of intensive agriculture and climate change in aquatic ecosystems while expanding the use of new techniques in environmental genomics to support large-scale monitoring of aquatic invertebrates and plants.

FORESTRY SECTOR COLLABORATION: COMPARING BIODIVERSITY IN ALBERTA'S HARVESTED AND POST-FIRE RECOVERY AREAS

In collaboration with InnoTech Alberta, we initiated a project with eight forest industry partners, funded by FRIAA, comparing trajectories of biodiversity change in harvested areas to those in post-fire recovery areas. This is a multi-year mapping, monitoring, and reporting project considering vascular plants, birds, and mammals, incorporating a wide provincial coverage of forest management areas across a number of partner companies. The first year of the project saw the development of comprehensive mapping of forestry areas, silvicultural treatments, and burned areas, which will eventually be added to the ABMI's public mapping portal.

SUPPORTING INDIGENOUS COMMUNITY PRIORITIES

The ABMI continues to engage and work with Indigenous communities to gain a better understanding of monitoring needs and how Indigenous knowledge can be used to provide a more comprehensive picture of biodiversity in Alberta. In 2022–23, the ABMI's Community-based Monitoring and Engagement unit partnered with seven Indigenous communities interested in establishing wildlife monitoring programs using remote cameras. We provided support on monitoring program design and proposal writing, and provided training programs on how to use remote cameras for wildlife monitoring. This included program scoping and training workshops (camera deployment and retrieval, image processing), and ongoing logistical and program support. We also continued to partner with the Government of the Northwest Territories to develop an online environmental sensor training curriculum aimed at Indigenous communities, to allow the building of community-led monitoring programs.

Introducing

Biodiversity Pathways

In 2022, ABMI launched a national subsidiary known as Biodiversity Pathways. Functioning as an independent and science-based not-for-profit organization, Biodiversity Pathways collaborates with a network of organizations and individuals across jurisdictions to develop, support, and implement science-based monitoring programs to inform decision-making. Its initial operations have included wildlife monitoring and research across Western Canada through the work of the Wildlife Science Centre (an expansion of the Caribou Monitoring Unit) as well as scoping and initiating human footprint monitoring in British Columbia.

Visit biodiversitypathways.ca.

Knowledge Translation and Engagement

> *We believe in the importance of effectively sharing our biodiversity data and products. By actively engaging with our partners, collaborators, and stakeholders, and gaining an understanding of the needs of end users, we strive to develop products and services that are open, accessible, and contribute to fulfilling the information needs of Albertans.*

Below, we highlight ABMI's commitment to knowledge translation and engagement. For more information, please visit abmi.ca where you can also sign up for our newsletter.

REPORTING ON ALBERTA'S SPECIES AND ECOLOGICAL INDICATORS

The ABMI's online reporting services continue to grow. In 2022–23 we released two new online reports: the Status of Land Cover and Biodiversity in Norbord Inc.'s Operating Areas, and the Wetland Atlas of Alberta.

West Fraser Report (formerly Norbord Inc.)

In August 2022, we released the Status of Land Cover and Biodiversity in Norbord Inc.'s Operating Areas, produced at the request of Norbord Inc. (now part of West Fraser). ABMI data were used to describe baseline conditions for several ecological indicators such as human footprint, interior native habitat, and biodiversity intactness. Species spotlights included Grizzly Bear and Moose. And we presented a new analysis used to evaluate how landbase changes (e.g., new forestry footprint, fire) were predicted to affect birds and habitat elements.

Wetland Atlas of Alberta

The ABMI published the Wetland Atlas of Alberta in early 2023—an online resource highlighting ABMI wetland data and research in an easy-to-understand format. The Wetland Atlas of Alberta describes the distribution of wetlands in Alberta and summarizes human footprint around open water wetlands. Also highlighted are research spotlights on wetland biodiversity, including: aquatic invertebrates, wetland-associated mosses, amphibians, and plants. This first edition of the atlas represents the state of the ABMI's wetland knowledge to date. We will continue

to update ABMI information in the atlas and will also work to highlight wetland-related research and projects being conducted by other wetland organizations and practitioners in Alberta.

OUTREACH AND ENGAGEMENT

We are dedicated to ongoing engagement and outreach activities and employ various channels to share information and updates. Our newsletters and blogs serve as valuable resources for sharing information, progress, and achievements. We also leverage the power of social media, where we actively interact with our followers. In 2022, we shared 477 more posts across our social media platforms than in 2021, resulting in 158 000 additional post impressions. In 2022, as part of our commitment to outreach and engagement, we organized a number of events such as the ABMI field day, where partners and collaborators were invited to learn about ABMI monitoring techniques. We also hosted an engagement session with the UofA's academic community to share more about who we are and learn what their data needs are.

IT'S OUR NATURE TO KNOW WEBINAR SERIES

In 2022, we continued our webinar series, titled "It's Our Nature to Know," to share biodiversity information and showcase the endeavours of ABMI. These webinars encompassed diverse topics, such as introducing the Wetland Atlas of Alberta, reviewing the ABMI's 2022 field season, providing a summary of the Human Footprint Inventory, and presenting an overview of the amphibian monitoring program, and over 700 individuals registered to attend them over the year. Moreover, we created a series of instructional videos on utilizing WildTrax. These webinars are accessible on ABMI's YouTube channel. The webinar series will continue next fiscal, with planned quarterly webinars to foster continuous learning and knowledge sharing opportunities.

WILDTRAX

WildTrax—an ABMI- and UofA-led data management and processing platform for environmental sensor data—currently supports data from over 235 different organizations including federal, provincial and municipal levels of government, Indigenous groups, NGOs, and industry. In 2022–23, we implemented significant advancements in WildTrax's acoustic processing functionalities. These advancements included support for ultrasonic media, an enhanced upload process, more processing control, and the purchasing of infrastructure to support a national sounds archive data repository.

Updates to the acoustic platform to support ultrasonic media marked the largest update to WildTrax in 2022–23

Updates to the acoustic platform to support ultrasonic media marked the largest update to WildTrax in 2022–23, creating the infrastructure for more processing control. Within the processing interface, spectrogram and audio settings are now customizable and dynamic, providing options such as controlling the frequency range of the displayed spectrograms, amplifying or applying noise filters to the audio to isolate a signal, or customizing the time and even the display colour. Users can now also control their preferred spectrogram and audio settings for all tasks within each project's settings. The acoustic sensor overhaul now allows users to upload and manage data from ultrasonic media, such as from bat monitoring programs, which was previously not available. Refinements were also made to the project and recording upload process. Such enhancements included the ability to assign preset species groups, reducing the risk of identification errors by excluding species that don't occur within the study area, or to create single or

limited-species projects to focus on species of interest. A webinar was provided following this development release.

Lastly, at the end of 2022–23, development of WildTrax's remote camera processing functionalities was initiated, and included enhancements to the tagging interface, tagging fields, uploading process, and integrated Artificial Intelligence. These updates are to be released in early 2023–24. The WildTrax platform will continue to be maintained and enhanced to support user needs.

DISCOVERING BIODIVERSITY WITH ABMI'S DATA AND TOOLS

While ABMI raw data are always freely available to download, we work hard to create value-added data products that are easily accessible in various online tools. The Biodiversity Browser website, which houses the ABMI's species profiles, was revamped in 2022 to not only give it a new look, but more importantly, to improve the site's user experience. We updated species results to include 2021 data for most taxonomic groups; these datasets are available on our data download page. In addition, we added more natural history information for individual species; with more than 3000 species profiles available in the Biodiversity Browser, the addition of this kind of content will be an ongoing effort. The Mapping Portal allows users to view the ABMI's map products without any special software. This past year we added new aquatic datasets including the ABMI's wetland inventory and stream connectivity layers (created by EPA). Species occurrence layers and habitat suitability layers were updated. And maps of the predicted distribution of habitat elements were added. We will continue to add spatial datasets as they are developed. Lastly, all of the ABMI's field-collected data are available for download through the ABMI website. In 2022–23, the 2021 field data were made publicly available.

The behind-the-scenes maintenance of these tools and datasets should not be underestimated. We are continually updating security, software, data and databases, and documentation, not to mention storage of all this information. Updates are ongoing to safely manage our ever-growing datasets and to ensure that user needs are met.

Operational Excellence

Much of the ABMI's success as an organization stems from consistent attention to the processes that support operational excellence: strategic and operational planning; recruitment and retention of talented employees; strong policies and procedures; and engagement with our Voting Members, Board of Directors, partners, collaborators, and stakeholders.

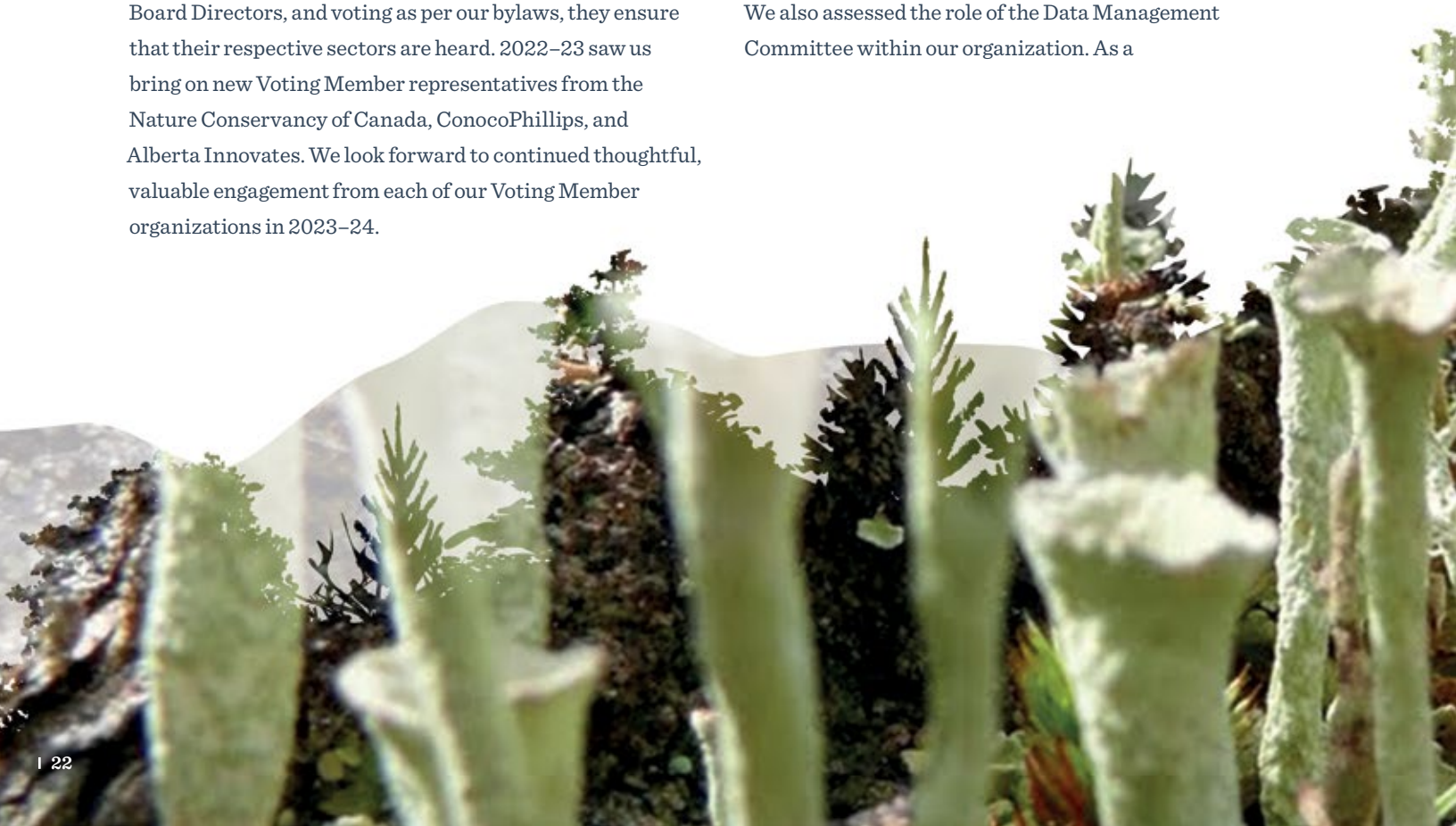
In 2022–23, we began to plan for and return to a combination of regular and modified operations as the COVID-19 pandemic began to wane. Our culture of adaptability allowed us to continue to achieve important outcomes to support environmental monitoring in Alberta.

MEMBER ENGAGEMENT

The ABMI is proud of the broad spectrum of interests represented by our Voting Member organizations. These organizations are intentionally invested in the strategic direction and future of our organization, and are provided with meaningful opportunities for input throughout our strategic and operational planning cycles. By appointing Board Directors, and voting as per our bylaws, they ensure that their respective sectors are heard. 2022–23 saw us bring on new Voting Member representatives from the Nature Conservancy of Canada, ConocoPhillips, and Alberta Innovates. We look forward to continued thoughtful, valuable engagement from each of our Voting Member organizations in 2023–24.

DATA QUALITY MANAGEMENT

Scientific credibility is a guiding principle of our operations. To ensure that we live up to this principle, we constantly evaluate how to integrate and/or refine quality assurance and quality control (QA/QC) processes as our programs evolve. Throughout 2022–23, we maintained our commitment to our existing QA/QC processes. Several quality management documents were updated, including our site confidentiality policy and its associated standard operating procedures (SOPs), as well as our camera trap processing SOP. In addition, two new SOPs were developed: one for acoustic data intake and processing, and the other for site naming specific to our support of the OSM program. We also assessed the role of the Data Management Committee within our organization. As a



result, updates were made to its role to better adapt to the continuous changes arising from the constant growth and evolution of our data management needs.

FINANCIAL ACCOUNTABILITY TO SPONSORS

The ABMI's funding comes from a variety of public and private sector sources, and our commitment to manage those funds responsibly and transparently is core to our operations. We adhere to best practices of financial accountability.

Careful financial stewardship also includes supporting our funding agreements via comprehensive engagement and reporting systems that assess and manage progress against deliverables. Our Board of Directors (via its audit committee) maintains careful oversight of our overall financial results.

ABMI Publications

for 2022–23

ABMI staff members publish peer-reviewed research and technical reports on a wide range of topics each year, as both primary investigators and as supporting members of collaborative teams. We make all our publications available via our publication archive.

Status of land cover and biodiversity in Norbord Inc.'s operating areas.

Alberta Biodiversity Monitoring Institute. 2022. Online report available at: https://abmi.ca/home/publications/601-650/617

Applying and testing a novel method to estimate animal density from motion-triggered cameras.

Becker M, DJ Huggard, M Dickie, C Warbington, J Schieck, E Herdman, R Serrouya, and S Boutin. 2022. Ecosphere 13(4):e4005. https://doi.org/10.1002/ecs2.4005

The spruce budworm genome: reconstructing the evolutionary history of antifreeze proteins.

Béliveau C, P Gagné, S Picq, O Vernygora, CI Keeling, K Pinkney, D Doucet, F Wen, JS Johnston, H Maaroufi, B Boyle, J Laroche, K Dewar, N Juretic, G Blackburn, A Nisole, B Brunet, M Brandão, L Lumley, J Duan, G Quan, CJ Lucarotti, AD Roe, FAH Sperling, RC Levesque, and M Cusson. 2022. Genome Biology and Evolution 14(6):1-18. https://doi.org/10.1093/gbe/evac087

Creating a detailed wetland inventory with Sentinel-2 time-series data and Google Earth engine in the prairie pothole region of Canada.

DeLancey ER, A Czekajlo, L Boychuk, F Gregory, M Amani, B Brisco, J Kariyeva, and JN Hird. 2022. Remote Sensing 14(14):3401. https://doi.org/10.3390/rs14143401

Picky eating as a means for coexistence.

Dickie M and R Serrouya. 2022. Proceedings of the National Academy of Sciences of the United States of America 119(40):e2213906119. https://doi.org/10.1073/pnas.2213906119

Where to begin? A flexible framework to prioritize caribou habitat restoration.

Dickie M, C Bampfylde, T J Habib, M Cody, K Benesh, M Kellner, M McLellan, S Boutin, and R Serrouya. 2023. Restoration Ecology:e13873. https://doi.org/10.1111/rec.13873

Intervention-forward adaptive management in the face of extinction.

Dickie M, AT Ford, R Steenweg, and R Serrouya. 2023. Trends in Ecology & Evolution 38(6):505-506. https://doi.org/10.1016/j.tree.2023.01.016

Amphibian eDNA pilot report: a collaborative project between InnoTech Alberta and ABMI.

Dooley J, S Koziel, and B Eaton. 2022. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Available at: https://www.abmi.ca/home/publications/601-650/623.

Assisted dispersal and retention of lichen-dominated biocrust material for arctic restoration.

Ficko SA, DH Haughland, and MA Naeth. 2022. Restoration Ecology 31(4):e13793. https://doi.org/10.1111/rec.13793

Isotope-based water balance assessment of open water wetlands across Alberta: regional trends with emphasis on the oil sands region.

Gibson JJ, P Eby, C Twitchell, C Gray, and J Kariyeva. 2022. Journal of Hydrology: Regional Studies 40:101036. https://doi.org/10.1016/j.ejrh.2022.101036

Getting to know our biomonitor neighbours: urban lichens and allied fungi of Edmonton, Alberta, Canada.

Haughland DL, A Hood, D Thauvette, SA Toni, M Cao, JD Birch, J Wasyliw, L Hjartarson, M Villeneuve, A Stordock, DA Fielder, M Lewis, D Evans, D Royko, R Bolduc, H Webster, JD Singh, KA Schafer, S Goyette, HE Davidson, and C Shier. 2022. Opuscula Philolichenum 21:33–181. https://www.nhm2.uio.no/botanisk/lav/RLL/PDF/R43924.pdf

Effects of natural land cover, anthropogenic disturbance, space, and climate on oribatid mite communities in Canada's oil sands region.

Lumley LM, ET Azeria, VA Giacobbo, and TP Cobb. 2023. Diversity 15(4):469. https://doi.org/10.3390/d15040469

Prioritizing populations based on recovery potential.

McLellan ML, M Dickie, S Boutin, M Becker, B Ernst, D Peel, KL Zimmerman, and R Serrouya. 2023. Conservation Science and Practice 5(4):e12905. https://doi.org/10.1111/csp2.12905

Demographic declines over time and variable responses of breeding bird populations to human footprint in the Athabasca Oil Sands Region, Alberta, Canada.

Saracco JF, P Pyle, DR Kaschube, M Kohler, CM Godwin, and KR Foster. 2022. Ornithological Applications 124(4):duac037. https://doi.org/10.1093/ornithapp/duac037

Ice, mountains, and people: applying a multi-proxy approach to reveal changes in Alberta's alpine ecosystems through ice patch research.

Tirlea D, T Kristensen, A Osicki , B Jensen, K Williams , R Caners, L Lumley, and R Woywitka. 2023. Journal of Glacial Archaeology 6:56-59. https://doi.org/10.1558/jga.25613

Media and Events

for 2022–23

CBC NEWS: HABITAT RESTORATION SHIFTS PREDATOR-PREY DYNAMICS OF ALBERTA'S CARIBOU AND WOLVES, STUDY SAYS

One of the threats facing Woodland Caribou in Alberta is increased predation by Gray Wolves because of linear disturbances (seismic lines, pipelines, access roads) associated with oil and gas development, which facilitate the movement of wolves through forested habitat. This CBC news article highlights a study by the Caribou Monitoring Unit of the ABMI, which examined efforts to restore these linear disturbances. The study found that revegetation of these linear features slows the speed of movement of Woodland Caribou and Gray Wolves by about 40% and 23%, respectively. Melanie Dickie, research coordinator for the ABMI's Caribou Monitoring Unit, explains that this, in turn, is expected to lead to fewer encounters between predator and prey, resulting in reduced predation on at-risk Woodland Caribou populations.

ABMI FIELD DAY

In September 2022, we hosted a field day at the Bunchberry Meadows Conservation Area, a parcel of land jointly managed by the Nature Conservancy of Canada and the Edmonton Area Land Trust, as part of our Annual General Meeting. We invited Member organizations and Board Directors to join us for hands-on demonstrations of Ecosystem Health field protocols, human footprint mapping, and emerging technologies such as eDNA. The day was a success, with many individuals "gamely" running back and forth in front of wildlife cameras!

FIELD GUIDE TO COMMON LICHENS OF EDMONTON

A printable booklet "Common Lichens of Edmonton Alberta" was created by ABMI lichenologist Dr. Diane Haughland. It includes easy-to-understand descriptions of the major types of lichen you'll find in Edmonton and photos of common species. Learn more by reading the full paper here or listen to Diane talk about how this guide came to be on CBC's Edmonton AM here.

A printable booklet "Common Lichens of Edmonton Alberta" was created by ABMI lichenologist Dr. Diane Haughland

Summarized Financial Statements

Year ended March 31, 2023

Independent Auditor's Report on the Summary Financial Statements

To the Board of Directors of Alberta Biodiversity Monitoring Institute

Opinion

The summary financial statements, which comprise the summary statement of financial position as at March 31, 2023, and the summary statements of revenues and expenditures and changes in net assets for the year ended March 31, 2023 and are derived from the audited financial statements of Alberta Biodiversity Monitoring Institute for the year ended March 31, 2023.

In our opinion, the accompanying summary financial statements are a fair summary of the audited financial statements, in accordance with Canadian Accounting Standards for Not-for-Profit Organizations.

Summary Financial Statements

The summary financial statements do not contain all the disclosures required by Canadian Accounting Standards for Not-for-Profit Organizations. Reading the summary financial statements and the auditor's report thereon, therefore, is not a substitute for reading the audited financial statements and the auditor's report thereon. The summary financial statements and the audited financial statements do not reflect the effects of events that occurred subsequent to the date of our report on the audited financial statements.

The Audited Financial Statements and Our Report Thereon

We expressed an unmodified audit opinion on the audited financial statements in our report dated September 21, 2023.

Management's Responsibility for the Summary Financial Statements

Management is responsible for the preparation of the summary financial statements in accordance with Canadian Standards for Not-for-Profit Organizations.

Auditor's Responsibility

Our responsibility is to express an opinion on whether the summary financial statements are a fair summary of the audited financial statements based on our procedures, which were conducted in accordance with Canadian Auditing Standard (CAS) 810, *Engagements to Report on Summary Financial Statements*.

Coyle E Company

Edmonton, Alberta
September 21, 2023

CHARTERED PROFESSIONAL ACCOUNTANTS

	2023	2022
ASSETS		
CURRENT		
Cash	$ 1,151,952	$ 1,041,370
Short term investments	1,734,834	2,003,682
Accounts receivable	1,535,211	902,850
Goods and services tax recoverable	208	-
Prepaid expenses	15,598	9,188
Due from related parties	398,090	-
	4,835,893	3,957,090
CAPITAL ASSETS	1,645,404	271,181
	$ 6,481,297	$ 4,228,271
LIABILITIES AND NET ASSETS		
CURRENT		
Accounts payable and accrued liabilities	$ 977,893	$ 693,006
Goods and services tax payable	-	67
Due to related party	-	43,948
Deferred contributions	992,401	372,597
Deferred capital contributions	1,241,500	-
	3,211,794	1,109,618
NET ASSETS	3,269,503	3,118,653
	$ 6,481,297	$ 4,228,271
REVENUES		
Government of Alberta	$ 5,931,240	$ 3,950,017
Government of Alberta Oil Sands Monitoring	3,832,781	3,080,352
Private sector	1,423,734	550,965
Application Centre	805,675	1,452,110
Government of Canada	448,485	635,000
Other government funding	83,426	15,000
Expense recoveries	76,503	52,966
Interest income	50,072	12,232
	12,651,916	9,748,642
STAFFING EXPENSES		
Executive Office	557,141	539,556
Science Centre	687,610	665,505
Geospatial Centre	1,487,417	1,252,659
Monitoring Centre	1,712,930	1,570,451
Lab Processing and Identification Centre	1,197,784	1,171,122
Information Centre	1,159,921	1,311,610
Operations Centre	677,372	-
Application Centre	-	363,597
	7,480,175	6,874,500

	2023	2022
OPERATING EXPENSES		
Executive Office	**275,434**	223,364
Science Centre	**13,220**	10,164
Geospatial Centre	**1,385,874**	35,221
Monitoring Centre	**1,595,396**	1,324,011
Lab Processing and Identification Centre	**176,190**	75,868
Information Centre	**245,052**	320,876
Operations Centre	**227,863**	-
Application Centre	**1,000,707**	1,677,980
	4,919,736	3,667,484
EXCESS (DEFICIENCY) OF REVENUE OVER EXPENDITURES FROM OPERATIONS	**252,005**	(793,342)
OTHER INCOME (EXPENSES)		
Loss on foreign exchange	**(101,155)**	
Canada Emergency Wage Subsidy	**-**	442,413
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENDITURES FOR THE YEAR	$ 150,850	$ (350,929)
NET ASSETS - BEGINNING OF YEAR	**$ 3,118,653**	$ 3,469,582
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENDITURES FOR THE YEAR	**150,850**	(350,929)
NET ASSETS - END OF YEAR	**$ 3,269,503**	$ 3,118,653

ON BEHALF OF THE BOARD

Director

Director

ABMI

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