Canadian Museum of Nature

Science Review 2022

canadian museum of nature
nature
musée canadien de la nature

Canada

RESEARCH CONDUCTED AND ENABLED BY THE CANADIAN MUSEUM OF NATURE

JEFFERY M. SAARELA

Vice-President, Research and Collections

AMANDA SAVOIE

Director, Centre for Arctic Knowledge and Exploration

SEAN TUDOR

Head, Collections Services and Information Management

Citation: Saarela, J.M., A. Savoie and S. Tudor. 2023. Canadian Museum of Nature Science Review 2022. Canadian Museum of Nature, Ottawa.

Cover photo: Paul Sokoloff © CMN 2023

CONTENTS


Marina
ABYSS

Scientific collections constitute important research infrastructure, enabling scientific research and discovery at local, regional, national and international levels. The collections of natural history museums are central to understanding and advancing knowledge of the past, present and future of biological and geological diversity as well as the public understanding of science. Documentation of the use of collections raises awareness of their relevance and facilitates their continued support and development.

The national natural history collection at the Canadian Museum of Nature is the foundation of the museum's scientific work on biodiversity and geodiversity in Canada and globally and has supported scientific research and public understanding of natural heritage for over 150 years. The collection is a world-class resource that enables global research and discovery about the natural world and how it is changing.

This Science Review documents the impact of the Canadian Museum of Nature on the generation of new scientific knowledge. In 2022, 260 scientific articles were published by Museum staff, associates, and other researchers whose work was enabled by the Museum's collections.

The global science impact of the Canadian Museum of Nature is substantial.

ABOUT THE CANADIAN MUSEUM OF NATURE

The Canadian Museum of Nature is Canada's national museum of natural sciences and natural history.

Our global vision is a sustainable natural future. As current environmental changes such as greenhouse gas emissions, species extinctions, and loss of natural spaces due to anthropogenic activities run counter to this vision, the museum aims to inspire change.

Our global mission is to save the world for future generations with evidence, knowledge and inspiration.

The museum creates and delivers inspiring and memorable connections with nature through impactful research programs, collections management, exhibitions, and engagement in a 21st-century global context.

The museum's galleries and programs are based at the Victoria Memorial Museum Building, a National Historic Site of Canada, in Ottawa, Ontario.

The museum houses and curates Canada's national natural history collection at its Natural Heritage Campus in Gatineau, Quebec. The collection comprises over 14.6 million natural history specimens. These provide the evidence museum scientists, associates, colleagues, and other researchers use as a base for their studies, resulting in the generation of new knowledge about the natural world.

This authoritative scientific collection spans the tree of life, including specimens of algae, animals, lichens, plants, and protists, and documents geological diversity, including minerals, rocks, and gems. The specimens are organized into 3.4 million units or lots, of which some 3 million are accessioned into the permanent collection and the remainder exist as prepared or unprepared backlog material. The museum's National Biodiversity Cryobank of Canada, a biorepository of frozen tissues, samples, and specimens from across Canada and abroad, is a source of material for genomic research conducted by staff and the international research community.

Each year, the museum's collection grows by about 20,000 new specimens. These specimens are obtained through staff field research, exchanges with other museums, purchases, and donations from collectors.

The museum also houses vital library and archival references about nature: a large collection of books and periodicals that is particularly strong in the fields of the Canadian Arctic, ornithology, systematics and taxonomy; an archival collection; a nature art collection; and a mixed media collection.

Two research centres of excellence are located at the museum's Natural Heritage Campus: the Beaty Centre for Species Discovery and the Centre for Arctic Knowledge and Exploration.

SCIENCE REVIEW METHODS

PAPERS BY MUSEUM STAFF AND RESEARCH ASSOCIATES

Papers published in 2022 by Canadian Museum of Nature staff and associates were found using internal reporting mechanisms and literature searches.

PAPERS BY EXTERNAL AUTHORS ENABLED BY CANADIAN MUSEUM OF NATURE COLLECTIONS

External researchers access Canadian Museum of Nature collection information by personal visits to the collections, by requesting information about specimens, by borrowing museum specimens, and by retrieving museum collection data shared online. Papers published in 2022 by external authors that indicate Canadian Museum of Nature collections contributed to the published research were discovered via manual literature searches. Searches were conducted for papers that cite one or more Museum specimens, indicate that one or more of the museum's collections was searched for speciemens relevant to study regardless of whether suitable material was found, indicate significant use of Museum collections for consultation and identification of species, or indicate that specimens associated with the published work were deposited in the Museum.

To conduct these searches, the following Canadian Museum of Nature collection codes were queried in Google Scholar: CAN (vascular plant), CANA (alga), CMNAR (amphibian and reptile), CMNA (annelid), CMNAV (bird), CANM (bryophyte), CMNC (crustacean), CMNFI (fish), CMNIF (fossil invertebrate), CMNFV (fossil vertebrate), CMNI (general invertebrate), CMNEN (insect), CANL (lichen), CMNMA (mammal), CMNML (mollusc), CMNPB (palaeobotany), CMNPYM and CMNPYF (palynology), and CMNPA (parasite). The acronyms CMN and NMC (National Museum of Canada, as the Canadian Museum of Nature was formerly known) and "Canadian Museum of Nature" were also queried.

Only peer-reviewed papers and other peer-reviewed contributions were considered; theses and preprints were excluded. For each publication by authors not affiliated with the Museum, the primary author's country was used as a proxy to assess the extent of the global community that used the Museum's collections.

Papers published in 2022 that cite a Global Biodiversity Information Facility dataset including one or more Canadian Museum of Nature specimens, as indexed on the Canadian Museum of Nature GBIF publisher page, were identified. Given the volume of 2022 papers that cite a GBIF-mediated dataset including Museum data, it was impractical to carefully review each study to confirm that downloaded Museum occurrence data was used in analyses reported in the paper. Instead, a subset of these papers was reviewed and summarized as examples of how GBIF-mediated Canadian Museum of Nature collection data is used by the international scientific community to address research questions that require a large amount of reliable biodiversity information from broad geographical areas.

CATEGORIES OF RESEARCH PAPERS

To characterize the types of research conducted and enabled by the Canadian Museum of Nature in 2022, each paper was assigned to one of the following four themes: Earth History and Evolution, Endangered Species and Conservation, Environmental Health, and Species Discovery. Although many papers could be placed under more than one category, the single category that best encapsulated each work was used.

A selection of papers is summarized under each theme, with an explanation of each paper's potential broader impact and contribution to advancing knowledge. These examples demonstrate the diverse science that museum researchers are engaged in and the many ways that Canadian Museum of Nature collections are used by others to generate new knowledge about the natural world.

2022 SCIENCE REVIEW

In 2022, 260 scientific papers were published by Museum staff and associates or enabled by the Canadian Museum of Nature's collections, excluding studies that used GBIF-mediated Canadian Museum of Nature data because it was impractical to comprehensively document them.

PAPERS BY MUSEUM STAFF AND RESEARCH ASSOCIATES

Museum staff authored or co-authored 74 publications and Museum research associates authored or co-authored 54 papers.

PAPERS BY EXTERNAL AUTHORS ENABLED BY CANADIAN MUSEUM OF NATURE COLLECTIONS

Canadian Museum of Nature collections contributed to research published in 132 papers authored by researchers not affiliated with the museum. Of these papers, 112 cite one or more Museum specimens, four indicate the authors searched a Museum collection for relevant material but found none, four indicate the authors either consulted Museum collections to help with identifying species, and 12 indicate the authors deposited voucher specimens from their study in the Canadian Museum of Nature. Affiliations of first authors of these papers represent 29 countries (Figure 1). The United States (44 papers) and Canada (32) are the best-represented countries in the dataset.

CATEGORIES OF RESEARCH PAPERS

Ninety-one publications fall under the Earth History and Evolution research theme, which includes palaeobiology and mineralogy studies. Seventy-five of these publications are in the field of palaeobiology (14 co-authored by Museum staff, 20 by Museum research associates, and 41 by researchers not affiliated with the Museum) and 16 are in the field of mineralogy (eight co-authored by Museum staff, one by Museum research associates, and six by researchers not affiliated with the Museum).

Eight papers fall under the Environmental Health research theme. Museum staff co-authored five of these, and researchers not affiliated with the Canadian Museum of Nature authored three.

Two papers fall under the Endangered Species and Conservation theme, both co-authored by Museum staff.

One hundred fifty-four papers fall under the Species Discovery theme. This theme includes papers focused on the taxonomy, systematics, and ecology of living (i.e., not extinct) biodiversity. Museum staff authored or co-authored 43 of these, Museum research associates authored or co-authored 29, and researchers not affiliated with the Canadian Museum of Nature authored 82. The papers by external authors focus on algae (2 papers), beetles (34), birds (3), bryophytes (4), fishes (10), lichens (7), mammals (7), molluscs, copepods and other non-insect invertebrates (8), vascular plants (6), and an assemblage of organisms (1).

LIMITATIONS OF OUR APPROACH

Although aiming to be comprehensive, some papers have likely been missed in this review, given the manual effort required to find and confirm relevant publications that meet our criteria for inclusion and the highly variable way that museum specimens and their repositories are referred to in scientific papers. Papers that cite Museum vascular plant specimens are particularly difficult to track in the literature and almost certainly underrepresented in our list. This is because the collection's acronym is "CAN" (a common English word), and the standard practice in botanical literature is to cite collection codes with reference to an external resource that defines those codes rather than defining the code within the text, which is routine, for example, in the entomological literature.

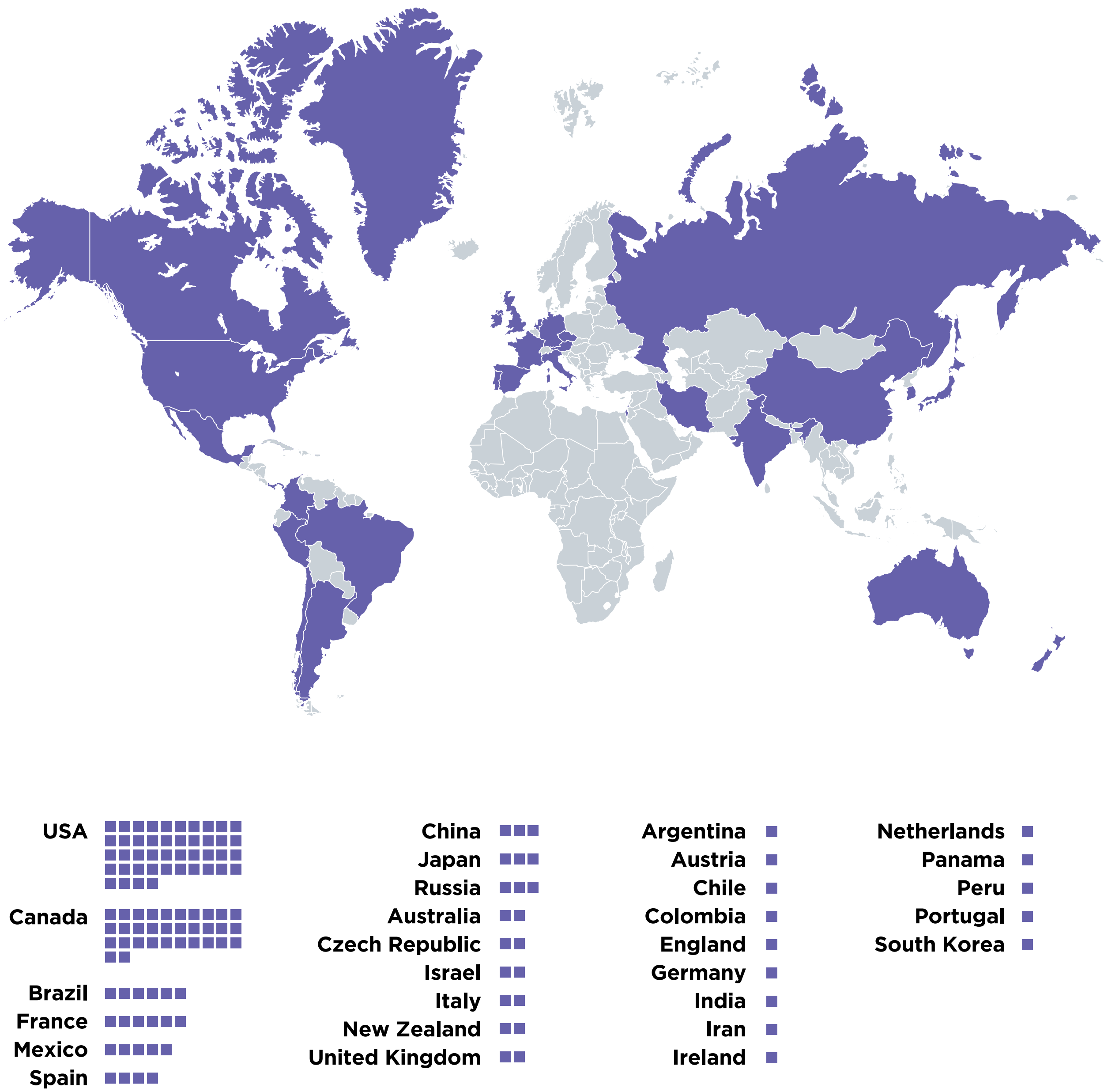


Figure 1. Summary of the geographical origins of papers published in 2022 and the number of papers from each country by researchers not affiliated with the Canadian Museum of Nature that used Canadian Museum of Nature collections or collections data, excluding studies that used GBIF-mediated Canadian Museum of Nature occurrence data.

SHARING DATA GLOBALLY

The Canadian Museum of Nature shares data online for 925,275 (30%) of its more than three million accessioned specimens or lots (Table 1).

Of these, 827,301 records are mobilized via the Global Biodiversity Information Facility (GBIF) and 97,974 (algae and mineral collections) via other online databases (Table 1). The completeness of these digital records varies, ranging from a species name and high-level geographical provenance (i.e., country and province/state; "skeletal" records) to complete collection information including geographical coordinates, which often must be determined secondarily, and one or more images of the specimen. A total of 74% of all mobilized museum data has geographical coordinate data and 73% of GBIF-mobilized museum data has coordinate data. One or more images are available for 13% of museum specimen records mobilized online; more than 89% of records with images are herbarium specimens, primarily vascular plants, which are flat and straightforward to image and have been a museum priority for imaging. Algal collections represent 10% of the total records with images. Non-botanical specimens represent less than 1% of all records with images.

The large number of papers that cite one or more Museum specimens or a GBIF dataset including specimen data from the Canadian Museum of Nature, even though the latter was not comprehensively documented, demonstrates how the Museum's collections contribute broadly to development of new knowledge by researchers from around the world.

As the global GBIF-mediated dataset grows, more and more researchers are likely to use the available information in their work. As more Canadian Museum of Nature specimens are digitized, a greater number of GBIF-mediated Canadian Museum of Nature data points will be available to the global community. As the proportion of georeferenced Canadian Museum of Nature specimens increases, a greater number of data points will be discoverable using map-based queries in the GBIF portal. As the proportion of images associated with Canadian Museum of Nature specimen records increases and those images are mobilized, the expected usage of those resources will increase, particularly in systematic and related biodiversity studies where an image may be useful or required for a specimen to be considered in a study (even if it is impossible to accurately identify a specimen to species level from an image, as is the case for many groups of organisms).

SHARING DATA GLOBALLY

Table 1. Summary of Canadian Museum of Nature collections, including number of physical specimens or lots, number of records digitized and mobilized online, number of mobilized records that are georeferenced, and number of mobilized records with an associated image. Digital resources are hosted on an Integrated Publishing Toolkit (http://ipt.nature.ca) and mediated by the Global Biodiversity Information Facility (GBIF) unless otherwise indicated. GBIF-mediated data summarized here were captured on 23 June 2023.

Canadian Museum of Nature Collection	Number of Physical Specimens or lots[1]	Number (%) of records[2] digitized and mobilized online	Number (%) of mobilized records georeferenced[3]	Number (%) of mobilized records with one or more specimen images
Herbarium[4]	1,072,528	298,238 (28)	215,872 (72)	105,140 (35)
Algae	161,881	55,418 (34)[5]	43,743 (79)[5]	11,938 (22)[5]
Bird	119,921	101,503 (85)	90,779 (89)	206 (0.2)
Crustacea	73,735	71,591 (97)	67,891 (95)	38 (0.05)
Fish	63,663	62,401 (98)	58,519 (94)	10 (0.02)
Mammal	59,703	59,668 (100)	44,475 (75)	11 (0.02)
Mollusc	132,992	50,989 (38)	38,190 (75)	252 (0.49)
Fossil Vertebrate	54,745	51,262 (94)	-[7]	46 (0.09)
Amphibian and Reptile	37,858	37,667 (99)	32,503 (86)	62 (0.16)
Faunal Assemblage	109,858	0 (0)	0 (0)	0 (0)
Insect	1,096,437	24,729 (2)	11,772 (48)	16 (0.06)
General Invertebrate and Annelid	42,150	30,945 (73)	27,713 (90)	48 (0.16)
Parasite	18,764	15,512 (83)	13,563 (87)	5 (0.03)
Palynology	14,569	14,566 (100)	-[7]	2 (0.01)
Palaeobotany	4,881	4,872 (100)	-[7]	1 (0.02)
Fossil Invertebrate	4,573	3,358 (73)	-[7]	0 (0)
Mineral	49,870	42,555 (85)[6]	35,743 (84)[6]	0 (0)[6]
TOTALS	**3,118,128**	**925,275 (30)**	**680,763 (74)**	**117,775 (13)**

1. These numbers are estimates and include only accessioned material; unprocessed backlog material is excluded.
2. "Records" means catalogueable units or lots, not total number of specimens (i.e., one jar of fishes, a catalogueable unit, may contain 12 individual specimens).
3. "Georeferenced" means the digital record includes geographical coordinates that allow the record to be mapped and retrieved in map-based queries. The numbers were determined including the GBIF location flag "Include records where coordinates are flagged as suspicious."
4. Including bryophytes, lichens and vascular plants. Algae are treated separately because their data are published in a separate database.
5. Mobilized via https://www.nature-cana.ca/databases/index.php
6. Mobilized via http://collections.nature.ca/en/Search/Index
7. Locality information for palaeobiology collections is shared only upon request.

EARTH HISTORY AND EVOLUTION

The Earth has a long history of change over time. Understanding the past can be key to managing the present and predicting the future. Museum scientists study and classify mineral diversity and work with rocks to understand how the Earth was formed. They also study fossils preserved in rocks and subfossils to understand how species have evolved, what aspects of their morphology may be important in explaining their biology, where they live, and how many of them there are (or were). By studying why some groups of organisms are successful with lots of species, and others not, we can better understand extinctions and how these might be explained and possibly even prevented. Understanding Earth history is a complex blend of geology and palaeobiology.

Papers co-authored by Canadian Museum of Nature staff

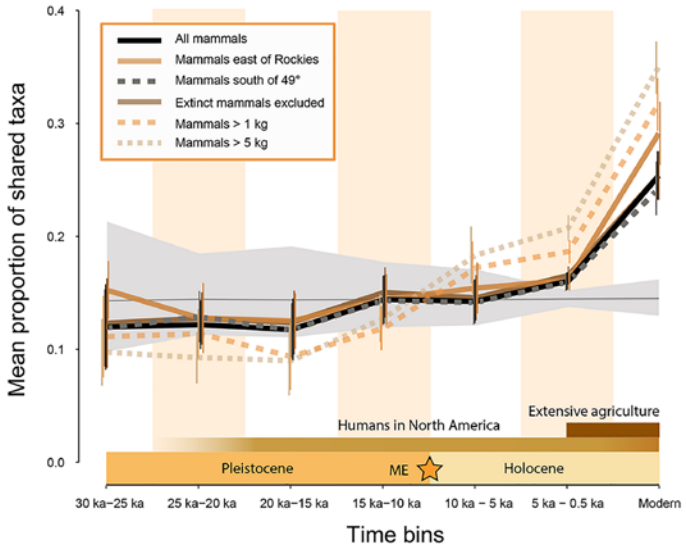
FRASER, D., A. VILLASEÑOR, A.B. TÓTH, M.A. BALK, J.T. ERONEN, W. ANDREW BARR, A.K. BEHRENSMEYER, M. DAVIS, A. DU, J. TYLER FAITH, G.R. GRAVES, N.J. GOTELLI, A.M. JUKAR, C.V. LOOY, B.J. MCGILL, J.H. MILLER, S. PINEDA-MUNOZ, R. POTTS, A.B. SHUPINSKI, L.C. SOUL AND S. KATHLEEN LYONS. 2022.

Late quaternary biotic homogenization of North American mammalian faunas.

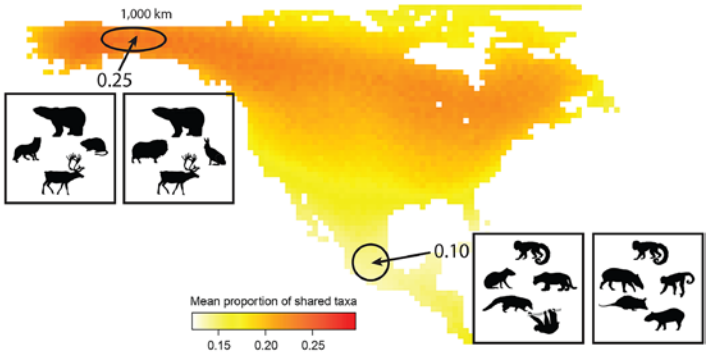
Nature Communications 13: 3940.
https://doi.org/10.1038/s41467-022-31595-8

Biotic homogenization, defined as increasing similarity in the composition of species among ecological communities, has been observed for numerous terrestrial and aquatic taxa over the past ~100 years. Although historical data provide valuable context for understanding anthropogenic effects, they provide only a partial, time-limited picture of biodiversity change.

In this study, Canadian Museum of Nature palaeontologist Dr. Danielle Fraser and colleagues from the Evolution of Terrestrial Ecosystems working group tested for biotic homogenization among North American mammals over the past 30,000 years, encompassing time periods before and after the arrival of humans in North America (~20,000 years ago). They found that by ~10,000 years ago, mammal assemblages in North America had undergone significant biotic homogenization. Homogenization occurred in two phases. The first phase followed the extinction of the mammal megafauna about 10,000 years ago, and the second phase was during human population expansion ~2,000 to 1,000 years ago. Modern mammal assemblages are the most homogenous of the last 30,000 years and are projected to become more homogenous over the 21st century. This is a conservation concern as homogenization can signal the replacement of spatially complex ecosystems by fewer, simpler ones and a loss of resilience. This study contributes to a growing body of evidence suggesting that humans have had ecological impacts for thousands of years.



Mammal assemblages undergo biotic homogenization during the Holocene. Source: Fraser et al. (2022), available under a Creative Commons Attribution 4.0 International licence.



Latitudinal patterns of mean taxonomic similarity for modern Western Hemisphere mammals measured as mean proportion of shared taxa. Source: Fraser et al. (2022), available under a Creative Commons Attribution 4.0 International licence.

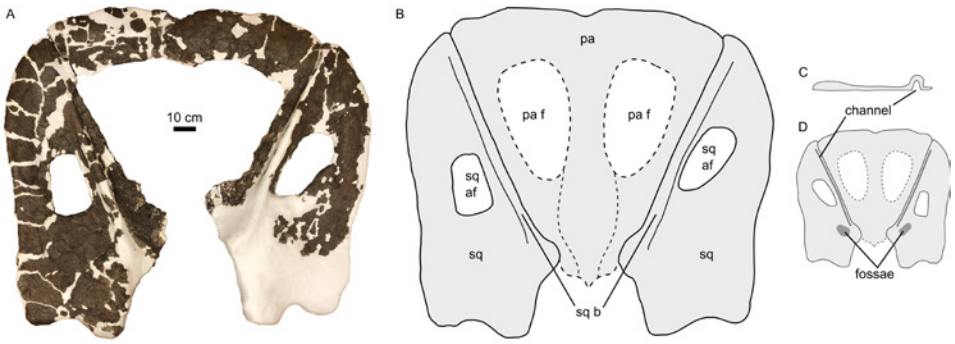
MALLON, J.C., **R.B. HOLMES**, E.L. BAMFORTH AND D. SCHUMANN. 2022.

The record of *Torosaurus* (Ornithischia: Ceratopsidae) in Canada and its taxonomic implications.

Zoological Journal of the Linnean Society 195: 157–171.
https://doi.org/10.1093/zoolinnean/zlab120

The horned dinosaur genus *Torosaurus* has a challenging history in terms of understanding its geographic distribution and taxonomy. *Torosaurus* has been reported from upper Maastrichtian (66.88 to 66.04 million years ago) deposits in Canada based on the presence of two frills, one from a locality in southern Saskatchewan and the other from a locality in southern Alberta. These records mark the genus' northernmost range. However, recent work has questioned the generic identity of the material. Some researchers have argued that *Torosaurus* is a skeletally mature growth form of *Triceratops*, which coexisted with *Torosaurus*. **In this study, Canadian Museum of Nature palaeobiologist Dr. Jordan Mallon and colleagues, including CMN research associate Dr. Robert Holmes, re-examined the *Torosaurus* frill material from Canada to clarify its taxonomic affinities.** They concluded that the frills are most plausibly assigned to *Torosaurus*, confirming its presence in Canada. Based on study of thin-sectioned bone from a femur associated with one of the frills, they found that the animal was still growing at the time of its death. Based on this evidence, they concluded that the material is not simply a mature growth form of *Triceratops*. Studies like this one contribute to our understanding of life on Earth in deep time.

A Torosaurus cast skeleton at the Milwaukee Public Museum in Milwaukee, Wisconsin, United States. Image: Michael Barera, available under a Creative Commons Attribution-Share Alike 4.0 International, via Wikimedia Commons.



Parietosquamosal frill of Torosaurus cf. T. latus (EM P16.1, housed in the Eastend Museum, Saskatchewan). A, dorsal surface; B, interpretive reconstruction of dorsal surface; C, schematic transverse cross-section of squamosal near caudal edge, based on sketch by H. Jones; D, schematic of frill, showing paired fossae and channels on ventral surface of squamosals, based on sketch by H. Jones. Image: Mallon et al. (2022), available under a Creative Commons Attribution-NonCommercial 4.0 International licence.

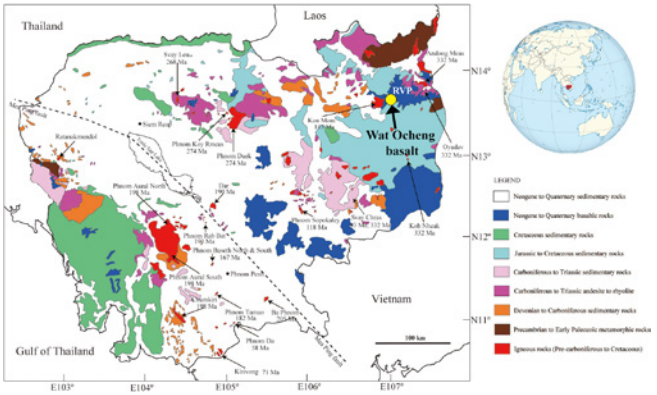
PIILONEN, P.C., **G. POIRIER**, W. LECHNER, **R. ROWE** AND R.P. RICHARDS. 2022.

Zeolite minerals from Wat Ocheng, Ta Ang, Ratanakiri province, Cambodia – occurrence, composition and paragenesis.

Canadian Mineralogist 60: 133–153.
https://doi.org/10.3749/canmin.2000113

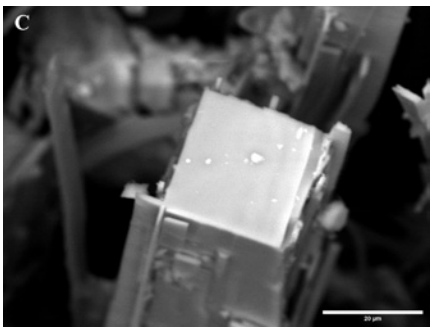
The Ratanakiri Volcanic Province is a large (1500 km^2) alkaline basalt field comprising both alkaline and transitional basalts located in the far northeast of Cambodia, along the border with Vietnam and bounded by the Tonlé Srepok and Tonlé Sesan (tonlé = river). It is part of the larger Southeast Asian Volcanic Province, which includes basalts in Vietnam, Thailand, and Laos. The Wat Ocheng basalt flow in the southwest corner of the Ratanakiri Volcanic Province is the first known occurrence of zeolite minerals in the Ratanakiri Volcanic Province and in Cambodia. **In this study, Canadian Museum of Nature research scientist Dr. Paula Piilonen and colleagues, including CMN senior research assistants Glenn Poirier and Ralph Rowe, characterized the zeolite minerals at this locality.** The Wat Ocheng basalt flow is a fine grained, vesicular to amygdaloidal tholeiite composed of lath-like plagioclase, interstitial augite, chabazite-Ca and phillipsite-Ca and minor skeletal ulvöspinel. The basalt amygdales contain six zeolite species (analcime, chabazite-Ca, gonnardite, natrolite, phillipsite-Ca, thomsonite-Ca) in addition to aragonite, calcite, celadonite, pyrite, and a smectite-group mineral. The distribution of zeolites within the amygdales is not homogeneous, indicating (1) decreased porosity between connected vesicles due to clay and fine-grained zeolite crystallization and (2) variations in the local fluid geochemistry, temperature and pH between the vesicles. The chemistry of the host rock minerals (Na-dominant plagioclase and volcanic glass) has had a strong control on the composition of minerals which formed in the amygdales. The unique epitaxial intergrowth of thomsonite-Ca on earlier natrolite is a direct expression of the Na-rich nature of the original basalt and the hydrothermal fluids. The authors define four phases of mineralization starting with early-stage clay minerals, two phases of zeolite crystallization and the last stage culminating in secondary calcite.

Piilonen and co-authors won the 2022 Hawley Medal for this paper. The Mineralogical Association of Canada awards the Hawley Medal to the authors of the best paper to appear in The Canadian Mineralogist each year. The award is named in honor of Dr. J.E. Hawley (1897-1965) who was distinguished professor of mineralogy at Queen's University.



Geological map of Cambodia. The Ratanakiri Volcanic Province (northeastern Cambodia, RVP) and other quaternary basalts in the country are in dark blue. The location of the Wat Ocheng basalt at Ta Ang, Ratanakiri province, where zeolite has been observed, is indicated by the yellow circle. Source: Piilonen et al. (2022).

Chabazite-Ca, one of the zeolite minerals identified from Wat Ocheng, Cambodia. Field of view: 6 mm. Source: Piilonen et al. (2022).



Secondary electron image of prismatic natrolite with a thin epitaxial growth of thomsonite-Ca, two zeolite minerals from Wat Ocheng, Cambodia. Source: Piilonen et al. (2022).

Papers by external researchers that cite Canadian Museum of Nature collections

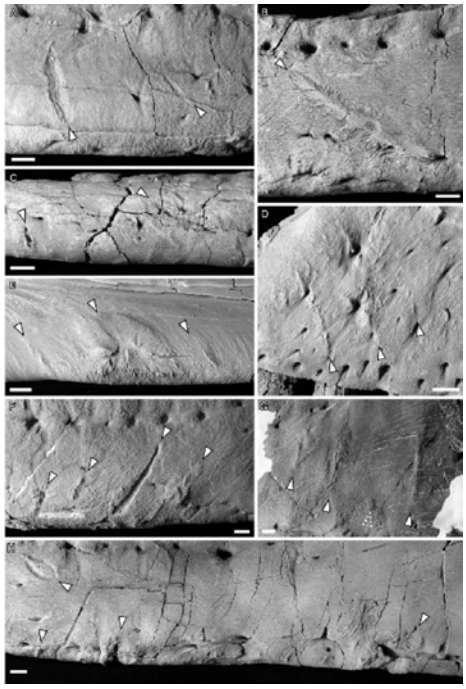
BROWN, C.M., P.J. CURRIE AND F. THERRIEN. 2022.

Intraspecific facial bite marks in tyrannosaurids provide insight into sexual maturity and evolution of bird-like intersexual display.

Paleobiology 48: 12–43.
https://doi.org/10.1017/pab.2021.29

Intrasexual selection is a type of natural selection in which members of the same sex compete for access to members of the opposite sex. Intraspecific aggression is a widespread intrasexual selective behavior important to understanding animal behavior. Although intraspecific aggression can be readily studied in living species, it is difficult to characterize in extinct ones, which limits researchers' ability to understand its evolution. Archosauria is an animal lineage that includes extinct (non-avian dinosaurs, pterosaurs, crocodilian relatives) and extant (crocodylians, birds) organisms. Among living archosaurs, intraspecific aggression is much more extensive in crocodylians than in birds, which show extreme visual/vocal intrasexual display. In this study, Caleb Brown and colleagues studied the origins of these behavioural differences and their patterns in tyrannosaurids, a group of non-avian dinosaurs that occupy an evolutionary position midway between basal dinosaurs and birds. They documented the morphology, frequency, and ontogeny (origin and development) of intraspecific facial bite lesions, indicators of intraspecific aggression, in a large sample of tyrannosaurids to infer intraspecific aggression patterns in the lineage. **The authors studied fossils of tyrannosaurid species housed in several museums, including specimens that are part of the Canadian Museum of Nature Fossil Collection.** They found that bite-mark lesions are present in multiple tyrannosaurid lineages. Based on these results, they suggested intraspecific face-biting behavior may be an ancestral character state for tyrannosaurids rather than having evolved independently multiple times in the lineage. Absence of bite-mark lesions in the theropod lineage that includes birds and their closest non-avian dinosaur relatives may be related to the evolution of feathers.

Artistic reconstructions of hypothesized intraspecific agonism (face-biting behavior) in Tyrannosauridae. Left, Two Gorgosaurus individuals square off in face-biting behavior. Right, The aftermath of face-biting behavior, showing recent wounds and older scars, in left lateral view. Art by Julius T. Csotonyi. Source: Brown et al. (2022), available under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International licence.



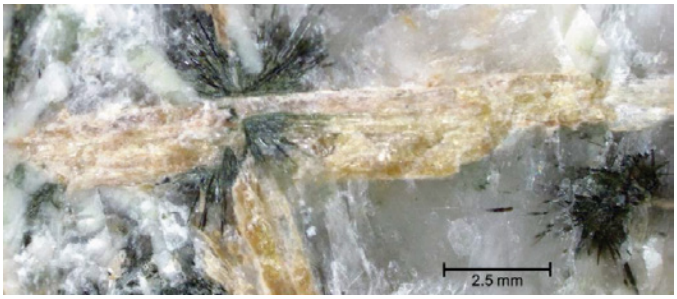
Photographs of ammonium chloride–dusted tyrannosaur cranial bones with healed and partially healed tooth-strike lesions indicated (arrows). Source: Brown et al. (2022), available under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International licence.

DAY, M.C., E. SOKOLOVA, F.C. HAWTHORNE, L. HORVÁTH AND E. PFENNINGER-HORVÁTH. 2022.

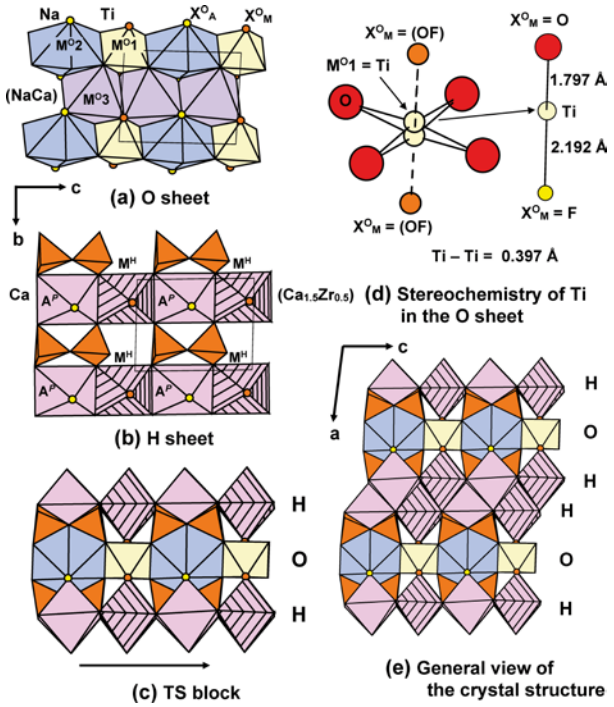
Bortolanite, Ca2(Ca1.5Zr0.5)Na(NaCa)Ti(Si2O7)2(FO)F2, a new rinkite-group (seidozerite supergroup) TS-block mineral from the Bortolan Quarry, Poços de Caldas Massif, Minas Gerais, Brazil.

The Canadian Mineralogist 60: 699–712.
https://doi.org/10.3749/canmin.2200001

Mineralogy experts discover and describe about 100 new mineral species every year. In this study, Maxwell Day and colleagues described the new mineral species bortonalite. This new species is a rinkite-group (seidozerite supergroup) TS-block (TS = Titanium-Silicate) mineral. The sample the authors examined was collected in August of 1996 by Laszlo Horváth in the Bortolan quarry, Poços de Caldas massif, Minas Gerais, Brazil. **The authors deposited the holotype specimen of bortolanite in the Canadian Museum of Nature Mineral Collection.** The tiny holotype, mounted on a glass fiber, is a fragment of the crystal (0.54 × 0.29 × 0.09 mm) used for electron-microprobe analysis. Bortonalite is pale-yellow to brown and has a vitreous luster and a pale-yellow to beige streak. The new species is of late magmatic origin and is related to the rinkite-group minerals fogoite-(Y), hainite-(Y), and götzenite. Bortolanite is one of 49 well-characterized TS-block minerals in the seidorizite group. Minerals associated with bortolanite are götzenite, nepheline, alkali feldspar, aegirine, natrolite, analcime, and manganoan pectolite. Studies like this one increase our knowledge of the geological diversity of our planet.



Pale-yellow lath-shaped aggregates of bortolanite intergrown with black radial acicular aegirine in a white matrix of albite, nepheline, natrolite, and analcime. Source: Day et al. (2022).



Details of the TS block in the crystal structure of bortolanite, a new species of mineral. Source: Day et al. (2022).

GREENWOOD, D.R., J.G. CONRAN AND C.K. WEST. 2022.

Palm fronds from western Canada are the northernmost palms from the Late Cretaceous of North America and may include the oldest Arecaceae.

Review of Palaeobotany and Palynology 301: 104641. https://doi.org/10.1016/j.revpalbo.2022.104641

During the Cretaceous, a geological period that lasted from 145 to 66 million years ago, the rapid diversification of flowering plants transformed Earth's vegetation. Several flowering plant families that exist today first appear in the fossil record during the mid- to Late Cretaceous. One of these is the palm family, Arecaceae. In this study, Greenwood and colleagues report Late Cretaceous palm leaf fossils from localities in southern Alberta and Saskatchewan, Canada. Previously, Canadian palm records from this period were known primarily from British Columbia. **Among the material studied is a specimen housed in the Canadian Museum of Nature Fossil Collection collected by W. Langston Jr. in Saskatchewan in 1962. The study also references W. Langston Jr.'s unpublished field notes for an Alberta locality on file at the Canadian Museum of Nature.** The authors assigned the Canadian Museum of Nature specimen to the fossil genus *Sabalites*, along with specimens from two other localities in Saskatchewan. The presence of fossil palms in southern Alberta and Saskatchewan indicates that the climate during the Late Cretaceous in high mid-latitudes of North America (c. 55° N) was warm, tropical to temperate, and humid. Studies like this one that advance our understanding of biodiversity in the deep past during different climate regimes can help us predict how contemporary biodiversity may respond to the rapidly warming climate.

Late Cretaceous palm leaf fossils, all Sabalites. Specimen number 5 (CMN PB 4636), from the Frenchman Formation (Maastrichtian), Chambery Coulee and Morgan Creek area, Saskatchewan, is housed in the Canadian Museum of Nature Fossil Collection. Source: Greenwood et al. (2022), available under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International licence.

ENDANGERED SPECIES AND CONSERVATION

Biodiversity is in trouble. Natural habitats are being lost, species diversity on Earth is declining, and we may be entering the next great period of extinction. Museum collections represent huge databases of relevant information about species presence in space and time. By studying collections, scientists can identify centres of diversity (hotspots), areas of endemism and ecosystems undergoing change. Through partnerships with organizations concerned with conservation, museums are irreplaceable sources of information in assessing species for their endangered status.

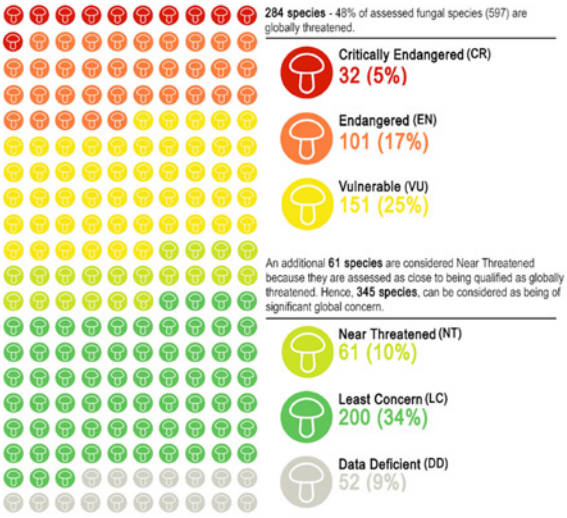
Papers co-authored by Canadian Museum of Nature staff

GREILHUBER, R. IRŠĖNAITĖ, J.B. JORDAL, T. KOSMANN, J. LENDEMER, **R.T. MCMULLIN**, A. MEŠIĆ, V. MOTATO-VÁSQUEZ, Y. OHMURA, R.R. NÆSBORG, C. PERINI, I. SAAR, D. SIMIJACA, R. YAHR AND A. DAHLBERG. 2022.

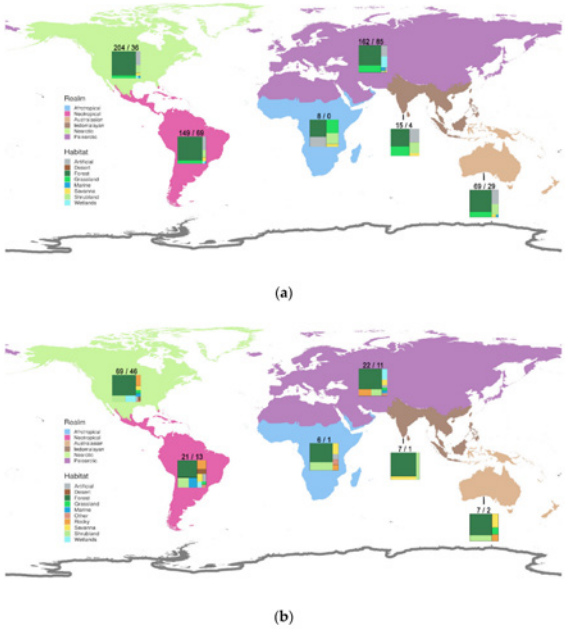
What do the first 597 global fungal Red List assessments tell us about the threat status of fungi?

Diversity 14: 736.
https://doi.org/10.3390/d14090736

Fungal species are not immune to the threats facing animals and plants and are thus also prone to extinction. Yet, until 2015, fungi were nearly absent on the International Union for the Conservation of Nature (IUCN) Red List. Recent efforts to identify fungal species under threat have significantly increased the number of published fungal assessments. **In this study, Greilhuber and colleagues, including Canadian Museum of Nature lichenologist Dr. Troy McMullin, provided the first global review of the extinction risk of fungi and the threats they face.** The review is based on the 597 species of fungi (lichenized and non-lichenized) included in the 2022-1 IUCN Red List update (21 July 2022). The authors found that nearly 50% of the assessed species are Threatened, 10% Near Threatened and 9% Data Deficient. The authors identified habitat loss/degradation followed by climate change, invasive species, and pollution as the primary threats to fungi. They discuss bias in the data and knowledge gaps and suggest actions to address these gaps. Given that fungal diversity and distributions are still poorly documented, there is great opportunity for the discovery of new knowledge, including by amateur mycologists and other community scientists using platforms such as iNaturalist.



Number of species in different Red List categories for the 597 fungi currently globally assessed on the IUCN Red List (July 2022). Source: Greilhuber et al. (2022), available under a Creative Commons Attribution 4.0 International licence.



Number of assessed species/threatened species in different biogeographic realms for (a) nonlichenized fungi and (b) lichens. The boxes illustrate the corresponding habitat occupied by these species. Source: Greilhuber et al. (2022), available under a Creative Commons Attribution 4.0 International licence.

Papers by external researchers that used Canadian Museum of Nature occurrence data mediated by the Global Biodiversity Information Facility

MIGICOVSKY, Z., B. AMYOTTE, J. ULRICH, T.W. SMITH, N.J. TURNER, J. PICO, C. CIOTIR, M. SHARIFI, G. MELDRUM, B. STORMES AND T. MOREAU. 2022.

Berries as a case study for crop wild relative conservation, use, and public engagement in Canada.

PLANTS, PEOPLE, PLANET 4: 558–578.
https://doi.org/10.1002/ppp3.10291

Crop wild relatives have a critical role to play in ensuring the future of food security and agriculture given climate change. In this study, Migicovsky and colleagues highlight the nutritional, cultural, and botanical significance of berries in Canda and explore how they can serve as a case study for the conservation, use, and public engagement of crop wild relatives. **The authors assessed the geographic distribution of 143 berry species in Canada with distribution models based on occurrence records mediated by the Global Biodiversity Information Facility, including many records from the Canadian Museum of Nature's National Herbarium of Canada.** They describe Canadian berries' health benefits, geographic distribution, and species at risk and suggest opportunities for conservation of berry species in both natural (e.g., protected areas) and non-natural contexts (e.g., botanical gardens, gene banks). They also describe the practices, strategies, and approaches used by Indigenous Peoples to steward berries and emphasize the importance of preserving and passing on this knowledge.

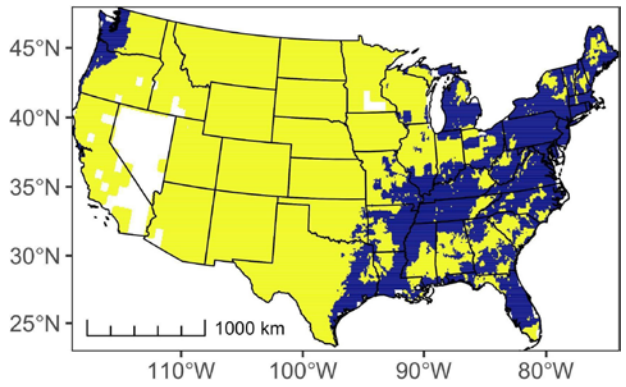
Vaccinium vitis-idaea (mountain cranberry), a native berry species growing on Baffin Island, Nunavut. This species is culturally important to Indigenous Peoples in Canada. Photo: Roger Bull/Canadian Museum of Nature.

MOUBARAK, M., I.R. FISCHHOFF, B.A. HAN AND A.A. CASTELLANOS. 2022.

A spatially explicit risk assessment of salamander populations to *Batrachochytrium salamandrivorans* in the United States.

Diversity and Distributions 28: 2316–2329.
https://doi.org/10.1111/ddi.13627

The fungal pathogen *Batrachochytrium dendrobatidis* (Bd), which causes the disease chytridiomycosis, is threatening amphibian populations worldwide. Recently, a closely related fungal pathogen called *Batrachochytrium salamandrivorans* (Bsal), which was thought to be confined to Asia, has spread to Europe, where it has caused significant declines in salamander populations. Although Bsal has not yet been detected in the United States, it poses a significant risk to salamander populations in the country, which has the highest salamander biodiversity globally. In this study, Moubarak and colleagues assessed the risk of salamander populations in the United States to Bsal. To do this, they (1) predicted the environmental suitability for the Bsal pathogen in the United States; (2) predicted the susceptibility of salamander species to Bsal infection using a machine-learning modelling approach that correlated life history traits with data on confirmed species infections; and (3) mapped the geographic ranges of the subset of species predicted to be susceptible to Bsal infection. **One of the datasets the authors used in their model comprised salamander occurrence data mediated by the Global Biodiversity Information Facility, including several thousand records from the Canadian Museum of Nature Amphibian and Reptile Collection**. The authors concluded that environmental suitability and susceptibility of salamander species to *Bsal* infection in the United States overlap the most in the Pacific Northwest, near the Gulf of Mexico, along the Atlantic coast, and in inland states east of the Plains region. Identification of these areas where risk of salamanders to a potential *Bsal* infection is greatest can guide conservation actions to protect at-risk salamander species from a possible new threat.



The areas (coloured blue) of the United States with the top quartile of risk scores to the pathogen Batrachochytrium salamandrivorans, based on a combination of environmental suitability for the pathogen and the susceptibility of species of salamander to infection. Source: Moubarak et al. (2022), available under a Creative Commons Attribution 4.0 International licence.

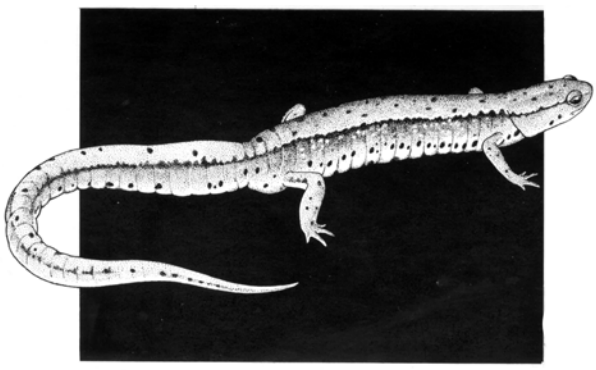


Illustration of a four-toed salamander (Hemidactylium scutatum), a lungless salamander native to eastern North America. Illustration: Charles Douglas/Canadian Museum of Nature.

ENVIRONMENTAL HEALTH

With increasing human population, our natural world is changing. Understanding human impacts on the natural world, such as those related to climate change, introduction of invasive species, and habitat loss, is key to ensuring a sustainable future. In many instances, knowledge about plants and animals can be used to measure and assess the general health of today's ecosystems. Identifying indicator species, those whose presence or absence are indicative of changes in ecosystem health, is often a simple and fast way to detect change. Border security and the prevention of introduced species is also a concern, as invasive species can often have profound impacts on the ecosystems to which they are newly introduced.

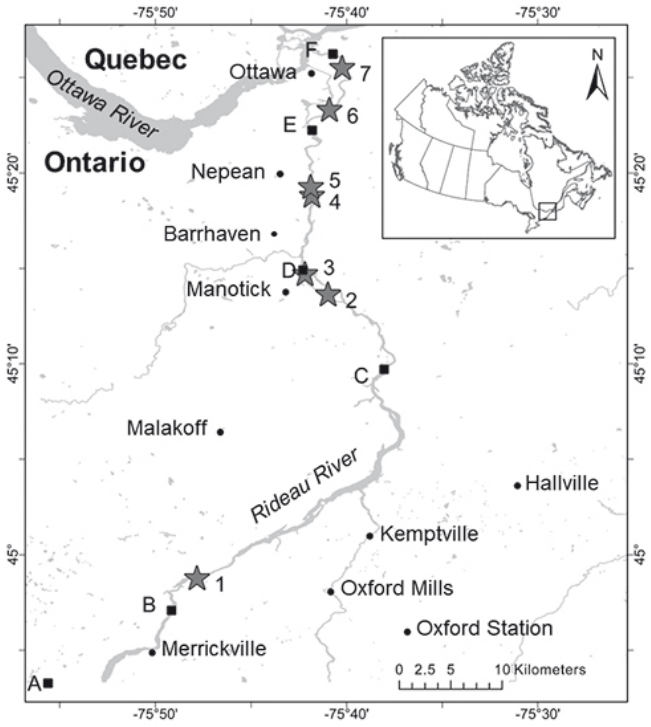
Papers co-authored by Canadian Museum of Nature staff

TROTTIER, L., J. CHÉTELAT, C. VIS, **P.B. HAMILTON**, F.R. PICK AND J.C. VERMAIRE. 2022.

Water chemistry and periphyton biomass in the Rideau River: Have conditions changed after 24 years?

Journal of Limnology 81.
https://doi.org/10.4081/jlimnol.2022.2065

The Rideau River watershed in Ontario, Canada, has experienced significant changes over the past three decades due to a shift from rural and agricultural land towards urban land use, as well as the introduction and expansion of invasive species. Researchers can characterize how human activities are altering riverine ecosystems by studying changes over time in periphyton biomass, a mixture of algae and microorganisms attached to underwater surfaces. **To better understand the impact of environmental changes on the Rideau River, Trottier and colleagues, including Canadian Museum of Nature senior research assistant Paul Hamilton, analyzed the spatial and temporal patterns of periphyton biomass collected in 1995 and 2019 at sites along a 66 km stretch of the river.** They also examined changes between 2000 and 2018 in water nutrient and chloride concentrations. They found that nitrogen declined between 2000 and 2018 in areas that have not undergone urbanization since the 2000s. However, total phosphorus declined, and chloride increased at midstream and downstream sites that have undergone urbanization during the same period. They found no change in periphyton biomass along the river between 1995 and 2019 despite the declines in nitrogen and phosphorus concentrations. These results suggest that periphyton has been able to persist in the face of ongoing anthropogenic changes in the river ecosystem. Given periphyton's important role in benthic aquatic food webs and in providing habitat for small organisms, improved understanding of how periphyton reacts to environmental changes will aid us in anticipating how river ecosystems respond to human activities.



Map showing the sample sites (stars, 1–7) and the six Provincial Water Quality Monitoring Network stations (squares, A–F) along the Rideau River in Ontario, Canada. Source: Trottier et al. (2022), available under a Creative Common Attribution-NonCommercial 4.0 International licence.

Papers by external researchers that cite Canadian Museum of Nature collections

BERGMAN, J.N., G.D. RABY, K.L. NEIGEL, C.D. RENNIE, S. BALSHINE, J.R. BENNETT, A.T. FISK AND S.J. COOKE. 2022.

Tracking the early stages of an invasion with biotelemetry: behaviour of round goby (*Neogobius melanostomus*) in Canada's historic Rideau Canal.

Biological Invasions 24: 1149–1173.
https://doi.org/10.1007/s10530-021-02705-2

Round goby (Neogobius melanostomus). Photo: Peter van der Sluijs, available under a Creative Commons Attribution-Sharealike 3.0 Unported licence, via Wikimedia Commons.

The round goby, a small, bottom-dwelling fish native to the Black and Caspian Seas, has invaded many freshwater ecosystems in Europe and North America, including the Laurentian Great Lakes. The invasion of round gobies can have significant ecological and economic impacts on invaded ecosystems and the human communities that depend on them. In 2019, researchers discovered round goby in a central area of the Rideau Canal in eastern Ontario, Canada, where the species had not been reported previously. In this study, Bergmann and colleagues characterized the establishment and spread of the round goby in the Rideau Canal to inform management strategies for this invasive species in this 202 km waterway between Lake Ontario and the Ottawa River. They implanted acoustic transmitters into 45 round gobies and used these tags to track how the fish moved in the canal. This was the first study to track a round goby invasion using telemetry to inform management. **The researchers donated some round goby individuals captured during their study to the Canadian Museum of Nature Fish Collection as voucher specimens.** Now part of the permanent scientific record, these specimens are available for other researchers to study, and they contribute to documentation of the spread of this invasive species over time and space. The researchers found that most tagged fish stayed near the release site, but 26% dispersed. One fish had traveled 500 meters downstream after 27 days. They also found that downstream dispersal is occurring. They suggest that modifications to lock operations and infrastructure along the Rideau Canal could reduce round goby expansion upstream from the invasion site through lockstations.

CHOY, E.S., L.K. BLIGHT, J.E. ELLIOTT, K.A. HOBSON, M. ZANUTTIG AND K.H. ELLIOTT. 2022.

Stable mercury trends support a long-term diet shift away from marine foraging in Salish Sea glaucous-winged gulls over the last century.

Environmental Science & Technology 56: 12097–12105.
https://doi.org/10.1021/acs.est.1c03760

Glaucous-winged Gull (Larus glaucescens), Oregon coast. Photo: Andy Reago & Chrissy McClarren, available under a Creative Commons Attribution 2.0 Generic licence, via Wikimedia Commons.

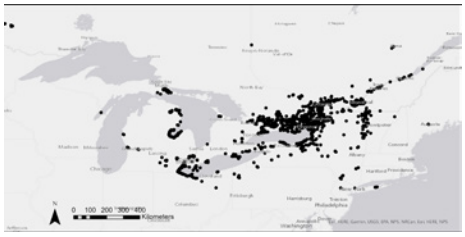
Mercury emissions have increased substantially since the Industrial Revolution. Once mercury enters the food chain, it can be taken up by organisms and accumulated in their tissues, particularly in predators at the top of the food chain. Since the mid-1980s, mercury concentrations in the North Pacific Ocean have increased because of increased emissions from Asia. It is not known, however, if mercury concentrations in wildlife that live in Pacific Ocean ecosystems have increased during the same time. In this study, Choy and colleagues examined 109-year trends in mercury concentrations in glaucous-winged gulls (*Larus glaucescens*), generalist marine predators that may be strong indicators of mercury transfer in Pacific marine food webs. They measured mercury in feathers collected from 1887 to 1996 at 28 nesting colonies in the Salish Sea ecosystem in British Columbia, Canada, and Washington, United States. **The authors obtained feather samples from glaucous-winged gull museum skins, including from specimens that are part of the Canadian Museum of Nature Bird Collection.** The results showed no evidence of a trend in mercury concentrations in glaucous-winged gulls from 1887 to 1996. The researchers concluded that changes in glaucous-winged gull diet over time, for which other studies have provided evidence, may have countered increased mercury deposition in the birds. The evidence suggests that glaucous-winged gulls have decreased consumption of marine fish. Studies like this one demonstrate the scientific value of the long time series that natural history specimens represent and the information they can provide about environmental conditions over time.

Papers by external researchers that used Canadian Museum of Nature occurrence data mediated by the Global Biodiversity Information Facility

HANSEN, S.E., B.C. CAHILL, R.A. HACKETT, M.J. MONFILS, R.T. GOEBEL, S. ASENCIO AND A. MONFILS. 2022.

Aggregated occurrence records of invasive European frog-bit (*Hydrocharis morsus-ranae* L.) across North America.

Biodiversity Data Journal 10: e77492.
https://doi.org/10.3897/BDJ.10.e77492



Presence records of European frog-bit in Canada and the United States. Occurrences in Washington State and Florida are not shown. Source: Hansen et al. (2022), distributed under the terms of the CC0 Public Domain Dedication.

Invasive european frog-bit (Hydrocharis morsus-ranae) growing in Leeds and Grenville County, Ontario. Photo: Petroglyph, available under a available under a Creative Commons Attribution-NonCommercial 2.0 Generic licence, via Flickr.

European frog-bit (*Hydrocharis morsus-ranae* L.) is a free-floating aquatic plant invasive in Canada, the United States and India. It is native to Europe and northern and western Asia and is believed to have first been introduced to North America in Ottawa, Ontario in 1932. It has since spread by way of the St. Lawrence River and connected waterways to southern Ontario and Quebec and parts of the northern United States. Invasive European frog-bit occurs in freshwater coastal wetlands and inland waters, where it can form dense mats that have the potential to limit recreational and commercial use of waterways, alter water chemistry and impact native species and ecosystems. Data on the past and present distribution of this invasive species provide geospatial information that can be used to infer the pattern of invasion and inform management and monitoring targeted at preventing secondary spread. This study reports a European frog-bit dataset containing 12,037 preserved specimen and observation-based occurrence records, including 9,994 presence records spanning two Canadian provinces and ten U.S. states and 2,043 absence records spanning five U.S. states. **The dataset includes records of 15 Global Biodiversity Information Facility-mediated European frog-bit specimens housed in the Canadian Museum of Nature's National Herbarium of Canada.** The aggregated European frog-bit dataset provides a curated resource that has been used to guide a Michigan management strategy and provides information for ongoing efforts to develop invasion risk assessments, species distribution models and decision-support tools for conservation and management.

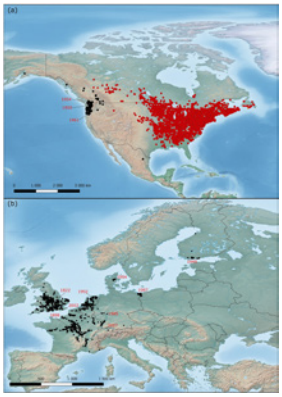
Text modified from Hansen et al. (2022), distributed under the terms of the CC0 Public Domain Dedication.

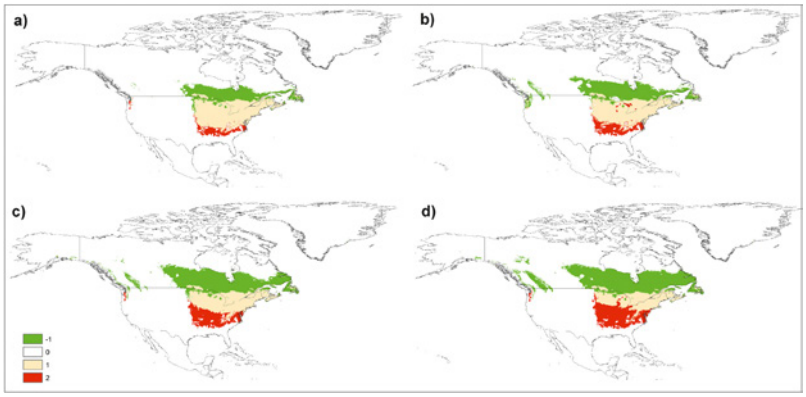
REWICZ, A., M. MYŚLIWY, T. REWICZ, W. ADAMOWSKI AND M. KOLANOWSKA. 2022.

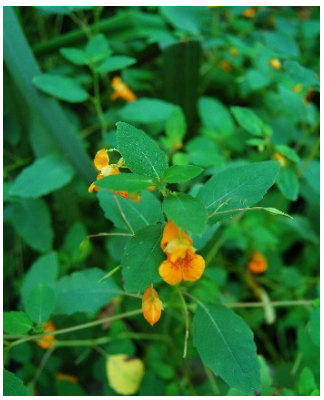
Contradictory effect of climate change on American and European populations of *Impatiens capensis* Meerb. – is this herb a global threat?

Science of The Total Environment 850: 157959.
https://doi.org/10.1016/j.scitotenv.2022.157959

Biological invasions are among the major threats to biodiversity. The native North American plant species *Impatiens capensis* (spotted jewelweed) is currently spreading across Europe, where some countries consider it invasive. In this study, Rewicz and colleagues aimed to generate information on the potential present and future distribution of spotted jewelweed under various climate change scenarios, including evaluation of the differences in bioclimatic preferences of native and non-native populations. **The authors compiled a database of *I. capensis* localities largely based on Global Biodiversity Information Facility-mediated occurrence data, including records from the Canadian Museum of Nature's National Herbarium of Canada.** They then modeled the future distribution of the climatic niche of spotted jewelweed in 2080–2100 based on various climate projections. The models predict that climate change will shift the native range of spotted jewelweed to the north and the range of nonnative European populations to the northwest. The authors also found that, in response to climate change, the distribution of niches suitable for spotted jewelweed in North America will expand whereas the range of suitable habitats for European populations could be reduced by 31 to 95%. Studies such as this one that model the future distribution of species ranges in the context of climate change would not be possible without the authoritative baseline information on the past and present distribution of species represented by specimens in natural history collections.







Left, Distribution of Impatiens capensis in (a) North America and (b) Europe. Red dots indicate a native range, black dots a non-native range; dates of the first record in particular countries in Europe, provinces in Canada, and the states in the United States. Source: Rewicz et al. (2022), available under a Creative Commons Attribution-NonCommercial 4.0 International licence.

Centre, Future changes in the distribution of suitable niches of Impatiens capensis in North America according to SSP1-2.6 (a), SSP2-4.5 (b), SSP3-7.0 (c), and SSP5-8.5 (d) climate change scenarios. Models were created based on all species records. Legend: –1 – range expansion, 0 – no occurrence, 1 – no changes, 2 – range contraction. Source: Rewicz et al. (2022), available under a Creative Commons Attribution-NonCommercial 4.0 International licence.

Right, Spotted jewelweed (Impatiens capensis). Photo: Derek Ramsey, available under a Creative Commons Attribution-Sharealike-2.5 Generic licence, via Wikipedia.

SPECIES DISCOVERY

Knowledge about the diversity of life on our planet, how life responds to short and long-term local, regional, and global change, as well as its geological underpinnings, continues to grow, with numerous new species of plants, animals and minerals being discovered, named, and classified every year by scientists around the globe. Identifying species and their inter-relationships is also an important part of understanding the processes and impacts of environmental change. Museums play a central but underappreciated role in developing knowledge about biodiversity and geodiversity by acquiring, studying, and sharing scientific specimens in their collections. Through programs of off-site loans, visiting scientists and online data mobilization, museum collections are mined for previously unstudied or 'lost' specimens, which often represent new additions to the tree of life. Museum scientists also use evidence from DNA from extant species to reconstruct the evolutionary history of life on Earth and monitoring approaches to track ecological and evolutionary changes.

Papers authored or co-authored by Canadian Museum of Nature staff

FAUTEUX, D. 2022.

First record of a least weasel in Nunavik.

Arctic Science.
https://doi.org/10.1139/as-2022-0029

Knowledge of the distribution of several small mammals in Nunavik, Québec, Canada, currently does not rely on any recorded observations due to the rarity of wildlife surveys in that area. This is problematic because understanding how wildlife populations are changing in response to the rapidly warming Arctic climate requires knowledge of population states in the past. **In this study, Canadian Museum of Nature research scientist Dr. Dominique Fauteux reports the first scientific record of the least weasel (*Mustela nivalis*) from Nunavik.** Fauteux and Canadian Museum of Nature assistant collections manager Gregory Rand captured the animal alive, in a trap, near Salluit in July 2021, while studying lemmings and voles as part of a multiyear monitoring program. They identified the animal as a least weasel based on characters that distinguish the species from similar small mammals, namely small body mass, presence of prominent testicles indicating maturity, the short length of the tail, and pale colour at the tip of the tail. Although researchers expected the species to occur in Nunavik given its broad distribution in the Canadian Arctic, its presence there has not previously been supported by a scientific record. Inuit who live in the area, however, report seeing weasels regularly on the land.[1] As such, Fauteux's discovery is a good example of the disconnect between western research and local knowledge. Fauteux plans to monitor the least weasel in the area in future years in collaboration with community members.

Pictures of the least weasel captured on 18 July 2021 near Salluit, Quebec, Canada. Photos: Gregory Rand. Source: Fauteux (2022), available under a Creative Commons Attribution 4.0 International licence.

General view of the tundra habitat along the Foucault River near Salluit, Quebec, Canada, where D. Fauteux and G. Rand observed a least weasel. Source: Fauteux (2022), available under a Creative Commons Attribution 4.0 International licence.

Distribution map of the least weasel for eastern Canada. The shaded area represents the estimated range of the least weasel, the red triangles represent previous records, and the red star represents the new record documented at Salluit. Source: Fauteux (2022), available under under a Creative Commons Attribution 4.0 International licence.

1 Pressman, N. 27 December 2022. Weasel 'discovery' in Nunavik highlights gap between local knowledge and research. https://www.cbc.ca/news/canada/north/least-weasel-nunavik-1.6676192

HENDRYCKS, E.A. AND C. DE BROYER. 2022.

New deep-sea Atlantic and Antarctic species of *Abyssorchomene* De Broyer, 1984 (Amphipoda, Lysianassoidea, Uristidae) with a redescription of *A. abyssorum* (Stebbing, 1888).

European Journal of Taxonomy 825: 1-76.
https://doi.org/10.5852/ejt.2022.825.1829

Photo of Abyssorchomene patriciae, a new species from the Northwest Atlantic Ocean. Source: Hendrycks and de Broyer (2022), available under a Creative Commons Attribution 4.0 International licence.

Amphipods are a diverse group of invertebrates that inhabit mostly aquatic environments, with some terrestrial species as well. Researchers recognize more than 10,500 species, most of which are marine animals. Scavenging amphipods are important components of deep-sea marine ecosystems and food webs because they rapidly consume and recycle organic matter and are a food source for other organisms. Deep-sea amphipods are difficult to identify because many species are morphologically similar. **In this study, Canadian Museum of Nature senior research assistant Ed Hendrycks and his colleague described two new deep-sea amphipod species of the genus *Abyssorchomene* from the Atlantic and Southern oceans and provide new information about two other species in the same genus.** The specimens they studied were collected during multiple expeditions in the Atlantic and Southern oceans, including as part of the Census of Marine Life project, at depths to 5093 m. Type material of the species they studied is curated in the Canadian Museum of Nature's crustacean collection and in collections in Belgium, Denmark, England, France, and Germany. The authors suggest that several species morphologically similar to *A. abyssorum* await description. The need to improve our understanding of global marine biodiversity is urgent given that ocean environments are changing rapidly due to climate change.

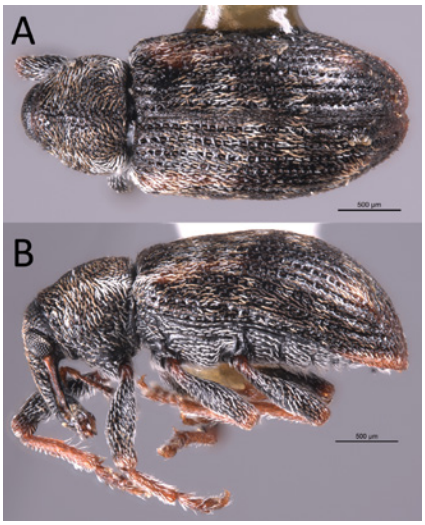
Illustrations of portions of Abyssorchomene patriciae, a new species from the Northwest Atlantic Ocean. Source: Hendrycks and de Broyer (2022), available under a Creative Commons Attribution 4.0 International licence.

LEWIS, J.H. AND **R.S. ANDERSON**. 2022.

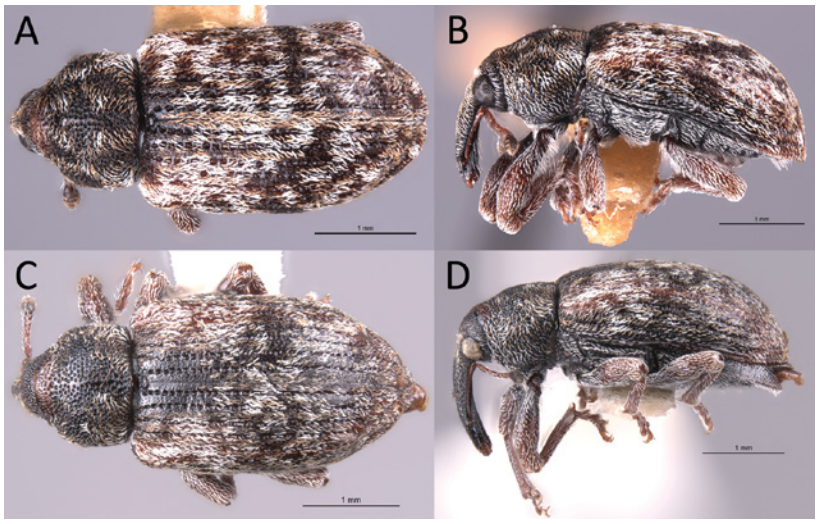
A revision of the North American genus *Proctorus* (Coleoptera, Curculionidae, Ellescini) with descriptions of two new species.

ZooKeys 1131: 135–153.
https://doi.org/10.3897/zookeys.1131.90392

Proctorus is a small genus of weevils that only occurs in North America. Until recently, researchers recognized only two species that feed on species in the willow family, Salicaceae. **In this study, Jake Lewis, recipient of a graduate student award from the Canadian Museum of Nature, and CMN entomologist Dr. Robert Anderson revised the genus *Proctorus*, including descriptions of two new species that had long been overlooked.** The study is based on specimens curated in 13 public and private insect collections, including the Canadian Museum of Nature's entomology collection. One of the new species, *Proctorus emarginatus*, is only known from three male specimens. This rare species is known only from northwestern North America, where it was last collected in 1988. Its natural history is essentially unknown. The other new species, *Proctorus truncates*, is known from seven Canadian provinces and six U.S. states. The authors provide a photographic key to *Proctorus* to facilitate species identification. Studies like this one illustrate that there remains much to learn about biodiversity in Canada and the United States.



Images of the holotype specimen of Proctorus emarginatus, a new species known only from three specimens collected in northwestern Canada. A dorsal (♂) B lateral (♂). The holotype is deposited in the Canadian Museum of Nature Entomology Collection. Source: Lewis and Anderson (2022), available under the terms of the CC0 Public Domain Dedication.



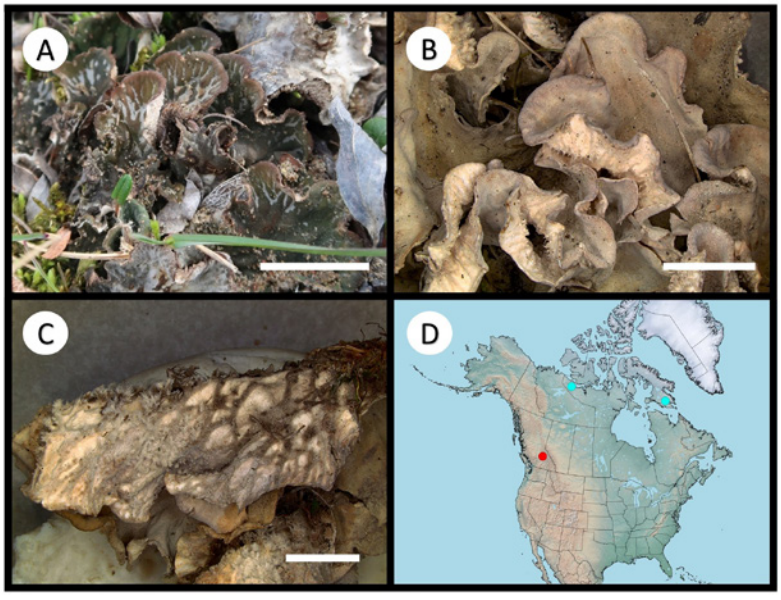
Images of Proctorus truncatus, a new species. A dorsal (♂) B lateral (♂) C dorsal (♀) D lateral (♀). Source: Lewis and Anderson (2022), available under the terms of the CC0 Public Domain Dedication.

MCMULLIN, R.T. AND J. MIADLIKOWSKA. 2022.

Two rare *Peltigera* species new to the Canadian Arctic, *P. islandica* and *P. lyngei*.

Plant and Fungal Systematics 67: 17–23.
https://doi.org/10.35535/pfsyst-2022-0002

Peltigera (Peltigerales, Ascomycota) is a globally distributed genus of relatively large foliose macrolichens. Since many species in the genus are morphologically similar, they may be overlooked in the field and their distributions may be poorly understood. **In this study, Canadian Museum of Nature lichenologist Dr. R. Troy McMullin and his colleague report the occurrence of two rare *Peltigera* species from the Canadian Arctic.** The new records are based on collections McMullin made as part of his ongoing surveys of lichen biodiversity in Nunavut, Canada. The specimens are curated in the Canadian Museum of Nature's National Herbarium of Canada and in Duke University's Duke Herbarium. The authors confirmed the species identifications using morphological, chemical, and molecular data. Researchers previously knew *Peltigera islandica*, described in 2016, only from British Columbia and *P. lyngei* only from Alaska, USA, and Svalbard, Norway. The new records fill large gaps in our understanding of the species' distributions. These discoveries illustrate the need for continued survey work in the Canadian Arctic to gather fundamental baseline data about Arctic biodiversity given the region is changing rapidly due to climate change.



Peltigera islandica. A–C, images of the specimen McMullin 20779 housed in the National Herbarium of Canada. D, North American distribution.

Scales: A = 2.0 cm; B–C = 5.0 mm. In map, blue dots = new records, red dots = previous collections. Source: McMullin and Miadlikowska (2022), available under a Creative Commons Attribution 4.0 International licence.

LANGOR, D.W., **R.S. ANDERSON**, P. BOUCHARD AND S.D. LANGOR. 2022.

New records of Curculionoidea from Newfoundland and Labrador, with the first records of *Orthochaetes setiger* ([Beck]) (Curculionidae, Curculioninae, Styphlini) for North America.

ZooKeys 1136: 125–162.
https://doi.org/10.3897/zookeys.1136.91567

The Curculionidae are the largest beetle family in Canada with 839 recorded species. This family and six closely related families are classified in the superfamily Curculionoidea, a group commonly known as weevils. Of the 976 species of weevils recorded in Canada, 111 species have been reported in Newfoundland and Labrador. **In this study, Langor and colleagues, including Canadian Museum of Nature entomologist Dr. Robert Anderson, report 30 new weevil species records from Newfoundland and Labrador and remove seven unsubstantiated species records from the province's fauna.** They also report *Orthochaetes setiger* ([Beck]), native to Europe, as a new Canadian and North American record, based on specimens from Newfoundland and Labrador and British Columbia. The new provincial records are based on specimens housed in eight institutions, including the Canadian Museum of Nature. Of the 134 curculionoid species now recorded from Newfoundland and Labrador, one third are non-native species. Researchers believe many of these were brought to the island in ballast soil in fishing ships from western Europe. Non-native weevil species are collected much more frequently than native species in Newfoundland and Labrador, but the researchers were unable to determine if the low incidence of collection of native species reflects low abundance or collection biases.

Photo of Orthochaetes setiger (Beck), a species native to Europe and reported for the first time as adventive in Canada based on specimens from Newfoundland and Labrador. Body length is 2.5 mm. Source: Langor et al. (2022), available under a Creative Commons Attribution 4.0 International licence.

SAARELA, J.M., **P.C. SOKOLOFF**, **L.J. GILLESPIE** AND **R.D. BULL.** 2023.

Vascular plant biodiversity of Katannilik Territorial Park, Kimmirut and vicinity on Baffin Island, Nunavut, Canada: an annotated checklist of an Arctic flora.

PhytoKeys 217: 1–135.
https://doi.org/10.3897/phytokeys.217.90573

Establishing a baseline for Arctic biodiversity is necessary to be able to track changes in species diversity and distribution over time in the context of rapid Arctic climate change. **In this study, four Canadian Museum of Nature botanists documented the vascular plant diversity of Katannilik Territorial Park and vicinity on southern Baffin Island, Nunavut, Canada, based on historical and contemporary collections.** They compiled a dataset of nearly 1600 collections gathered in the study area throughout the last century, including 838 collections they gathered during fieldwork in 2012. These new collections are curated in the Canadian Museum of Nature's National Herbarium of Canada. The vascular flora of the area comprises 35 families, 98 genera, 211 species, two nothospecies and seven infraspecific taxa. The study newly recorded 51 taxa in 22 families in the study area. All vascular plant taxa recorded in the study area are native except for two grass species recorded in the hamlet of Kimmirut. Studies like this one demonstrate that we still have much to learn about plant biodiversity in the Canadian Arctic. The new information will be useful for future biogeographical, ecological, taxonomic, evolutionary and related research and represents a baseline for monitoring and assessing plant biodiversity change over time.

Images of vascular plant species recorded in Kattanalik Territorial Park and vicinity, Nunavut, Canada. A, Montia fontana. B, Diapensia lapponica. C, Harrimanella hypnoides. D, Kalmia procumbens. E, Phyllodoce caerulea. F, G Hippuris vulgaris. H Plantago maritima. Photos A, B, C left, E left, F–H by R.D. Bull, C right, D by L.J. Gillespie and E right by P.C. Sokoloff. Source: Saarela et al. (2022), available under a Creative Commons Attribution 4.0 International licence.

Papers by external researchers that cite Canadian Museum of Nature collections

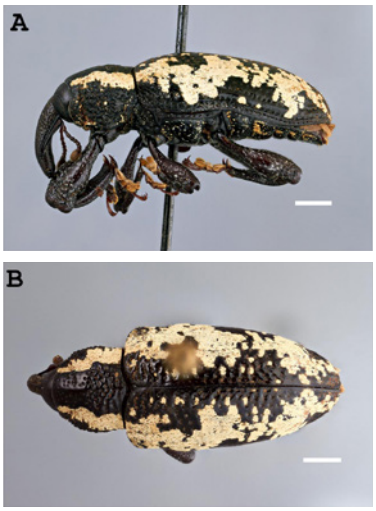
ANZALDO, S.S. AND V. DIAZ-GRISALES. 2022.

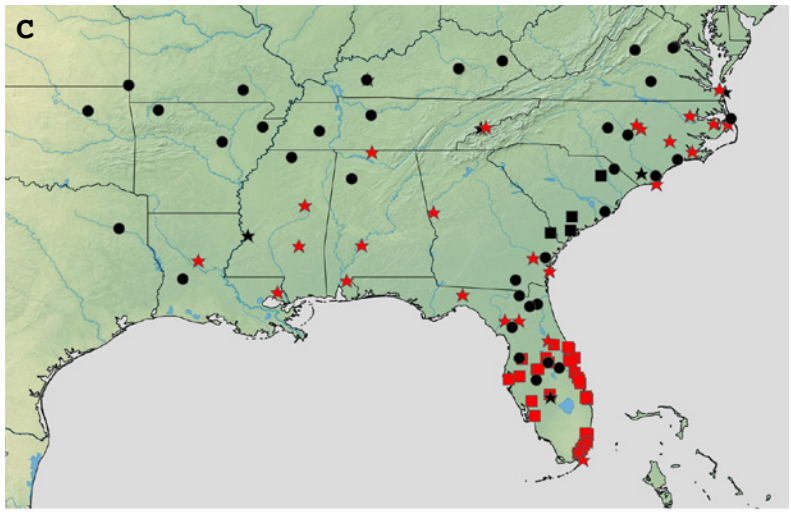
Heilipus squamosus (LeConte, 1824): clarification of the correct name for the "avocado tree girdler" with updates on its biology and distribution (Coleoptera, Curculionidae, Molytinae, Hylobiini).

Biodiversity Data Journal 10: e85499.
https://doi.org/10.3897/BDJ.10.e85499

The weevil genus *Heilipus* contains 88 species in the New World. Of these, only one species occurs in the United States. This species was a pest of avocado (*Persea americana*, Lauraceae) in Florida in the 1930s to 1950s. Two different names have been applied to this species, resulting in confusion about the valid name of the species and its distribution. In this study, Anzaldo and Diaz-Grisales addressed these problems. They first confirmed that *Heilipus squamosus* is the valid name of species native to the United States. **The authors studied specimens of the species housed in multiple collections, including specimens that are part of the Canadian Museum of Nature's Entomology Collection, and reviewed observations recorded on community science platforms.** In addition to the eight southeastern US states in which the beetle had been recorded previously, the authors newly recorded the species from seven states, expanding the species' distribution to the northern and western regions of the United States. Though native host plants have been unconfirmed by rearing records, the authors reviewed the evidence indicating the possible native host plants in the plant family Lauraceae. They suggest that the species may be rare because its potential host plants are rare.

Heilipus squamosus. Scale bars = 2 mm. A: lateral habitus. B: dorsal habitus. C: distribution map (circles = iNaturalist/BugGuide records, stars = specimen data, squares = literature records; red symbols = 20th century records, black symbols = 21st century records). Source: Anzaldo and Diaz-Grisales (2022), available under a Creative Commons Attribution 4.0 International licence.



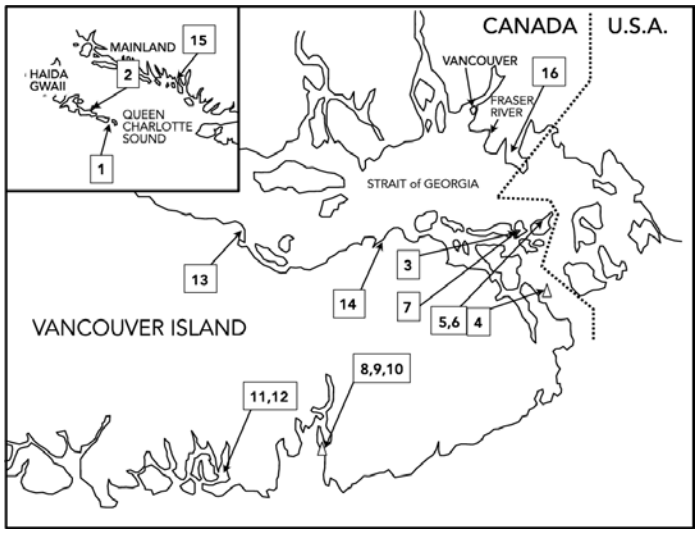


LEWIS, A. 2022.

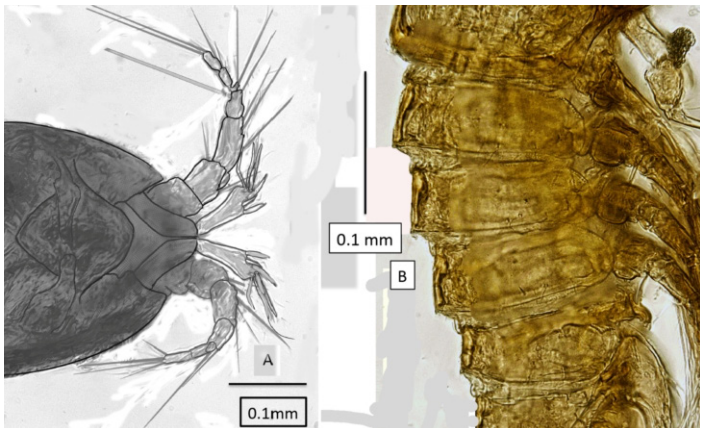
Heterolaophonte natator n. sp. (Copepoda, Harpacticoida) from Haida Gwai, British Columbia — and possible relatives in the U.K. and Iceland.

Crustaceana 95: 147–164.
https://doi.org/10.1163/15685403-bja10175

Copepods are a group of small crustaceans that live in freshwater and marine habitats around the world. *Heterolaophonte* is a genus of copepods in the family Laophontidae with about 50 known species that live in benthic environments of oceanic basins. Researchers have reported several species from British Columbia. In this study, Alan Lewis described the new species *Heterolaophonte natator* based on material associated with collections of eelgrass (*Zostera marina*, Zosteraceae) from sites in the Strait of Georgia, the west coast of Vancouver Island, and Haida Gwai, British Columbia. **The author deposited the holotype, allotype, and paratypes of the new species in the Canadian Museum of Nature's Invertebrate Collection.** The name *natator* is Latin for swimmer and was chosen because the shapes of the species' body and thoracic legs indicate the potential for swimming. The new species is one of several species of *Heterolaophonte* that live in areas that were once glaciated and is morphologically similar to some species from European waters.



Map showing the location of the sampling area off British Columbia where the material for this study was collected. Legends: 1–16, the 16 sampling localities visited; HG, Haida Gwai = formerly Queen Charlotte Islands. Source: Lewis (2022), available under a Creative Commons Attribution 4.0 International licence.



Heterlaophonte natator n. sp. female: A, rostrum, dorsal view; B, metasome, lateral view. Source: Lewis (2022), available under a Creative Commons Attribution 4.0 International licence.

STROUPE, S., D. FORGACS, A. HARRIS, J.N. DERR AND B.W. DAVIS. 2022.

Genomic evaluation of hybridization in historic and modern North American Bison (*Bison bison*).

Scientific Reports 12: 6397.
https://doi.org/10.1038/s41598-022-09828-z

Bison bison. Source: Jack Dykinga, United States Department of Agriculture, public domain, via Wikimedia Commons.

During the late nineteenth century, the North American bison underwent a significant population bottleneck resulting in a reduction in population size of over 99% — a species-level near-extinction event. At the low point of this population crash, few wild plains bison (*Bison bison bison*) and wild wood bison (*Bison bison athabascae*) survived. Most surviving bison in the late 1800s were maintained by cattle ranchers, some of whom encouraged hybridization between bison and domestic cattle to produce a more useful animal. Over the last 20 years, researchers have identified the legacy of this introgression using mitochondrial DNA and nuclear microsatellite techniques. However, no genome-wide assessment has been performed, and some herds were believed to be free of introgression. In this study, Stroupe and colleagues conducted whole genome sequencing from nineteen modern and six historical bison to identify signatures of nuclear introgression from cattle during the last 200 years. **Samples of two of the historical specimens the authors studies were obtained from the Canadian Museum of Nature's Mammal Collection: material of plains bison collected in 1909 and of wood bison collected in 1892.** The results provide evidence for introgression from cattle, including in populations thought to be free from hybridization with cattle. Unexpectedly, the authors found evidence of cattle introgression in all historical bison samples they analyzed. They authors suggest the introgression pattern detected is best explained by multiple historical hybridization events between bison and cattle with significant genetic recombination over the last 200 years. Documentation of introgression of cattle DNA into bison is relevant to long-term bison conservation efforts. This study is a good example of how historical museum specimens can contribute to our understanding of past and present biodiversity patterns.

Papers by external researchers that used Canadian Museum of Nature occurrence data mediated by the Global Biodiversity Information Facility

MALLEN-COOPER, M., E. RODRÍGUEZ-CABALLERO, D.J. ELDRIDGE, B. WEBER, B. BÜDEL, H. HÖHNE AND W.K. CORNWELL. 2023.

Towards an understanding of future range shifts in lichens and mosses under climate change.

Journal of Biogeography 50: 406–417.
https://doi.org/10.1111/jbi.14542

Lichens and mosses are important in all ecosystems, especially in tundra and drylands, but their ability to survive in a changing climate depends on their ability to migrate. This study used global occurrence data to estimate the current and future habitat suitability of 16 abundant species of lichen and moss, including *Cladonia stellaris*, a lichen species that is an important forage item for caribou. **Mallen-Cooper and colleagues obtained occurrence data for their study species from the Global Biodiversity Information Facility, including over 1500 records housed in the Canadian Museum of Nature's National Herbarium of Canada.** Their distribution models predicted that suitable area would expand for eight species and decline for four species due to climate change. They found that some species will need to migrate at rates greater than 16 km per year to reach suitable habitats over the next 80 years. This may be difficult due to limited dispersal abilities and unsuitable habitat in human-modified landscapes.

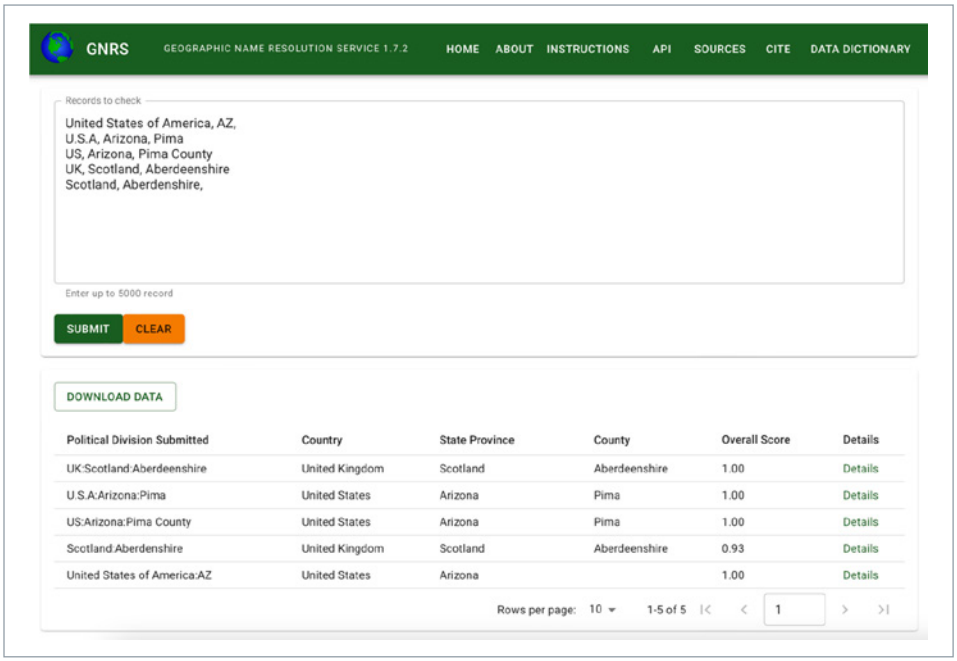
Cladonia stellaris in a clearing, Grands-Jardins National Park, Quebec, Canada. Photo: Cephas, available under a Creative Commons Attribution-Sharelike 3.0 licence, via Wikimedia Commons.

BOYLE, B.L., B.S. MAITNER, G.G.C. BARBOSA, R.K. SAJJA, X. FENG, C. MEROW, E.A. NEWMAN, D.S. PARK, P.R. ROEHRDANZ AND B.J. ENQUIST. 2022.

Geographic name resolution service: A tool for the standardization and indexing of world political division names, with applications to species distribution modeling.

PLOS ONE 17: e0268162.
https://doi.org/10.1371/journal.pone.0268162

Large databases of species occurrences – locations where a species has been observed – are essential for studying species distributions in the past and for modeling species distributions in the present and future. However, accurately identifying the location of observations is sometimes difficult because of spelling errors, abbreviations, multiple languages, and alternative codes for political division names in occurrence records. This can lead to flawed results and reduce usable data. To solve this problem, Boyle and colleagues created the Geographic Name Resolution Service, an application that corrects and standardizes political division names using a reference database. **In a test of over 239 million plant species occurrences, including more than 200 thousand records from the Canadian Museum of Nature mediated by the Global Biodiversity Information Facility, the Geographic Name Resolution Service was able to resolve 92% of political division names, allowing for more accurate assessment of geocoordinate accuracy and detection of errors.** By identifying, differentiating, and correcting erroneous or inaccurate geographic distribution information, this new tool will contribute to verifying the accuracy of species occurrence data, improving its usability for biodiversity research.



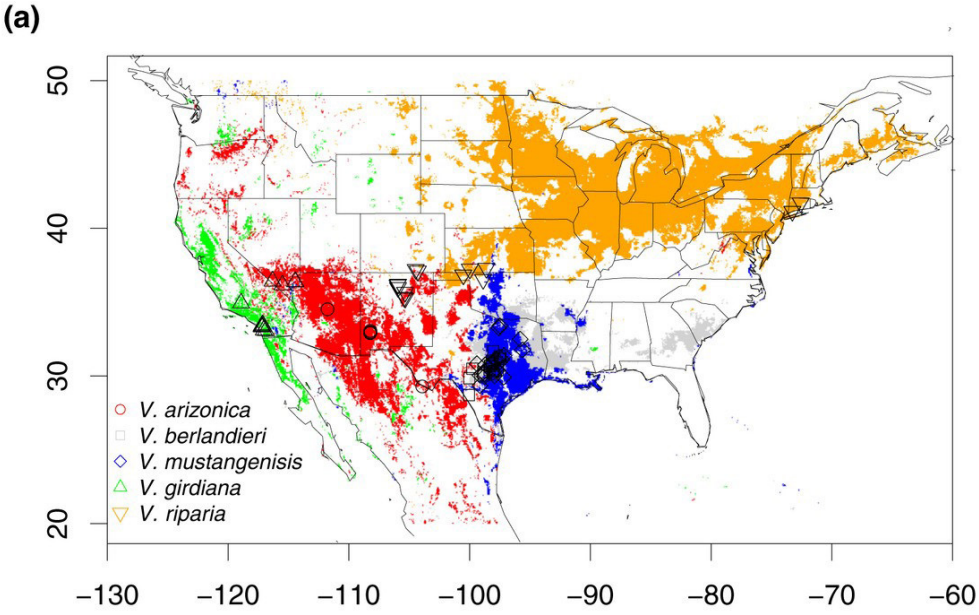
Screenshot of the Geographic Name Resolution Service web user interface. Source: Boyle et. al (2022), available under a Creative Commons Attribution 4.0 International licence.

AGUIRRE-LIGUORI, J.A., A. MORALES-CRUZ AND B.S. GAUT. 2022.

Evaluating the persistence and utility of five wild *Vitis* species in the context of climate change.

Molecular Ecology 31: 6457–6472.
https://doi.org/10.1111/mec.16715

As the climate changes, we need crops that can adapt and continue to produce despite changing conditions. The wild relatives of our cultivated food crops contain a wealth of genetic diversity that can be used to improve their resilience and productivity. In this study, Aguirre-Liguori and colleagues studied five North American wild grape species to assess which of them were most likely to persist in the face of climate change and which could provide genetic material to help cultivated grapevines adapt. To do this, they used a combination of species distribution models, genetic analysis, and assessments of resistance to Pierce's disease, which is a major threat to grapevines. **The authors used occurrence data mediated by the Global Biodiversity Information Facility, including data from the Canadian Museum of Nature's National Herbarium of Canada, to construct species distribution models of wild grape species.** They found that accessions of mustang grape (*Vitis mustangensis*), a species native to the southern United States, are well-suited to survive in future climates. They identified six *V. mustangensis* accessions that could provide genetic material to help cultivated grapevines in the United States adapt to changing climatic conditions.



Present day species distribution model showing the estimated bioclimatic niche of each of five species of Vitis. Source: Aguirre-Liguori et al. (2002), available under a Creative Commons Attribution-NonCommercial 4.0 International licence.

Riverbank grape (Vitis riparia). Photo: Emma Lehmberg/Canadian Museum of Nature.

JOHN, C. AND E. POST. 2022.

Projected bioclimatic distributions in Nearctic Bovidae signal the potential for reduced overlap with protected areas.

Ecology and Evolution 12: e9189.
https://doi.org/10.1002/ece3.9189

Muskoxen on Ellesmere Island, Northwest Territories [Nunavut], 1971. Photo: Stu MacDonald/Canadian Museum of Nature.

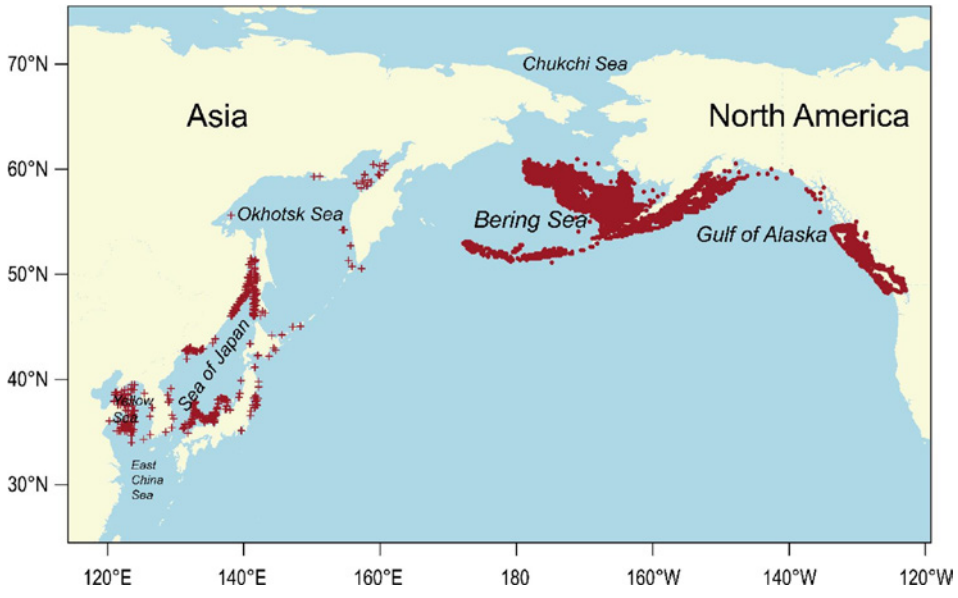
The cattle family (Bovidae) is an important group of animals for cultural, economic, and ecological reasons. In this study, John and Post explored the impact of climate change on the distribution of North America's five wild cattle species – bighorn sheep (*Ovis canadensis*), thinhorn sheep (*Ovis dalli*), North American bison (*Bison bison*), mountain goat (*Oreamnos americanus*), and muskox (*Ovibos moschatus*) – that inhabit various habitats across the continent, such as deserts, prairies, mountains, and tundra. They modeled the distribution of each species based on climate, topography, and land cover data to understand how climate change may affect them. **The authors obtained species distribution data for their model from the Global Biodiversity Information Facility, including occurrences from the Canadian Museum of Nature's Mammal Collection.** They then projected these models to the end of the 21st century under two anticipated climate change scenarios. The results revealed that, by 2100, suitable habitats would shift inconsistently across species and that these shifts would lead to species-specific variations in the overlap between potential habitats and existing protected areas. These findings have implications for conservation planning and wildlife management in North America.

LI, L., L. ZHAO, J. FU, B. SUN AND C. LIU. 2022.

Predicting the habitat suitability for populations of Pacific cod under different climate change scenarios considering intraspecific genetic variation.

Ecological Indicators 142: 109248.
https://doi.org/10.1016/j.ecolind.2022.109248

Studies have shown that many marine species will move to new locations in search of suitable habitats as the climate changes. Understanding the potential distribution of fish species under future climate scenarios is thus important for guiding conservation and management efforts. This study focused on Pacific cod, an economically important fish species found in the North Pacific that is classified into western and eastern populations based on genetic differences. Using georeferenced occurrence records and environmental predictors, Li and colleagues characterized the habitats where the two Pacific cod populations are found. **The authors obtained occurrence data for Pacific cod from the literature, the Ocean Biogeographic Information System, and the Global Biodiversity Information Facility, including occurrences from the Canadian Museum of Nature's Fish Collection.** They then projected the future habitat suitability of the two populations under different climate change scenarios. They found that the western and eastern Pacific cod populations will be affected differently by climate change. The study demonstrates that incorporating genetic variation into species distribution models is important for predicting habitat suitability under climate change scenarios. This can help us develop more effective conservation and management strategies that consider the unique characteristics of different populations within a species.



Map of the current distribution of Pacific cod. Red crosses and red points correspond to the available occurrence records of the western and eastern Pacific cod populations, respectively. Source: Li et al. (2022), available under a Creative Commons Attribution 4.0 International licence.

WOLF, J.M., J.M. JESCHKE, C.C. VOIGT AND Y. ITESCU. 2022.

Urban affinity and its associated traits: A global analysis of bats.

Global Change Biology 28: 5667–5682.
https://doi.org/10.1111/gcb.16320

*A big brown bat (*Eptesicus fuscus*) crawling along the surface of a rock. at Cave Hollow Pit. Photo: John MacGregor (Land Between the Lakes KY/TN), public domain, via Wikimedia Commons.*

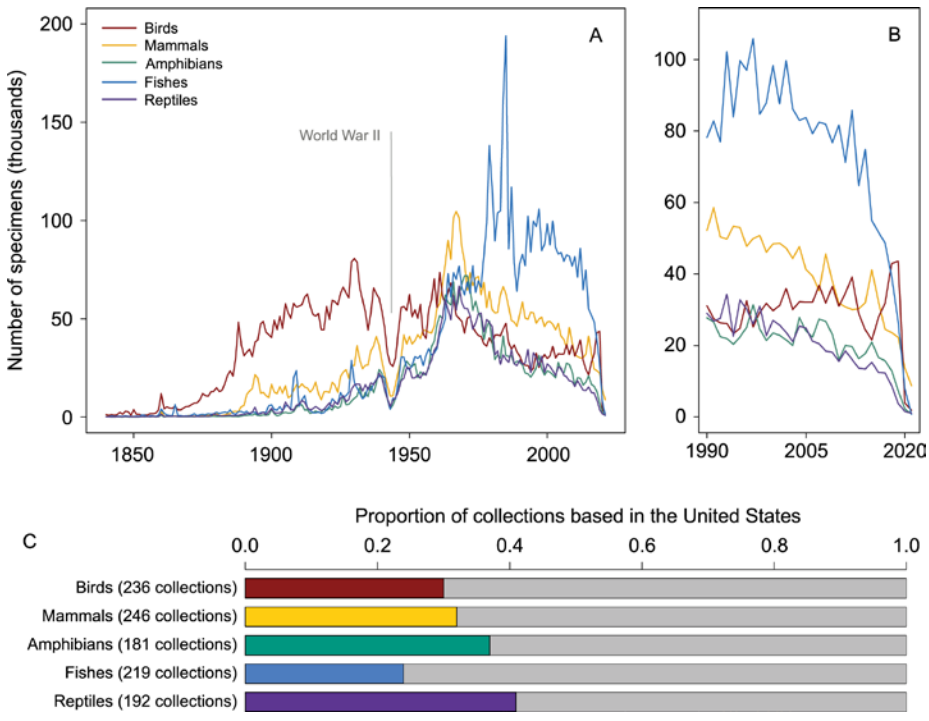
Urbanization negatively impacts biodiversity, and the need to guide biodiversity, conservation and management efforts in urban environments requires methods to estimate a species' tendency to live in urban areas. In this study, Wolf and colleagues developed a new approach to quantify urban affinity of species based on occurrence data and to characterize how urban affinity is associated with traits that may help species thrive in, tolerate or avoid urban areas. **The authors used bat species (order Chiroptera) as a case study and obtained species occurrences for all accepted bat species mediated by the Global Biodiversity Information Facility, including records from the Canadian Museum of Nature's Mammal Collection.** They found that different urban affinity indices resulted in different rankings of species on the urban affinity spectrum. In addition, they identified traits in bats associated with urban affinity, namely shorter forearms, lower echolocation frequencies, a longer call duration, and a less specialized roosting strategy. They concluded that simple indices that quantify species' urban affinity are practical and should be applied to more species to improve understanding of the relationship between urbanization and species' traits.

ROHWER, V.G., Y. ROHWER AND C.B. DILLMAN. 2022.

Declining growth of natural history collections fails future generations.

PLOS Biology 20: e3001613.
https://doi.org/10.1371/journal.pbio.3001613

Rohwer and colleagues demonstrate that additions of vertebrate specimens to natural history collections are declining at this time of rapid and widespread environmental change. **Using natural history collection data from more than 245 institutions mediated by the Global Biodiversity Information Facility – including occurrence data from the Canadian Museum of Nature's collections – the authors show that the addition of new specimens of birds, mammals, amphibians, fishes and reptiles has declined by 54% to 76% from 1965 to 2019.** They discuss the factors they believe have contributed to declining collections growth. They also propose ways we can reverse the decline of scientific collecting to ensure we build and maintain a strong collection record of biodiversity over time and space to support future research and conservation initiatives.



Growth of natural history collections through time using a subset of the world's collections available through the Global Biodiversity Information Facility. (A) Broad fluctuations exist across five vertebrate groups in the number of specimens added to natural history museums since 1840. (B) Recent declines in collections growth from 1990 to 2021. (C) GBIF includes collections from over 60 countries, but many collections are based in the United States of America. Colored bars indicate the proportion of USA-based collections for each vertebrate group, which represent 25% to 42% of data. Source: Rohwer et al. (2002), available under a Creative Commons Attribution 4.0 International licence.

2022 PUBLICATIONS ENABLED BY THE CANADIAN MUSEUM OF NATURE

Under each theme, publications are organized in three groups: Canadian Museum of Nature Staff, Canadian Museum of Nature Research Associates, and Other Authors. Staff and research associate authors are in boldface.

Evidence of use of Canadian Museum of Nature collections or collection data in papers by authors not affiliated with Canadian Museum of Nature are indicated as follows:† – publication cites one or more Canadian Museum of Nature specimens; ‡ – publication indicates Canadian Museum of Nature collections were searched for material relevant to a study; # – publication indicates Canadian Museum of Nature collections were consulted to aid identification of species; * – publication indicates authors deposited voucher specimens in the Canadian Museum of Nature.

Publications with a 2023 date were first available online in 2022.

Earth History

CANADIAN MUSEUM OF NATURE STAFF

Mineralogy

Bosi, F., C. Biagioni, F. Pezzotta, H. Skogby, U. Hålenius, J. Cempírek, F.C. Hawthorne, **A.J. Lussier**, Y.A. Abdu, M.C. Day, M. Fayek, C.M. Clark, **J.D. Grice** and D.J. Henry. 2022. Uvite, CaMg3(Al5Mg)(Si6O18)(BO3)3(OH)3(OH), a new, but long-anticipated mineral species of the tourmaline supergroup from San Piero in Campo, Elba Island, Italy. Mineralogical Magazine 86: 767–776. https://doi.org/10.1180/mgm.2022.54

Courchesne, B., M. Schindler, **A.J. Lussier** and N. Mykytczuk. 2022. Macro- to nanoscale mineral relationships in surficial cobalt-arsenic-bearing mine tailings of the Cobalt Mining Camp, Northeastern Ontario, Canada. The Canadian Mineralogist 60: 309–329. https://doi.org/10.3749/canmin.2000103

Lykova, I., J.D. Scott and J.R. Montgomery. 2022. DeWitts Corners, Bathurst Township, Ontario, Canada. Rocks & Minerals 97: 556–564. https://doi.org/10.1080/00357529.2022.2087152

Lykova, I., J. Montgomery and J. Biczok. 2022. Strange scepter quartz from the Lyndhurst Area, Ontario, Canada. Rocks & Minerals 97: 254–259. https://doi.org/10.1080/00357529.2022.2028100

Lykova, I., **R. Rowe**, **G. Poirier**, H. Friis and K. Helwig. 2022. Bounahasite, Cu+Cu2+2(OH)3Cl2, a new mineral from the Bou Nahas Mine, Morocco. Mineralogical Magazine. https://doi.org/10.1180/mgm.2022.13

Piilonen, P.C., **G. Poirier**, **R. Rowe**, C. Robak and Q. Wight. 2022. Quintinite from Mount Mather Creek, British Columbia. MicroNews 56: 2–12.

Piilonen, P.C., **G. Poirier**, **R. Rowe**, R. Mitchell and C. Robak. 2022. Mount Mather Creek, British Columbia – a new sodalite-bearing carbohydrothermal breccia deposit including a new Canadian occurrence for the rare minerals edingtonite and quintinite. Mineralogical Magazine 86: 282–306. https://doi.org/10.1180/mgm.2022.29

Piilonen, P.C., **G. Poirier**, W. Lechner, **R. Rowe** and R.P. Richards. 2022. Zeolite minerals from Wat Ocheng, Ta Ang, Ratanakiri province, Cambodia – occurrence, composition and paragenesis. THe Canadian Mineralogist 60: 1–21. https://doi.org/10.3749/canmin.2000113

Palaeobiology

Christison, B.E., F. Gaidies, S. Pineda-Munoz, A.R. Evans, **M.A. Gilbert** and **D. Fraser**. 2022. Dietary niches of creodonts and carnivorans of the late Eocene Cypress Hills Formation. Journal of Mammalogy 103: 2–17. https://doi.org/10.1093/jmammal/gyab123

Dong, L., L. Jia, J. Wang and **X.-C. Wu**. 2022. A tyrannosauroid from the Upper Cretaceous in Tianzhen, Shanxi Province, China and its burial environment. Acta Geologica Sinica 96 (11): 3741–3749. https://doi.org/10.19762/j.cnki.dizhixuebao.2021240

Farlow, J.O., D. Coroian, P.J. Currie, J.R. Foster, **J.C. Mallon** and F. Therrien. 2022. "Dragons" on the landscape: Modeling the abundance of large carnivorous dinosaurs of the Upper Jurassic Morrison Formation (USA) and the Upper Cretaceous Dinosaur Park Formation (Canada). The Anatomical Record. https://doi.org/10.1002/ar.25024

Fraser, D., A. Villaseñor, A.B. Tóth, M.A. Balk, J.T. Eronen, W. A. Barr, A.K. Behrensmeyer, M. Davis, A. Du, J. T. Faith, G.R. Graves, N.J. Gotelli, A.M. Jukar, C.V. Looy, B.J. McGill, J.H. Miller, S. Pineda-Munoz, R. Potts, A.B. Shupinski, L.C. Soul and S. K. Lyons. 2022. Late quaternary biotic homogenization of North American mammalian faunas. Nature Communications 13: 3940. https://doi.org/10.1038/s41467-022-31595-8

Landry, Z., M.J. Roloson and **D. Fraser**. 2022. Investigating the reliability of metapodials as taxonomic indicators for Beringian horses. Journal of Mammalian Evolution 29: 863–875. https://doi.org/10.1007/s10914-022-09626-4

Mallon, J.C., D.C. Evans, Y. Zhang and H. Xing. 2023. Rare juvenile material constrains estimation of skeletal allometry in *Gryposaurus notabilis* (Dinosauria: Hadrosauridae). The Anatomical Record 306: 1646–1668. https://doi.org/10.1002/ar.25021 (available online 06 July 2022)

Mallon, J.C., **R.B. Holmes**, E.L. Bamforth and D. Schumann. 2022. The record of *Torosaurus* (Ornithischia: Ceratopsidae) in Canada and its taxonomic implications. Zoological Journal of the Linnean Society 195: 157–171. https://doi.org/10.1093/zoolinnean/zlab120

Miyashita, T. 2022. "Arch"-etyping vertebrates. Science 377: 154–155. https://doi.org/10.1126/science.adc9198

Moore, B.R.S., M.J. Roloson, P.J. Currie, **M.J. Ryan**, R.T. Patterson and **J.C. Mallon**. 2022. The appendicular myology of *Stegoceras validum* (Ornithischia: Pachycephalosauridae) and implications for the head-butting hypothesis. PLOS ONE 17: e0268144. https://doi.org/10.1371/journal.pone.0268144

Shen, Y.-B. and **X.-C. Wu**. 2022 Revision of the Devonian clam shrimp (Diplostraca: Spinicaudata) from the Canadian Arctic and discussion on the early morphotypes of the leaiins. Acta Palaeontologica Sinica 61: 217–225. https://doi.org/10.19800/j.cnki.aps.2021027

Wang, W., Q. Shang, L. Cheng, **X.-C. Wu** and C. Li. 2022. Ancestral body plan and adaptive radiation of sauropterygian marine reptiles. iScience 25: 105635. https://doi.org/10.1016/j.isci.2022.105635

Wu, X.-C., Y.-C. Wang, H.-L. You, Y.-Q. Zhang and L.-P. Yi. 2023. New brevirostrines (Crocodylia, Brevirostres) from the Upper Cretaceous of China. Cretaceous Research 144: 105450. https://doi.org/10.1016/j.cretres.2022.105450

Wyenberg-Henzler, T., R.T. Patterson and **J.C. Mallon**. 2022. Ontogenetic dietary shifts in North American hadrosaurids (Dinosauria: Ornithischia). Cretaceous Research 135: 105177. https://doi.org/10.1016/j.cretres.2022.105177

Xing, L., K. Niu, T.-R. Yang, D. Wang, **T. Miyashita** and **J.C. Mallon**. 2022. Hadrosauroid eggs and embryos from the Upper Cretaceous (Maastrichtian) of Jiangxi Province, China. BMC Ecology and Evolution 22: 60. https://doi.org/10.1186/s12862-022-02012-x

CANADIAN MUSEUM OF NATURE RESEARCH ASSOCIATES

Mineralogy

Saumur, B.M., **M.-C. Williamson** and J.H. Bédard. 2022. Targeting Ni-Cu mineralization in the Canadian High Arctic large igneous province: integrating geochemistry, magmatic architecture and structure. Mineralium Deposita 57: 207–233. https://doi.org/10.1007/s00126-021-01054-3

Palaeobiology

Allen, L.F., M.R. Stimson, O.A. King, R.E. Norrad, S.G. Lucas, A. Mann, S.J. Hinds, A.F. Park, J.H. Calder, **H. Maddin** and M. Montplaisir. 2022. A *Batrachichnus salamandroides* trackway from the Minto Formation of central New Brunswick, Canada: Implications for alternative tracemaker interpretations. Atlantic Geoscience 58: 239–260. https://doi.org/10.4138/atlgeo.2022.010

Arbez, T., J. Atkins and **H.C. Maddin**. 2022. Cranial anatomy and systematics of *Dendrerpeton* cf. *helogenes* (Tetrapoda: Temnospondyli) from the Pennsylvanian of Joggins, revisited through micro-CT scanning. Papers in Palaeontology 8: e1412. https://doi.org/10.1002/spp2.1421

Arnaout, B., E.M. MacKenzie, K.E. Lantigua, K. Brzezinski, I.W. McKinnell and **H.C. Maddin**. 2022. The histology of sutures in chicken skulls: Types, conservation, and ontogeny. Journal of Anatomy 240: 503–515. https://doi.org/10.1111/joa.13574

Bergström, A., D.W.G. Stanton, U.H. Taron, L. Frantz, M.-H.S. Sinding, E. Ersmark, S. Pfrengle, M. Cassatt-Johnstone, O. Lebrasseur, L. Girdland-Flink, D.M. Fernandes, M. Ollivier, L. Speidel, S. Gopalakrishnan, M.V. Westbury, J. Ramos-Madrigal, T.R. Feuerborn, E. Reiter, J. Gretzinger, S.C. Münzel, P. Swali, N.J. Conard, C. Carøe, J. Haile, A. Linderholm, S. Androsov, I. Barnes, C. Baumann, N. Benecke, H. Bocherens, S. Brace, R.F. Carden, D.G. Drucker, S. Fedorov, M. Gasparik, M. Germonpré, S. Grigoriev, P. Groves, S.T. Hertwig, V.V. Ivanova, L. Janssens, R.P. Jennings, A.K. Kasparov, I.V. Kirillova, I. Kurmaniyazov, Y.V. Kuzmin, P.A. Kosintsev, M. Lázničková-Galetová, C. Leduc, P. Nikolskiy, M. Nussbaumer, C. O'Drisceoil, L. Orlando, A. Outram, E.Y. Pavlova, A.R. Perri, M. Pilot, V.V. Pitulko, V.V. Plotnikov, A.V. Protopopov, A. Rehazek, M. Sablin, A. Seguin-Orlando, J. Storå, C. Verjux, V.F. Zaibert, **G. Zazula**, P. Crombé, A.J. Hansen, E. Willerslev, J.A. Leonard, A. Götherström, R. Pinhasi, V.J. Schuenemann, M. Hofreiter, M.T.P. Gilbert, B. Shapiro, G. Larson, J. Krause, L. Dalén and P. Skoglund. 2022. Grey wolf genomic history reveals a dual ancestry of dogs. Nature 607: 313–320. https://doi.org/10.1038/s41586-022-04824-9

Brum, A.S., T.R. Simoes, G.A. Souza, A.E.P. Pinheiro, R.G. Figueiredo, **M.W. Caldwell**, J.M. Sayao and A.W.A. Kellner. 2022. Ontogeny and evolution of the elasmosaurid neck highlight greater diversity of Antarctic plesiosaurians. Palaeontology: e12593. https://doi.org/10.1111/pala.12593

Chevrinais, M., C. Morel, **C.B. Renaud** and R. Cloutier. 2022. Ontogeny of *Euphanerops longaevus* from the Upper Devonian Miguasha Fossil–Fish–Lagerstätte and comparison with the skeletogenesis of the sea lamprey *Petromyzon marinus*. Canadian Journal of Earth Sciences 60: 350–365. https://doi.org/10.1139/cjes-2022-0062

Crawford, C.H., A. Webber-Schultz, P.B. Hart, Z.S. Randall, C. Cerrato-Morales, A.B. Kellogg, H.E. Amplo, A. Suvarnaraksha, L.M. Page, **P. Chakrabarty** and B.E. Flammang. 2022. They like to move it (move it): walking kinematics of balitorid loaches of Thailand. Journal of Experimental Biology 225: jeb242906. https://doi.org/10.1242/jeb.242906

Davies, N.S., J.C. Gosse, A. Rouillard, **N. Rybczynski**, J.I.N. Meng, A.V. Reyes and J. Kiguktak. 2022. Wood jams or beaver dams? Pliocene life, sediment and landscape interactions in the Canadian High Arctic. Palaios 37: 330–347. https://doi.org/10.2110/palo.2021.065

Ghezelayagh, A., R.C. Harrington, E.D. Burress, M.A. Campbell, J.C. Buckner, **P. Chakrabarty**, J.R. Glass, W.T. McCraney, P.J. Unmack, C.E. Thacker, M.E. Alfaro, S.T. Friedman, W.B. Ludt, P.F. Cowman, M. Friedman, S.A. Price, A. Dornburg, B.C. Faircloth, P.C. Wainwright and T.J. Near. 2022. Prolonged morphological expansion of spiny-rayed fishes following the end-Cretaceous. Nature Ecology & Evolution 6: 1211–1220. https://doi.org/10.1038/s41559-022-01801-3

Kanno, S., S. Tokumaru, S. Nakagaki, Y. Nakajima, A. Misaki, Y. Hikida and **T. Sato**. 2022. Santonian-Campanian neoselachian faunas of the Upper Cretaceous Yezo Group in Nakagawa Town, Hokkaido, Japan. Cretaceous Research 133: 105139. https://doi.org/10.1016/j.cretres.2022.105139

MacKenzie, E.M., J.B. Atkins, D.E. Korneisel, A.S. Cantelon, I. McKinnell and **H.C. Maddin**. 2022. Normal development in *Xenopus laevis*: a complementary staging table for the skull based on cartilage and bone. Developmental Dynamics 251: 1340–1356. https://doi.org/10.1002/dvdy.465

Mann, A., J. Pardo and **H.C. Maddin**. 2022. Snake-like limb loss in a Carboniferous amniote. Nature Ecology & Evolution 6: 614–621. https://doi.org/10.1038/s41559-022-01698-y

Murray, A.M. and **R.B. Holmes**. 2022. Osteology of the cranium and Weberian apparatus of African catfish families (Teleostei: Ostariophysi: Siluriformes) with an assessment of genera from the Palaeogene of Africa. Vertebrate Anatomy, Morphology, Palaeontology 9: 156–191. https://doi.org/10.18435/vamp29382

Murray, A.M., M. Chida and **R.B. Holmes**. 2022. New enchodontoid fish (Teleostei: Aulopiformes) from the Late Cretaceous of Lebanon. Journal of Vertebrate Paleontology 42: e2101370. https://doi.org/10.1080/02724634.2022.2101370

Scott, E.E., K. Chiba, F. Fanti, B.Z. Saylor, D.C. Evans and **M.J. Ryan**. 2022. Taphonomy of a monodominant *Gryposaurus* sp. bonebed from the Oldman Formation (Campanian) of Alberta, Canada. Canadian Journal of Earth Sciences 59: 389–405. https://doi.org/10.1139/cjes-2020-0200

Scott, S.H.W., **M.J. Ryan** and D.C. Evans. 2023. Postcranial description of *Wendiceratops pinhornensis* and a taphonomic analysis of the oldest monodominant ceratopsid bonebed. The Anatomical Record 306: 1824–1841. https://doi.org/10.1002/ar.25045 (available online 24 August 2022)

Simões, T.R., C.F. Kammerer, **M.W. Caldwell** and S.E. Pierce. 2022. Successive climate crises in the deep past drove the early evolution and radiation of reptiles. Science Advances 8: eabq1898. https://doi.org/10.1126/sciadv.abq1898

Strong, C.R.C., M.D. Scherz and **M.W. Caldwell**. 2022. Convergence, divergence, and macroevolutionary constraint as revealed by anatomical network analysis of the squamate skull, with an emphasis on snakes. Scientific Reports 12: 14469. https://doi.org/10.1038/s41598-022-18649-z

Toyoda, N., T. Ito, **T. Sato** and T. Nishimura. 2022. Ontogenetic differences in mandibular morphology of two related macaque species and its adaptive implications. The Anatomical Record 305: 3430–3440. https://doi.org/https://doi.org/10.1002/ar.24936

Woolley, M.R., A. Chinsamy and **M.W. Caldwell**. 2022. Unraveling the taxonomy of the South African mosasaurids. Frontiers in Earth Science 10. https://doi.org/10.3389/feart.2022.971968

OTHER AUTHORS

Mineralogy

Celestian, A.J. 2022. New mineral names: high-pressure and precious minerals. American Mineralogist 107: 778–780. https://doi.org/10.2138/am-2022-NMN107411 [†, #]

Day, M.C., E. Sokolova, F.C. Hawthorne, L. Horváth and E. Pfenninger-Horváth. 2022. Bortolanite, Ca2(Ca1.5Zr0.5)Na(NaCa)Ti(Si2O7)2(FO)F2, a new Rinkite-group (Seidozerite Supergroup) TS-block mineral from the Bortolan Quarry, Poços de Caldas Massif, Minas Gerais, Brazil. The Canadian Mineralogist 60: 699–712. https://doi.org/10.3749/canmin.2200001 [*]

Mauthner, M. 2022. Artist Susan M. Robinson (b. 1949). Rocks & Minerals 97: 271–275. https://doi.org/10.1080/00357529.2022.2028103 [†]

Miyawaki, R., F. Hatert, M. Pasero and S.J. Mills. 2022. IMA Commission on New Minerals, Nomenclature and Classification (CNMNC) – Newsletter 70. European Journal of Mineralogy 34: 591–601. https://doi.org/10.5194/ejm-34-591-2022 [†]

Schoepfer, V.A. and M.B.J. Lindsay. 2022. Repartitioning of co-precipitated Mo(VI) during Fe(II) and S(-II) driven ferrihydrite transformation. Chemical Geology 610: 121075. https://doi.org/10.1016/j.chemgeo.2022.121075 [†]

Schoepfer, V.A. and M.B.J. Lindsay. 2022. X-ray absorption spectroscopy and X-ray diffraction data for molybdenum minerals and compounds. Data in Brief 45: 108576. https://doi.org/10.1016/j.dib.2022.108576 [†]

Palaeobiology

Adrian, B. 2022. Stratigraphic range extension of the turtle *Boremys pulchra* (Testudinata, Baenidae) through at least the uppermost Cretaceous. Fossil Record 25: 275–285. https://doi.org/10.3897/fr.25.85563 [†]

Allmon, W.D. 2022. "Extreme dinosaurs" and the continuing evolution of dinosaur paleoart. In R.M. Clary, G.D. Rosenberg and D.C. Evans (Eds.). The Evolution of Paleontological Art. Geological Society of America. https://doi.org/10.1130/2021.1218(23) [†]

Bell, P.R., C. Hendrickx, M. Pittman, T.G. Kaye and G. Mayr. 2022. The exquisitely preserved integument of *Psittacosaurus* and the scaly skin of ceratopsian dinosaurs. Communications Biology 5: 809. https://doi.org/10.1038/s42003-022-03749-3 [†]

Brown, C.M., P.J. Currie and F. Therrien. 2022. Intraspecific facial bite marks in tyrannosaurids provide insight into sexual maturity and evolution of bird-like intersexual display. Paleobiology 48: 12–43. https://doi.org/10.1017/pab.2021.29 [†]

Burke, V. and W. Tattersdill. 2022. Science fiction worldbuilding in museum displays of extinct life. Configurations 30: 313–340. https://doi.org/10.1353/con.2022.0019 [†]

Dalman, S., S. Jasinski and S. Lucas. 2022. A new chasmosaurine ceratopsid from the Upper Cretaceous (Campanian) Farmington Member of the Kirtland Formation, New Mexico. New Mexico Museum of Natural History and Science Bulletin 90: 127–153. [†]

Dalman, S.G., S.G. Lucas, S.E. Jasinski and N.R. Longrich. 2022. *Sierraceratops turneri*, a new chasmosaurine ceratopsid from the Hall Lake Formation (Upper Cretaceous) of south-central New Mexico. Cretaceous Research 130: 105034. https://doi.org/10.1016/j.cretres.2021.105034 [†]

Dyer, A., M. Powers and P. Currie. 2023. Problematic putative pachycephalosaurids: Synchrotron µCT imaging shines new light on the anatomy and taxonomic validity of *Gravitholus albertae* from the Belly River Group (Campanian) of Alberta, Canada. Vertebrate Anatomy Morphology Palaeontology 10: 65–110. https://doi.org/10.18435/vamp29388 [†]

Ernst, A. and H.A. Nakrem. 2022. Two trepostome bryozoans from the Assistance Formation (Permian, Roadian) near Lake Hazen, Ellesmere Island, Canada. GFF 144: 1–8. https://doi.org/10.1080/11035897.2021.1989716 [†]

Farlow, J.O., J.N. Lallensack, R.T. Müller and J.A. Hyatt. 2022. Pedal skeletal proportions of bipedal and potentially bipedal dinosaurs and other archosaurs: Interpreting the makers of early Mesozoic footprints. Bulletin of the Peabody Museum of Natural History 63: 33–90. https://doi.org/10.3374/014.063.0201 [†]

Fernandes, A.E., O. Mateus, B. Andres, M.J. Polcyn, A.S. Schulp, A.O. Gonçalves and L.L. Jacobs. 2022. Pterosaurs from the Late Cretaceous of Angola. Diversity 14: 741. https://doi.org/10.3390/d14090741 [†]

Fontana, L. 2022. Contexts and Subject Matter. In L. Fontana (Ed.). Reindeer Hunters of the Ice Age in Europe: Economy, Ecology, and the Annual Nomadic Cycle. Springer International Publishing, Cham, pp. 13–66. https://doi.org/10.1007/978-3-031-06259-9_2 [†]

Galloway, J.M., R.A. Fensome, G.T. Swindles, T. Hadlari, J. Fath, C. Schröder-Adams, J.O. Herrle and A. Pugh. 2022. Exploring the role of High Arctic Large Igneous Province volcanism on Early Cretaceous Arctic forests. Cretaceous Research 129: 105022. https://doi.org/10.1016/j.cretres.2021.105022 [†]

Gensel, P.G. 2022. Partially permineralized adpressions of *Wilhowia phocarum* Gensel gen. et sp. nov., a new basal euphyllophyte from the Lower Devonian Battery Point Formation, North Shore of Gaspé Bay, Quebec, Canada. International Journal of Plant Sciences 183: 604–629. https://doi.org/10.1086/721263 [†]

Gentry, A.D., C.R. Kiernan and J.F. Parham. 2023. A large non-marine turtle from the Upper Cretaceous of Alabama and a review of North American "Macrobaenids". The Anatomical Record 306: 1411–1430. https://doi.org/10.1002/ar.25054 (available online 19 August 2022) [†]

Greenwood, D.R., J.G. Conran and C.K. West. 2022. Palm fronds from western Canada are the northernmost palms from the Late Cretaceous of North America and may include the oldest Arecaceae. Review of Palaeobotany and Palynology 301: 104641. https://doi.org/10.1016/j.revpalbo.2022.104641 [†]

Horrocks, M. and D.M. Jarzen. 2022. Hornwort (Anthocerotopsida) spores in Late Quaternary wetland sediments and dryland soils, Rapa Nui (Easter Island). Palynology 46: 1–8. https://doi.org/10.1080/01916122.2021.1965667 [#]

Huang, H.-H.M., M. Yasuhara, D.J. Horne, V. Perrier, A.J. Smith and S.N. Brandão. 2022. Ostracods in databases: State of the art, mobilization and future applications. Marine Micropaleontology 174: 102094. https://doi.org/10.1016/j.marmicro.2022.102094 [†]

Ijouiher, J. 2022. The Desert Bones: The Paleontology and Paleoecology of Mid-Cretaceous North Africa. Indiana University Press, 326 pp. [†]

Kilmury, A.A. and K.S. Brink. 2022. Late Cretaceous vertebrate faunal assemblages of the Manitoba escarpment, Canada: Implications for Western Interior Seaway provinciality and biodiversity. Palaeogeography, Palaeoclimatology, Palaeoecology 601: 111119. https://doi.org/10.1016/j.palaeo.2022.111119 [†]

Kim, S.L., J.D. Yeakel, M.A. Balk, J.J. Eberle, S. Zeichner, D. Fieman and J. Kriwet. 2022. Decoding the dynamics of dental distributions: insights from shark demography and dispersal. Proceedings of the Royal Society B: Biological Sciences 289: 20220808. https://doi.org/10.1098/rspb.2022.0808 [†]

Libke, C., P.R. Bell, C.M. Somers and R.C. McKellar. 2022. New scale type from a small-bodied hadrosaur in the Frenchman Formation of southern Saskatchewan: Potential implications for integumentary diversity in *Edmontosaurus annectens*. Cretaceous Research 136: 105215. https://doi.org/10.1016/j.cretres.2022.105215 [†]

Lindblad, K.T., J.W. Moreno-Bernal, R.C. McKellar and M.I. Velez. 2022. The Northern Crocodile: first report of *Borealosuchus* (Eusuchia; Crocodylia) from Saskatchewan's lower Ravenscrag Formation (earliest Paleocene) with implications for biogeography. Canadian Journal of Earth Sciences 59: 623–638. https://doi.org/10.1139/cjes-2022-0010 [†]

Maidment, S.C.R., K.E.J. Chapelle, J.A. Bonsor, D. Button and P.M. Barrett. 2022. Osteology and relationships of *Cumnoria prestwichii* (Ornithischia: Ornithopoda) from the late Jurassic of Oxfordshire, UK. Monographs of the Palaeontographical Society 176: 1–55. https://doi.org/10.1080/02693445.2022.2162669 [†]

Matsumoto, R., S.-i. Fujiwara and S.E. Evans. 2022. Feeding behaviour and functional morphology of the neck in the long-snouted aquatic fossil reptile *Champsosaurus* (Reptilia: Diapsida) in comparison with the modern crocodilian *Gavialis gangeticus*. Journal of Anatomy 240: 893–913. https://doi.org/10.1111/joa.13600 [†]

Melo, B.F. and M.L.J. Stiassny. 2022. Systematic review and cranial osteology of *Petersius* with redescription of *P. conserialis* (Teleostei: Alestidae) from the Rufiji and Ruvu rivers of Tanzania. American Museum Novitates 2022 (3992): 1–16. https://doi.org/10.1206/3992.1 [†]

Ortiz David, L.D., B.J. González Riga and A.W.A. Kellner. 2022. *Thanatosdrakon amaru*, gen. et sp. nov., a giant azhdarchid pterosaur from the Upper Cretaceous of Argentina. Cretaceous Research 137: 105228. https://doi.org/10.1016/j.cretres.2022.105228 [†]

Pittman, M., N.J. Enriquez, P.R. Bell, T.G. Kaye and P. Upchurch. 2022. Newly detected data from *Haestasaurus* and review of sauropod skin morphology suggests Early Jurassic origin of skin papillae. Communications Biology 5: 122. https://doi.org/10.1038/s42003-022-03062-z [†]

Qin, W., H. Yi and K. Gao. 2022. A neomorphic ossification connecting the braincase, squamosal, and quadrate in choristoderan reptiles: insights from µCT data. Fossil Record 25: 1–10. https://doi.org/10.3897/fr.25.79595 [†]

Rowe, A.J. and E. Snively. 2022. Biomechanics of juvenile tyrannosaurid mandibles and their implications for bite force: evolutionary biology. The Anatomical Record 305: 373–392. https://doi.org/10.1002/ar.24602 [†]

Sereno, P.C., N. Myhrvold, D.M. Henderson, F.E. Fish, D. Vidal, S.L. Baumgart, T.M. Keillor, K.K. Formoso and L.L. Conroy. 2022. *Spinosaurus* is not an aquatic dinosaur. eLife 11: e80092. https://doi.org/10.7554/eLife.80092 [†]

Serrano-Brañas, C.I. and A. Prieto-Márquez. 2022. Taphonomic attributes of the holotype of the lambeosaurine dinosaur *Latirhinus uitstlani* from the late Campanian of Mexico: Implications for its phylogenetic systematics. Journal of South American Earth Sciences 114: 103689. https://doi.org/10.1016/j.jsames.2021.103689 [†]

Serrano-Brañas, C.I., B. Espinosa-Chávez, S.A. Maccracken, D.B. Guevara and E. Torres-Rodríguez. 2022. First record of caenagnathid dinosaurs (Theropoda, Oviraptorosauria) from the Cerro del Pueblo Formation (Campanian, Upper Cretaceous), Coahuila, Mexico. Journal of South American Earth Sciences 119: 104046. https://doi.org/10.1016/j.jsames.2022.104046 [†]

Son, M., Y.-N. Lee, B. Zorigt, Y. Kobayashi, J.-Y. Park, S. Lee, S.-H. Kim and K.Y. Lee. 2022. A new juvenile *Yamaceratops* (Dinosauria, Ceratopsia) from the Javkhlant Formation (Upper Cretaceous) of Mongolia. PeerJ 10: e13176. https://doi.org/10.7717/peerj.13176 [†]

Surring, L., M. Burns, E. Snively, D. Barta, T. Holtz, A. Russell, L. Witmer and P. Currie. 2022. Consilient evidence affirms expansive stabilizing ligaments in the tyrannosaurid foot. Vertebrate Anatomy Morphology Palaeontology 10: 49–64. https://doi.org/10.18435/vamp29387 [†]

Takasaki, R., K. Chiba, A.R. Fiorillo, K.S. Brink, D.C. Evans, F. Fanti, M. Saneyoshi, A. Maltese and S. Ishigaki. 2023. Description of the first definitive *Corythosaurus* (Dinosauria, Hadrosauridae) specimens from the Judith River Formation in Montana, USA and their paleobiogeographical significance. The Anatomical Record 306: 1918–1938. https://doi.org/10.1002/ar.25097 (available online 23 October 2022) [†]

Tsogtbaatar, C., T. Cullen, G. Phillips, R. Rolke and L.E. Zanno. 2022. Large-bodied ornithomimosaurs inhabited Appalachia during the Late Cretaceous of North America. PLOS ONE 17: e0266648. https://doi.org/10.1371/journal.pone.0266648 [†]

van Vliet, H.J., M. Bosselaers, S. Schouten and K. Post. 2022. Eocene cetaceans from the Belgian-Dutch coastal waters. Deinsea 20: 1–34. [†]

Warshaw, E.A. and D.W. Fowler. 2022. A transitional species of *Daspletosaurus* Russell, 1970 from the Judith River Formation of eastern Montana. PeerJ 10: e14461. https://doi.org/10.7717/peerj.14461 [†]

Wosik, M. and D.C. Evans. 2022. Osteohistological and taphonomic life-history assessment of *Edmontosaurus annectens* (Ornithischia: Hadrosauridae) from the Late Cretaceous (Maastrichtian) Ruth Mason dinosaur quarry, South Dakota, United States, with implication for ontogenetic segregation between juvenile and adult hadrosaurids. Journal of Anatomy 241: 272–296. https://doi.org/10.1111/joa.13679 [†]

Wyenberg-Henzler, T. 2022. Ecomorphospace occupation of large herbivorous dinosaurs from Late Jurassic through to Late Cretaceous time in North America. PeerJ 10: e13174. https://doi.org/10.7717/peerj.13174 [†]

Endangered Species and Conservation

CANADIAN MUSEUM OF NATURE STAFF

Lendemer, J.C. and **R.T. McMullin**. 2022. *Alectoria fallacina*. The IUCN Red List of Threatened Species 2022: e.T194660207A194678104. https://doi.org/10.2305/IUCN.UK.2022-1.RLTS.T194660207A194678104.en

Mueller, G.M., K.M. Cunha, T.W. May, J.L. Allen, J.R.S. Westrip, C. Canteiro, D.H. Costa-Rezende, E.R. Drechsler-Santos, A.M. Vasco-Palacios, A.M. Ainsworth, G. Alves-Silva, F. Bungartz, A. Chandler, S.C. Gonçalves, I. Krisai-Greilhuber, R. Iršėnaitė, J.B. Jordal, T. Kosmann, J. Lendemer, **R.T. McMullin**, A. Mešić, V. Motato-Vásquez, Y. Ohmura, R.R. Næsborg, C. Perini, I. Saar, D. Simijaca, R. Yahr and A. Dahlberg. 2022. What do the first 597 global fungal Red List assessments tell us about the threat status of fungi? Diversity 14: 736. https://doi.org/10.3390/d14090736

Environmental Health

CANADIAN MUSEUM OF NATURE STAFF

Long, S., **P.B. Hamilton**, B. Fu, J. Xu, L. Han, X. Suo, Y. Lai, G. Shen, F. Xu and B. Li. 2023. Bioaccumulation and emission of organophosphate esters in plants affecting the atmosphere's phosphorus cycle. Environmental Pollution 318: 120803. https://doi.org/10.1016/j.envpol.2022.120803

Tan, B., P. Hu, X. Niu, X. Zhang, J. Liu, T. Frenken, **P.B. Hamilton**, G.D. Haffner, S.R. Chaganti, A.S. Nwankwegu and L. Zhang. 2022. Microbial community day-to-day dynamics during a spring algal bloom event in a tributary of Three Gorges Reservoir. Science of The Total Environment 839: 156183. https://doi.org/10.1016/j.scitotenv.2022.156183

Trottier, L., J. Chételat, C. Vis, **P.B. Hamilton**, F.R. Pick and J.C. Vermaire. 2022. Water chemistry and periphyton biomass in the Rideau River: Have conditions changed after 24 years? Journal of Limnology 81. https://doi.org/10.4081/jlimnol.2022.2065

Zhi, Y., **P.B. Hamilton**, W. Guoyong, N. Hong, L. Liang, D. Xiong and Y. Syun. 2022. Virtual water indicator for comprehensive water pressures: Model and case studies. Journal of Hydrology 608: 127664. https://doi.org/10.1016/j.jhydrol.2022.127664

Reid, J.L., J.N. Bergman, A.N. Kadykalo, J.J. Taylor, W.M. Twardek, T. Rytwinski, A.D. Chhor, A. Frempong-Manso, **A.L. Martel**, N.W.R. Lapointe, J.R. Bennett, V.M. Nguyen, A.J. Reid, J. Marty, S.A. Robinson, D.A.R. Drake, A.K. Winegardner, I. Gregory-Eaves, M.K. Taylor, J.P. Smol, I.F. Creed, C.M. O'Connor and S.J. Cooke. 2022. Developing a national level evidence-based toolbox for addressing freshwater biodiversity threats. Biological Conservation 269: 109533. https://doi.org/10.1016/j.biocon.2022.109533

OTHER AUTHORS

Choy, E.S., L.K. Blight, J.E. Elliott, K.A. Hobson, M. Zanuttig and K.H. Elliott. 2022. Stable mercury trends support a long-term diet shift away from marine foraging in Salish Sea glaucous-winged gulls over the last century. Environmental Science & Technology 56: 12097–12105. https://doi.org/10.1021/acs.est.1c03760 [†]

Hansen, S.E., B.C. Cahill, R.A. Hackett, M.J. Monfils, R.T. Goebel, S. Asencio and A. Monfils. 2022. Aggregated occurrence records of invasive European frog-bit (*Hydrocharis morsus-ranae* L.) across North America. Biodiversity Data Journal 10: e77492. https://doi.org/10.3897/BDJ.10.e77492 [†]

Bergman, J.N., G.D. Raby, K.L. Neigel, C.D. Rennie, S. Balshine, J.R. Bennett, A.T. Fisk and S.J. Cooke. 2022. Tracking the early stages of an invasion with biotelemetry: behaviour of round goby (*Neogobius melanostomus*) in Canada's historic Rideau Canal. Biological Invasions 24: 1149–1173. https://doi.org/10.1007/s10530-021-02705-2 [†, *]

Species Discovery

CANADIAN MUSEUM OF NATURE STAFF

Algae, Plants and Lichens

Algae

Ageli, M.K., **P.B. Hamilton**, A.J. Bramburger, R.P. Weidman, Z. Song, J. Russell, H. Vogel, S. Bijaksana and G.D. Haffner. 2022. Benthic-Pelagic state changes in the primary trophic level of an ancient tropical lake. Palaeogeography, Palaeoclimatology, Palaeoecology 594: 110937. https://doi.org/10.1016/j.palaeo.2022.110937

Bringloe, T.T., D.P. Wilkinson, J. Goldsmit, **A.M. Savoie**, K. Filbee-Dexter, K.A. Macgregor, K.L. Howland, C.W. McKindsey and H. Verbruggen. 2022. Arctic marine forest distribution models showcase potentially severe habitat losses for cryophilic species under climate change. Global Change Biology 28: 3711–3727. https://doi.org/10.1111/gcb.16142

Jovanovska, E., T. Hauffe, B. Stelbrink, A. Cvetkoska, Z. Levkov, B. Wagner, J.H. Lacey, N. Ognjanova-Rumenova, **P.B. Hamilton**, K.M. Brandenburg, C. Albrecht and T. Wilke. 2022. Environmental filtering drives assembly of diatom communities over evolutionary time-scales. Global Ecology and Biogeography 31: 954–967. https://doi.org/10.1111/geb.13471

Jüttner, I., **P.B. Hamilton**, C.E. Wetzel, B. Van De Vijver, L. King, M.G. Kelly, D.M. Williams and L. Ector. 2022. A study of the morphology and distribution of four *Achnanthidium* Kütz. species (Bacillariophyta), implications for ecological status assessment, and description of two new European species. Cryptogamie, Algologie 43: 147–176. https://doi.org/10.5252/cryptogamie-algologie2022v43a10

Van de Vijver, B., I. Jüttner and **P.B. Hamilton**. 2022. Typification and observations of *Cavinula scutelloides* (W.Smith ex W.Gregory) Lange-Bertalot (Cavinulaceae, Bacillariophyta). Notulae Algarum 242: 1–3.

Lichens

Allen, J.L., L.M. Calabria, H.E. Braid, E. Peterson, J. Villella, S. Sheehy, K. Glew, J.M. Graves, A. Berim, R.D. Bull, C.T. Lymbery and **R.T. McMullin**. 2022. *Umbilicaria phaea* var. *coccinea*: conservation status, variety rank, and secondary chemistry. The Bryologist 125: 389–407. https://doi.org/10.1639/0007-2745-125.3.387

Egbert, S., J.R. Hoffman, **R.T. McMullin**, J.C. Lendemer and J.L. Sorensen. 2022. Unraveling usnic acid: a comparison of biosynthetic gene clusters between two reindeer lichen (*Cladonia rangiferina* and *C. uncialis*). Fungal Biology 126: 697–706. https://doi.org/10.1016/j.funbio.2022.08.007

Lendemer, J.C. and **R.T. McMullin**. 2022. Lectotypification of the threatened endemic Appalachian lichen *Alectoria fallacina*. Taxon 71: 1077–1083. https://doi.org/10.1002/tax.12719

McMullin, R.T. 2022. The Secret World of Lichens. Firefly Books Ltd., Toronto, ON. 48 pp.

McMullin, R.T. and J. Miadlikowska. 2022. Two rare *Peltigera* species new to the Canadian Arctic, *P. islandica* and *P. lyngei*. Plant and Fungal Systematics 67: 17–23. https://doi.org/10.35535/pfsyst-2022-0002

McMullin, R.T. and J.L. Allen. 2022. An assessment of data accuracy and best practice recommendations for observations of lichens and other taxonomically difficult taxa on iNaturalist. Botany 100: 491–497. https://doi.org/10.1139/cjb-2021-0160

McMullin, R.T., J.R.M. Maloles, J.T. Skuza, C.-A. Wegenschimmel, C. Cadranel and K.H.I. Drotos. 2022. Lichens and allied fungi of Rouge National Urban Park in the Greater Toronto Area, Ontario. Urban Naturalist 9: 1–19.

Wiersma, Y.F. and **R.T. McMullin**. 2022. Are calicioids useful indicators of boreal forest continuity or condition? Biodiversity and Conservation 31: 1647–1664. https://doi.org/10.1007/s10531-022-02418-5

Zhang, Y., J. Clancy, J. Jensen, **R.T. McMullin**, L. Wang and S.D. Leavitt. 2022. Providing scale to a known taxonomic unknown--at least a 70-fold increase in species diversity in a cosmopolitan nominal taxon of lichen-forming fungi. Journal of Fungi 8: 490. https://doi.org/10.3390/jof8050490

Vascular Plants

Gillespie, L.J., R.J. Soreng, **R.D. Bull**, P.J. de Lange and R.D. Smissen. 2022. Morphological and phylogenetic evidence for subtribe Cinninae and two new subtribes, Hookerochloinae and Dupontiinae (Poaceae tribe Poeae PPAM clade). Taxon 71: 52–84. https://doi.org/10.1002/tax.12654

Nasiri, A., S. Kazempour-Osaloo, B. Hamzeh'ee, **R.D. Bull** and **J.M. Saarela**. 2022. A phylogenetic analysis of *Bromus* (Poaceae: Pooideae: Bromeae) based on nuclear ribosomal and plastid data, with a focus on *Bromus* sect. *Bromus*. PeerJ 10: e13884. https://doi.org/10.7717/peerj.13884

Saarela, J.M., P.C. Sokoloff, L.J. Gillespie and **R.D. Bull**. 2023. Vascular plant biodiversity of Katannilik Territorial Park, Kimmirut and vicinity on Baffin Island, Nunavut, Canada: an annotated checklist of an Arctic flora. PhytoKeys 217: 1–135. https://doi.org/10.3897/phytokeys.217.90573

Soreng, R.J., P.M. Peterson, F.O. Zuloaga, K. Romaschenko, L.G. Clark, J.K. Teisher, **L.J. Gillespie**, P. Barberá, C.A.D. Welker, E.A. Kellogg, D.-Z. Li and G. Davidse. 2022. A worldwide phylogenetic classification of the Poaceae (Gramineae) III: An update. Journal of Systematics and Evolution. https://doi.org/10.1111/jse.12847

Panchen, Z.A. 2022. Plant reproductive phenology along an elevation gradient in the extreme environment of the Canadian High Arctic. Plant Ecology & Diversity 15: 213–226. https://doi.org/10.1080/17550874.2022.2147804

Animals

Invertebrates

Beetles

Anderson, R.S. 2022. A new species of eyeless *Lymantes* Schoenherr (Coleoptera: Curculionidae: Molytinae: Lymantini) from Texas caves. Zootaxa 5087: 383–388. https://doi.org/10.11646/zootaxa.5087.2.8

Anderson, R.S. 2022. A second species of the genus *Erebaces* Pascoe, 1871 (Curculionidae, Molytinae, Cryptorhynchini) from the Philippines. Insecta Mundi 909: 1–3.

Anderson, R.S. 2022. New species of *Rhodobaenus* LeConte, 1876 (Coleoptera: Curculionidae: Dryophthorinae) from Central and South America. Zootaxa 5115: 267–273. https://doi.org/10.11646/zootaxa.5115.2.5

Anderson, R.S. and M.F.B. Higinio. 2022. *Koreguajus antennatus* Anderson and Bermúdez Higinio, a new genus and new species of Sphenophorina (Coleoptera: Curculionidae: Dryophthorinae; Rhynchophorini) from Colombia. Zootaxa 5190: 595–600. https://doi.org/10.11646/zootaxa.5190.4.10

Borovec, R. and **R.S. Anderson**. 2022. Three new species of *Trachyphloeosoma* Wollaston (Coleoptera: Curculionidae: Entiminae) from southeast Asia with the first record of the tribe Trachyphloeini from the Philippines. Zootaxa 5182: 93–100. https://doi.org/10.11646/zootaxa.5182.1.7

De Sousa, W.O. and **R.S. Anderson**. 2022. Two new Brazilian species in the *Coelocephalapion nodicorne* species-group (Brentidae, Apioninae, Apionini, Oxystomatina) associated with Euphorbiaceae. Zootaxa 5205: 220–230. https://doi.org/10.11646/zootaxa.5205.3.2

Floate, K.D., D. Wilches, P. Coghlin and **A.B.T. Smith**. 2022. Assessment of the *Aphodius fimetarius–Aphodius pedellus* (Coleoptera: Scarabaeidae) species complex in Canada. The Canadian Entomologist 154: e39. https://doi.org/10.4039/tce.2022.26

Grebennikov, V.V. and **R.S. Anderson**. 2022. Phylogeny, diversity and biogeography of flightless amphi-Pacific lymantine weevils (Coleoptera: Curculionidae: Molytinae). Acta Entomologica Musei Nationalis Pragae 62: 411–442. https://doi.org/10.37520/aemnp.2022.023

Langor, D.W., **R.S. Anderson**, P. Bouchard and S.D. Langor. 2022. New records of Curculionoidea from Newfoundland and Labrador, with the first records of *Orthochaetes setiger* ([Beck]) (Curculionidae, Curculioninae, Styphlini) for North America. ZooKeys 1136: 125–162. https://doi.org/10.3897/zookeys.1136.91567

Lewis, J.H. and **R.S. Anderson**. 2022. A revision of the North American genus *Proctorus* (Coleoptera, Curculionidae, Ellescini) with descriptions of two new species. ZooKeys 1131: 135–153. https://doi.org/10.3897/zookeys.1131.90392

Lewis, J.H. and **R.S. Anderson**. 2022. *Otiorhynchus desertus* Rosenhauer, 1847 (Coleoptera: Curculionidae): Confirmation of establishment in North America, and other new provincial records of adventive weevils from New Brunswick, Canada. The Coleopterists Bulletin 76: 441–444. https://doi.org/10.1649/0010-065X-76.3.441

Prena, J. and **R.S. Anderson**. 2022. The genus *Crostis* Casey (Coleoptera: Curculionidae: Baridinae) in North America. Zootaxa 5162: 153–162. https://doi.org/10.11646/zootaxa.5162.2.4

Silva, F.A.B., A.B.M. Ferreira and **F. Génier**. 2022. Taxonomic revision of the genus *Deltepilissus* Pereira, 1949 (Coleoptera: Scarabaeidae: Scarabaeinae: Deltochilini). Zootaxa 5120: 83–96. http://dx.doi.org/10.11646/zootaxa.5120.1.5

Skelley, P.E., **A.B.T. Smith** and E.F. Mora-Aguilar. 2022. A review of the flightless genus *Nanotermitodius* Howden, 2003 (Coleoptera: Scarabaeidae: Aphodiinae: Rhyparini). Zootaxa 5200: 355–364. https://doi.org/10.11646/zootaxa.5200.4.4

Webster, R.P., J.D. Sweeney, J.H. Lewis, J. Klymko, G. Martens-Carpenter, M. Giasson, L. Voscort, C. Chapman, N. Kirk Hillier and **R.S. Anderson**. 2022. Additions to the Coleoptera Fauna of New Brunswick, Nova Scotia, and Prince Edward Island, Canada. Journal of the Acadian Entomological Society 18: 1–13.

Zettler, M.L., **E.A. Hendrycks** and A. Freiwald. 2022. A new amphipod species of the bathyal genus *Dautzenbergia* Chevreux, 1900 (Amphipoda, Calliopioidea, Pontogeneiidae) associated with cold-water corals off Angola. Zootaxa 5213: 49–63. https://doi.org/10.11646/zootaxa.5213.1.3

Other invertebrates

Crispo, E. and **K.L. Ilves**. 2022. Three research-based quantitative reasoning modules for introductory organismal biology laboratories. CourseSource 9. https://doi.org/10.24918/cs.2022.48

Hendrycks, E.A. and C. De Broyer. 2022. New deep-sea Atlantic and Antarctic species of *Abyssorchomene* De Broyer, 1984 (Amphipoda, Lysianassoidea, Uristidae) with a redescription of *A. abyssorum* (Stebbing, 1888). European Journal of Taxonomy 825: 1–76. https://doi.org/10.5852/ejt.2022.825.1829

Vertebrates

Fishes

Astudillo-Clavijo, V., M.L.J. Stiassny, **K.L. Ilves**, Z. Musilova, W. Salzburger and H. López-Fernández. 2022. Exon-based phylogenomics and the relationships of African cichlid fishes: tackling the challenges of reconstructing phylogenies with repeated rapid radiations. Systematic Biology: syac051. https://doi.org/10.1093/sysbio/syac051

Mammals

Bergeron, G., M. Poirier and **D. Fauteux**. 2022. Imprévisibilité climatique, dérèglement des cycles de lemmings et biodiversité nordique. Le Climatoscope 4: 81–86.

Bolduc, D., **D. Fauteux**, É. Bharucha, J.-M. Trudeau and P. Legagneux. 2022. Ultra-light photosensor collars to monitor Arctic lemming activity. Animal Biotelemetry 10: 31. https://doi.org/10.1186/s40317-022-00302-1

Buhler, K.J., C. Fernando, J.E. Hill, T. Galloway, S. Carriere, H. Fenton, **D. Fauteux** and E.J. Jenkins. 2022. Combining deep sequencing and conventional molecular approaches reveals broad diversity and distribution of fleas and *Bartonella* in rodents and shrews from Arctic and Subarctic ecosystems. Parasites & Vectors 15: 366. https://doi.org/10.1186/s13071-022-05446-w

Fauteux, D. 2022. First record of a least weasel in Nunavik. Arctic Science. https://doi.org/10.1139/as-2022-0029

Fauteux, D. and G. Gauthier. 2022. Density-dependent demography and movements in a cyclic brown lemming population. Ecology and Evolution 12: e9055. https://doi.org/10.1002/ece3.9055

CANADIAN MUSEUM OF NATURE RESEARCH ASSOCIATES

Algae, Plants and Lichens

Vascular Plants

Brunton, D.F., M.J. Oldham and A.V. Gilman. 2021 [2022]. Himalayan Elecampane, *Inula racemosa* (Asteraceae), in North America. Rhodora 123: 19–30. https://doi.org/10.3119/20-33

Brunton, D.F. 2022. A catalogue of the bird specimen collection (1874–1949) of George and Edward White of Ottawa, Ontario. Ontario Birds 40: 89–103.

Brunton, D.F. 2022. Erratum: A synopsis of lycophytes in Manitoba, Canada: their status, distribution, and abundance. Canadian Field-Naturalist 136(3): 281–283. https://doi.org/10.22621/cfn.v136i3.3137

Chapman-Lam, C.J. 2022. First North American records of *Geum ×spurium* and noteworthy records of three additional Geum taxa. Phytoneuron 2022-60: 1–9.

Hough, M., A.V. Gilman and **C.J. Chapman-Lam.** 2022. *Geum ×hainesianum* (Rosaceae), a new hybrid avens from Eastern North America. Rhodora 123: 67–84. https://doi.org/10.3119/21-06

Knapp, W.M., **G.A. Levin** and K. Gandhi. 2022. (2903) Proposal to conserve the name *Juncus acuminatus* Michx. against *J. acuminatus* Balb. (Juncaceae) and including the lectotypification of *J. paradoxus*. Taxon 71: 905–906. https://doi.org/10.1002/tax.12774

Levin, G.A. 2022. Resurrection of *Drypetesnienkui* (Putranjivaceae), endemic to Hainan, China. PhytoKeys 206: 129–136. https://doi.org/10.3897/phytokeys.206.87737

Levin, G.A., **W.M. Cardinal-McTeague**, V.W. Steinmann and V.G. Sagun. 2022. Phylogeny, classification, and character evolution of *Acalypha* (Euphorbiaceae: Acalyphoideae). Systematic Botany 47: 477–497. https://doi.org/10.1600/036364422x16512572275034

Lindsay, S. et al. [including **G.A. Levin**]. 2022. Flora of Singapore: Checklist and bibliography. Gardens' Bulletin Singapore 74: Flora of Singapore: Checklist and bibliography. Gardens' Bulletin Singapore 74(suppl.1): 3–860. https://doi.org/10.26492/gbs74(suppl.1).2022-01

Montero-Muñoz, I., **G.A. Levin** and J.M. Cardiel. 2022. Four new species of *Acalypha* L. (Euphorbiaceae, Acalyphoideae) from Madagascar, with notes about their conservation status. South African Journal of Botany 146: 634–642. https://doi.org/10.1016/j.sajb.2021.11.052

Staniforth, R. and **D. Brunton**. 2022. A synopsis of lycophytes in Manitoba, Canada: their status, distribution, abundance, and habitats. The Canadian Field-Naturalist 136: 107–121. https://doi.org/10.22621/cfn.v136i2.2669

Animals

Invertebrates

Brodo, F., V.I. Lantsov and O.A. Khruleva. 2022. The subgenus *Arctotipula* Alexander in the genus *Tipula* Linnaeus (Diptera: Tipulidae) on Wrangel Island, Russia (Chukotka Autonomous Okrug). The Canadian Entomologist 154: e45. https://doi.org/10.4039/tce.2022.35

Ferreira, R.L. et al. [including **S. Peck**]. 2022. Brazilian cave heritage under siege. Science 375: 1238–1239. https://doi.org/10.1126/science.abo1973

MacIvor, J.S., C.W. de Keyzer, M.S. Marshall, G.S. Thurston and **T.M. Onuferko**. 2022. Establishment of the non-native horned-face bee *Osmia cornifrons* and the taurus mason bee *Osmia taurus* (Hymenoptera: Megachilidae) in Canada. PeerJ 10: e14216. https://doi.org/10.7717/peerj.14216

Onuferko, T. and C.S. Sheffield. 2022. A new species of *Epeolus* Latreille, 1802 (Hymenoptera: Apidae) from western North America. Insect Mundi 940: 1–12.

Vertebrates

Amphibians and Reptiles

Schueler, F.W. 2021 (2022). Why is Canadian herpetology the queen of the sciences. The Canadian Herpetologist 11: 18.

Fishes

Chakrabarty, P., M. Byrnes and J.S. Sparks. 2022. Gobiidae: *Glossogobius ankaranensis*. In S.M. Goodman (Ed.). The new natural history of Madagascar. Princeton University Press, Princeton, pp. 12951298.

Chakrabarty, P. and J.S. Sparks. 2022. Leiognathidae (Ponyfish, Slipmouths). In P.C. Heemstra, E. Heemstra, D.A. Ebert, W. Holleman and J.E. Randall (Eds.). Coastal Fishes of the Western Indian Ocean 3, pp. 415–428.

Chakrabarty, P., S.R. Midway and C.T. Hasler. 2022. Methods in Fish Biology: The Modern Toolbox. In S. Midway, C. Hassler and **P. Chakrabarty** (Eds.). Methods in Fish Biology 2nd Edition. American Fisheries Society**.**

Coad, B.W. 2022. The discovered subterranean habitats of cave fishes in the Zagros Mountains, Iran. In: Taheri, K., Groves, C., Mohammadi, Z., Biglari, F., Sharifi, A. and Raftar, R. K. (Eds.). Caves and Karst Research in Iran. Springer Nature, Series: Cave and Karst Systems of the World, On the Occasion of the International Year of Caves and Karst 2021. https://iyck2021.org/

Girard, M.G., M.P. Davis, T. H.H, D.J. Wedd, **P. Chakrabarty**, W.B. Ludt, A.P. Summers and W.L. Smith. 2022. Phylogenetics of archerfishes (Toxotidae) and evolution of the toxotid shooting apparatus. Integrative Organismal Biology 4: obac013. https://doi.org/10.1093/iob/obac013

Hart, P.B., R.J. Arnold, F. Alda, C.P. Kenaley, T.W. Pietsch, D. Hutchinson and **P. Chakrabarty**. 2022. Evolutionary relationships of anglerfishes (Lophiiformes) reconstructed using ultraconserved elements. Molecular Phylogenetics and Evolution 171: 107459. https://doi.org/10.1016/j.ympev.2022.107459

Janzen, F.H., W.G.R. Crampton and **N.R. Lovejoy**. 2022. A new taxonomist-curated reference library of DNA barcodes for Neotropical electric fish (Teleostei: Gymnotiformes). Zoological Journal of the Linnean Society 196: 1718–1742. https://doi.org/10.1093/zoolinnean/zlac039

Kolmann, M.A., F.P.L. Marques, J.C. Weaver, M.N. Dean, J.P. Fontenelle and **N.R. Lovejoy**. 2022. Ecological and phenotypic diversification after a continental invasion in neotropical freshwater stingrays. Integrative and Comparative Biology 62: 424–440. https://doi.org/10.1093/icb/icac019

Midway, S., C. Hasler and **P. Chakrabarty**. 2022. Methods for Fish Biology, 2nd edition. American Fisheries Society, Bethesda, Maryland, 824 pp.

Poo, S., S.M. Whitfield, A. Shepack, G.J. Watkins-Colwell, G. Nelson, J. Goodwin, A. Bogisich, P.L.R. Brennan, J. D'Agostino, M.S. Koo, J.R. Mendelson, III, R. Snyder, S. Wilson, G.P. Aronsen, A.C. Bentley, D.C. Blackburn, M.R. Borths, M.L. Campbell, D.A. Conde, J.A. Cook, J.D. Daza, D.P. Dembiec, J.L. Dunnum, C.M. Early, A.W. Ferguson, A. Greene, R. Guralnick, C. Janney, D. Johnson, F. Knightly, S. Poulin, L. Rocha, P.S. Soltis, B. Thiers and **P. Chakrabarty**. 2022. Bridging the research gap between live collections in zoos and preserved collections in natural history museums. BioScience 72: 449–460. https://doi.org/10.1093/biosci/biac022

Sparks, J.S. and **P. Chakrabarty**. 2022. Milyeringidae: Typhleotris. In S.M. Goodman (Ed.). The new natural history of Madagascar. Princeton University, Princeton, pp. 1298–1304.

Zhao, Y., A.G. Gluesenkamp, J.J. Wynne, D.B. Fenolio, D. Soares, M.L. Niemiller, M.E. Bichuette and **P. Chakrabarty**. 2022. Diversity, distribution, and conservation of cavefishes in China. In J.J. Wynne (Ed.). Cave Biodiversity: Speciation and Diversity of Subterranean Fauna. Johns Hopkins University Press.

Mammals

Damas, J. et al. [including **M. Nweeia**]. 2022. Evolution of the ancestral mammalian karyotype and syntenic regions. Proceedings of the National Academy of Sciences 119: e2209139119. https://doi.org/10.1073/pnas.2209139119

OTHER AUTHORS

Flora and Fauna

Simon, A.D.F., E.M. Adamczyk, A. Basman, J.W.F. Chu, H.N. Gartner, K. Fletcher, C.J. Gibbs, D.M. Gibbs, S.R. Gilmore, R.M. Harbo, L.H. Harris, E. Humphrey, A. Lamb, P. Lambert, N. McDaniel, J. Scott and B.M. Starzomski. 2022. Toward an atlas of Salish Sea biodiversity: the flora and fauna of Galiano Island, British Columbia, Canada. Part I. Marine zoology. Biodiversity Data Journal 10: e76050. [†]

Algae, Plants and Lichens

Algae

Enache, M.D., M.G. Potapova, M. Tyree Polaskey and S.A. Spaulding. 2022. *Aulacoseira newjerseyana* sp. nov. (Bacillariophyta) a new freshwater centric diatom species from the northeastern USA. Diatom Research 37: 263–271. https://doi.org/10.1080/0269249X.2022.2118834 [†]

Siver, P.A. and A. Skogstad. 2022. A first account of the heterotrophic eukaryote *Rabdiophrys* Rainer from the fossil record and description of a new species from an ancient Eocene Arctic freshwater lake. European Journal of Protistology 82: 125857. https://doi.org/10.1016/j.ejop.2021.125857 [*]

Bryophytes

Cano, M.J., J.A. Jiménez, M.T. Gallego and J. Guerra. 2022. A molecular approach to the phylogeny of the moss genus *Pseudocrossidium* (Pottiaceae, Bryopsida) and its taxonomic implications. Journal of Systematics and Evolution 60: 914–931. https://doi.org/10.1111/jse.12801 [†]

Gallego, M.T., M.J. Cano, J.A. Jiménez and J. Guerra. 2022. Circumscription and phylogenetic position of two propagulose species of *Syntrichia* (Pottiaceae, Bryophyta) reveals minor realignments within the Tribe Syntricheae. Plants 11: 626. https://doi.org/10.3390/plants11050626 [†]

Jiménez, J.A., M.J. Cano and J. Guerra. 2022. A multilocus phylogeny of the moss genus *Didymodon* and allied genera (Pottiaceae): Generic delimitations and their implications for systematics. Journal of Systematics and Evolution 60: 281–304. https://doi.org/10.1111/jse.12735 [†]

Passarella, M.A. and A.P. Luizi-Ponzo. 2022. Oncophoraceae (Bryophyta): a palynological treatment of species occurring in the Americas. Anais Academia Brasileira de Ciencias 94: e20201508. https://doi.org/10.1590/0001-3765202120201508 [†]

Lichens

Brinker, S., A.M. Evankow and E. Timdal. 2022. *Rhizoplaca ouimetensis* sp. nov. (Lecanoraceae) from Ontario, the first sorediate species in the genus. The Bryologist 125: 513–523. https://doi.org/10.1639/0007-2745-125.4.513 [†]

Jones, H., L.L. St. Clair, J. Hollinger, L.S. Cooper, R. Rosentreter, R. Keuler and S.D. Leavitt. 2022. Anderson and Shushan: Lichens of Western North America Fascicle VIII. Evansia 39: 69–81. https://doi.org/10.1639/0747-9859-39.2.69 [*]

Morse, C.A. 2022. Lichenes Exsiccati Magnicamporum Fascicle 3. Opuscula Philolichenum 21: 24–32. [*]

Morse, C.A. and D. Ladd. 2022. Lichenes Exsiccati Magnicamporum Fascicle 2, with comments on selected taxa. Opuscula Philolichenum 21: 1–23. [*]

Ortiz-Moreno, M.L., B. Moncada, A.M. Vasco-Palacios, R.F. de Almeida and E. Gaya. 2022. Fungi in Colombian and international biological collections. In R.F. de Almeida, R. Lücking, A.M. Vasco-Palacios, E. Gaya and M. Diazgranados (Eds.). Catalogue of Fungi in Colombia. Kew Publishing, Royal Botanic Gardens, Kew [†]

Raynor, S.J., J. Kesler and E.A. Manzitto-Tripp. 2022. New and noteworthy reports on Colorado lichens and lichen allies, 2: *Biatoropsis usnearum*. Phytoneuron 2022-40: 1–6. [‡]

Simon, A., B. Goffinet, L.-S. Wang, T. Spribille, T. Goward, T. Pystina, N. Semenova, N.V. Stepanov, B. Moncada, R. Lücking, N. Magain and E. Sérusiaux. 2022. Global phylogeny and taxonomic reassessment of the lichen genus *Dendriscosticta* (Ascomycota: Peltigerales). Taxon 71: 256–287. https://doi.org/10.1002/tax.12649 [†]

Vascular Plants

Bartolucci, F., E. De Santis and F. Conti. 2022. Nomenclatural synopsis, revised distribution and conservation status of *Ranunculus gracilis* (Ranunculaceae) in Italy. Plants 11: 3094. https://doi.org/10.3390/plants11223094 [‡]

Bjork, C.R. 2022. Notes on *Suaeda* (Amaranthaceae) in boreo-arctic North America. Phytoneuron 2022-60: 1–9. [†]

Björk, C.R. and T. Goward. Clarification of the identity of *Picea* x*albertiana* and a new nothospecies for hybrids of *P. engelmannii* and *P. glauca*. Phytoneuron 2022-65: 1–8. [*]

Shteir, A. and S. Zeller. 2022. Flora's Fieldworkers: Women and Botany in Nineteenth-Century Canada, McGill-Queen's University Press, 487 pp. [†]

Sugars, C. 2022. Settler Botanists, Nature's Gentlemen, and the Canadian Book of Nature: Catharine Parr Traill's Canadian Wild Flowers. In A. Leis (Ed.). Women, Collecting, and Cultures Beyond Europe (1st ed.). Routledge. https://doi.org/10.4324/9781003230809 [†]

Yu, Y., Q. Lu, A.G. Lapirov, J. Freeland and X. Xu. 2022. Clear phylogeographical structures shed light on the origin and dispersal of the aquatic boreal plant *Hippuris vulgaris*. Frontiers in Plant Science 13: 1046600. https://doi.org/10.3389/fpls.2022.1046600 [†]

Animals

Invertebrates

Beetles

Anzaldo, S.S. and V. Diaz-Grisales. 2022. *Heilipus squamosus* (LeConte, 1824): clarification of the correct name for the "avocado tree girdler" with updates on its biology and distribution (Coleoptera, Curculionidae, Molytinae, Hylobiini). Biodiversity Data Journal 10: e85499. https://doi.org/10.3897/BDJ.10.e85499 [†]

Arriaga-Varela, E., W. Tomaszewska, K. Szawaryn, J.A. Robertson, M. Seidel, A. Ślipiński and M. Fikáček. 2022. The resurrection of Cerasommatidiidae, an enigmatic group of coccinelloid beetles (Coleoptera: Coccinelloidea) based on molecular and morphological evidence. Zoological Journal of the Linnean Society: zlac082. https://doi.org/10.1093/zoolinnean/zlac082 [†]

Bonfim-Kubatamaia, E.D.G., C.R.V.D. Fonseca, M. Bevilaqua and F.O.G. Figueiredo. 2022. Richness and similarity of Passalidae (Coleoptera: Scarabaeoidea) from biological collections in the Brazilian Amazon. Anais da Academia Brasileira de Ciências 94: e20190642. https://doi.org/10.1590/0001-3765202220190642 [†]

Borovec, R. 2022. *Luciculio*, a new genus with nine new species from Limpopo and Mpumalanga in South Africa (Coleoptera: Curculionidae: Entiminae: Embrithini). Zootaxa 5169: 538–562. https://doi.org/10.11646/zootaxa.5169.6.2 [†]

Brunke, A.J. 2022. Revision of rove beetle genus *Bolitogyrus* Chevrolat (Staphylininae, Cyrtoquediini). Supplement 1. ZooKeys 1096: 1–16. https://doi.org/10.3897/zookeys.1096.80773 [†]

Caterino, M.S. 2022. First report of the *Euconnus* Thomson subgenus *Cladoconnus* Reitter in the New World, represented by thirteen new Appalachian species (Coleoptera, Staphylinidae, Scydmaeninae). Zookeys 1137: 133–175. https://doi.org/10.3897/zookeys.1137.97068 [†]

Chamorro, M.L. and T.M. Presnall. 2022. *Randersonia* Chamorro, a new genus with two new species of North American Cryptorhynchinae (Coleoptera: Curculionidae). Zootaxa 5222: 591–599. https://doi.org/10.11646/zootaxa.5222.6.6 [*]

Cupello, M., C.S. Ribeiro-Costa and F.Z. Vaz-De-Mello. 2021. The evolution of *Bolbites onitoides* (Coleoptera: Scarabaeidae: Phanaeini): its phylogenetic significance, geographical polychromatism and the subspecies problem. Zoological Journal of the Linnean Society 194: 973–1034. https://doi.org/10.1093/zoolinnean/zlab015 [†]

Degallier, N. and A. Tishechkin. 2022. Révision du genre *Scapicoelis* Marseul, 1862, avec la description de 28 espèces nouvelles (Insecta, Coleoptera, Histeridae, Haeteriinae). Faunitaxys 10: 1–87. [†]

Eiseman, C.S. and J.A. Blyth. 2022. Nantucket's Neglected Herbivores I: Coleoptera. Proceedings of the Entomological Society of Washington 124: 202–224. https://doi.org/10.4289/0013-8797.124.2.202 [†]

Fleming, K.J., J.A. Schaefer and D.V. Beresford. 2022. New records and range extensions of Carabidae of Ontario's boreal forest. The Canadian Entomologist 154: e44. https://doi.org/10.4039/tce.2022.33 [†]

Friedman, A.-L.-L. 2022. *Decodon verticillatus* (L.) Elliott (Lythraceae) suggested as a host of *Pseudotychius watsoni* Blatchley, 1922 (Coleoptera: Curculionoidea: Brentidae: Nanophyinae). The Coleopterists Bulletin 76: 354–356. https://doi.org/10.1649/0010-065x-76.3.354 [*]

García-Morales, L.J., V. Moctezuma and J.L. Sánchez-Huerta. 2022. New northernmost record for *Dynastes maya* Hardy and sympatry with *Dynastes hyllus* Chevrolat (Coleoptera: Scarabaeidae: Dynastinae). The Coleopterists Bulletin 76: 136–139. https://doi.org/10.1649/0010-065x-76.1.136 [†]

Gimmel, M.L. and R.A.B. Leschen. 2022. Revision of the genera of *Picrotini* (Coleoptera: Cryptophagidae: Cryptophaginae). Acta Entomologica Musei Nationalis Pragae: 61–109. https://doi.org/10.37520/aemnp.2022.006 [†]

Gunter, N.L., N.A. Saxton and T.A. Weir. 2022. *Oficanthon* Paulian, 1985, a junior synonym of *Lepanus* Balthasar, 1966 (Coleoptera: Scarabaeidae: Scarabaeinae), with redescription of *Lepanus mirabilis* (Paulian, 1985). Zootaxa 5194: 575–584. https://doi.org/10.11646/zootaxa.5194.4.6 [†]

Halffter, G., V. Moctezuma and G. Nogueira. 2022. A new species of Phanaeus MacLeay, 1819 (Coleoptera: Scarabaeidae: Scarabaeinae) from the mountains of Jalisco, Mexico. The Coleopterists Bulletin 76: 329–335. https://doi.org/10.1649/0010-065x-76.3.329 [†]

Hlaváč, P. and R. Borovec. 2022. *Oberprielerius*, a new genus for *Anchonidium uniforme* Voss, 1974, a microphthalmic species of Rhythirrinini (Coleoptera: Curculionidae: Cyclominae) from South Africa. Zootaxa 5196: 128–134. https://doi.org/10.11646/zootaxa.5196.1.6 [†]

Hsiao, Y. and D.A. Pollock. 2022. Morphology-based phylogeny of oval palm and flower beetles (Coleoptera: Mycteridae: Eurypinae), with descriptions of new genera and species from Australia. Zoological Journal of the Linnean Society 196: 677–703. https://doi.org/10.1093/zoolinnean/zlab122 [†]

Johnson, P.J. 2022. The first report of *Lissomus* Dalman (Coleoptera: Elateridae: Lissominae) from the Greater Antilles, with two new species from the Dominican Republic. Insecta Mundi 0911: 1–10. [†]

Johnston, M.A., K. Matsumoto and K. Kanda. 2022. Review of the genus *Ancylopoma* Pascoe with the description of a new species (Coleoptera: Tenebrionidae: Lagriinae). Annales Zoologici 72: 147–152. https://doi.org/10.3161/00034541anz2022.72.1.013 [†]

Leschen, R.A.B., S. Davis, S.D.J. Brown, T. Brav-Cubitt and T.R. Buckley. 2022. The enigmatic dead-leaf miner *Geochus* Broun (Coleoptera: Curculionidae): phylogenetic placement, a new species, and lectotype designations. The Coleopterists Bulletin 76: 1–35. https://doi.org/10.1649/0010-065x-76.1.1 [†]

Lewis, J.H. 2022. *Paradromius linearis* (Olivier, 1795) (Coleoptera: Carabidae) in coastal Nova Scotia: first North American record for the genus and species evidenced by morphology and DNA barcodes. The Coleopterists Bulletin 76: 445–448. https://doi.org/10.1649/0010-065x-76.3.445 [‡]

Medeiros, R.A.F., M. Seidel and P.C. Grossi. 2022. Revision of the genus *Byrsopolis* Burmeister, 1844 (Coleoptera: Melolonthidae: Rutelinae: Rutelini), with the description of six new species endemic to Brazil and Paraguay. Journal of Natural History 56: 1315–1364. https://doi.org/10.1080/00222933.2022.2115950 [†]

Meregalli, M. and R. Borovec. 2022. *Caldarinus gwarrie*, a new genus and species of edaphic weevil from South Africa with notes on some genera of Oosomini: (Coleoptera: Curculionidae: Entiminae). Bollettino della Società Entomologica Italiana 154: 7–14. https://doi.org/10.4081/bollettinosei.2022.7 [†]

Mondaca, J. 2022. Revision of the high Andean genus *Eremophygus* revision of the high Andean genus (Coleoptera: Scarabaeidae: Rutelinae: Rutelini). Insecta Mundi 0905: 1–11. [†]

Pacheco, T.L., B. Wipfler, M.L. Monné and D. Ahrens. 2022. The genus *Symmela* Erichson, 1835 (Coleoptera, Scarabaeidae, Sericini): taxonomy and phylogenetic analysis. Journal of Natural History 56: 607–705. https://doi.org/10.1080/00222933.2022.2084649 [†]

Paz, F., B.C. Ratcliffe and L. Figueroa. 2022. Three new species of *Cyclocephala* (Coleoptera: Scarabaeidae: Dynastinae) from Amazonian Peru and a checklist of *Cyclocephala* species in Peru. Zootaxa 5087: 427–440. https://doi.org/10.11646/zootaxa.5087.3.2 [†]

Schiefer, T.L. 2022. Reevaluation of the subgeneric classification of the North American species of *Prionus* Geoffroy (Coleoptera: Cerambycidae: Prioninae: Prionini), with a revision of the subgenus *Neopolyarthron* Semenov and notes on *Prionus* (*Antennalia*) *fissicornis* Haldeman and *Prionus* (Prionus) *californicus* Motschulsk. Transactions of the American Entomological Society 148: 335–504. https://doi.org/10.3157/061.148.0301 [†]

Schnepp, K.E. 2022. A new species of *Phyllophaga* Harris (Coleoptera: Scarabaeidae: Melolonthinae) from Puerto Rico. Insecta Mundi 914: 1–7. [†]

Skelley, P.E. and F.Z. Vaz-de-Mello. 2022. A second species of *Batesiana* Chalumeau, 1983 (Coleoptera: Scarabaeidae: Aphodiinae: Eupariini). The Coleopterists Bulletin 76: 612–618. https://doi.org/10.1649/0010-065x-76.4.612 [†]

Skelley, P.E. and O. Keller. 2022. A third species of *Haroldiellus* Gordon and Skelley, 2007 from Mexico and Central America (Coleoptera: Scarabaeidae: Aphodiinae: Aphodiini). Insecta Mundi 0916: 1–11. [†]

Skelley, P.E., J. Clavijo-Bustos and O. Keller. 2022. Extinct or extant? A new species of *Termitodius* Wasmann, 1894, (Coleoptera: Scarabaeidae: Aphodiinae: Rhyparini) with a short review of the genus. Insecta Mundi 0915: 1–14. [†]

Skelley, P.E., W. Tang and M.A. Pérez-Farrera. 2022. Review of *Pharaxonotha* Reitter (Coleoptera: Erotylidae: Pharaxonothinae) inhabiting the cycad genus *Dioon* Lindl. (Cycadales), with descriptions of nine new species and comments on *P. kirschii* Reitter. Insecta Mundi 0917: 1–41. [†]

von Groll, E., L.d.A. Moura and G.S. Carvalho. 2022. Revision, morphometry and cladistics of *Erynephala* (Coleoptera: Chrysomelidae: Galerucinae: Galerucini). Zoologischer Anzeiger 296: 1–32. https://doi.org/10.1016/j.jcz.2021.11.001 [†]

Other Invertebrates

Castelin, M., R. Collin, R. Harbo, E. Spence, K. Aschenbrenner, W. Merilees, S.R. Gilmore, C. Abbott and D.J. Eernisse. 2022. Size doesn't matter: Integrative taxonomy shows *Crepidula adunca* and *Crepidula norrisiarum* have overlapping shell sizes and broadly concordant distributions. The Biological Bulletin 242: 222–237. https://doi.org/10.1086/720422 [†]

Choudhury, A., T. Scholz and J.S. Beuchel. 2022. A new species of *Bothriocephalus* (Cestoda: Bothriocephalidae) from *Lepomis* spp. (Actinopterygii: Centrarchidae) in North America. Journal of Parasitology 108: 343–352. https://doi.org/10.1645/21-70 [†]

Fernández, J. 2022. Nuevos táxones animales descritos en la península ibérica y Macaronesia desde 1994 (XXII). Graellsia 78: e176. https://doi.org/10.3989/graellsia.2022.v78.356 [†]

Forsyth, R.G., M.A. Arsenault and R. Curley. 2022. Leaf-litter-dwelling microsnails of Prince Edward Island, Canada (Mollusca, Gastropoda, Eupulmonata). Check List 18: 1005–1015. https://doi.org/10.15560/18.5.1005 [†]

Lewis, A. 2022. *Heterolaophonte natator* n. sp. (Copepoda, Harpacticoida) from Haida Gwai, British Columbia — and possible relatives in the U.K. and Iceland. Crustaceana 95: 147–164. https://doi.org/10.1163/15685403-bja10175 [*]

Rejman, E.E., K. Hák-Kovács and J.R. Barta. 2022. The first *Isospora* apecies (Apicomplexa: Eimeriidae) described from the Northern Yellow-Shafted Flicker (Colaptes auratus luteus) in Ontario, Canada. Acta Parasitologica 67: 1162–1171. https://doi.org/10.1007/s11686-022-00555-z [*]

Smith, M.L., J. Wallace, D.C. Tank, J. Sullivan and Bryan C. Carstens. 2022. The role of multiple Pleistocene refugia in promoting diversification in the Pacific Northwest. Molecular Ecology 31: 4402–4416. https://doi.org/10.1111/mec.16595 [†]

Williams, J.D., J.M. Wisniewski and G.R. Dinkins. 2022. Range extension and review of the conservation status of the freshwater mussel *Alasmidonta mccordi* Athearn, 1964 (Bivalvia, Unionidae) in the Coosa River drainage of Alabama and Georgia. Check List 18: 391–398. https://doi.org/10.15560/18.2.391 [†]

Vertebrates

Birds

Burrell, M.V.A., M.D. Read, A.D. Buckley, K.G.D. Burrell, D.J. MacNeal, R.D. Martin, N.M. Richardson and A.P. Timpf. 2022. Bird Records Committee Report for 2021. Ontario Birds August 2022: 58–88. [*]

Kenyon, H.L. and P.R. Martin. 2022. Experimental test of selection against hybridization as a driver of avian signal divergence. Journal of Evolutionary Biology 35: 1087–1098. https://doi.org/doi.org/10.1111/jeb.14058 [†]

Mills, E.L. and L. Laviolette. 2022. Birds of Brier Island, Nova Scotia, revised and updated. Proceedings of the Nova Scotian Institute of Science (NSIS) 52: 1–166. [†]

Fishes

Denys, G.P., P. Daszkiewicz, F. Urtizberea and L. Bernatchez. 2022. Diadromous fishes from Saint-Pierre and Miquelon archipelago: diagnoses, taxonomy, nomenclature and distribution. Cybium: Revue Internationale d'Ichtyologie 46: 385–413. [†]

Grigorov, I.V., K.K. Kivva and A.M. Orlov. 2022. The Aleutians and beyond: distribution, size composition, and catch dynamics of the Aleutian Skate *Bathyraja aleutica* across the North Pacific. Animals 12: 3507. https://doi.org/10.3390/ani12243507 [†]

Hodgson, E., C. Chu, N. Mochnacz, V. Shikon and E. Millar. 2022. Information needs for considering cumulative effects in fish and fish habitat decision-making. DFO Canadian Science Advisory Secretariat Research Document 2022/078. ix + 59 pp. [†]

Murugan, A., G. Mahadevan and R. Fricke. 2022. First record of the speckled Maori wrasse, *Oxycheilinus arenatus* (Valenciennes, 1840) (Actinopterygii: Perciformes: Labridae), from Indian coastal waters. Acta Ichthyologica et Piscatoria 52: 135–139. https://doi.org/10.3897/aiep.52.84796 [†]

Nozères, C., D. Bernier, H. Bourdages and L. Isabel. 2022. Revision of fish and invertebrate catches based on original records and photos from the CCGS Teleost ecosystem survey in the Estuary and northern Gulf of St. Lawrence from 20042015. Canadian Manuscript Report of Fisheries and Aquatic Sciences 3239, iv + 164 pp. [†]

Oliver, A.J.M., W.T. Slack and A.W. Katzenmeyer. 2022 Occurrence of silver, bighead, and black carp in waters managed by the US Army Corps of Engineers. Technical Report (Engineer Research and Development Center (U.S.)) no. ERDC/EL TR-22-14. [‡]

Robertson, D.R., C.J. Estape, A.M. Estape, L. Richter, E. Pena and B. Victor. 2022. An updated, illustrated inventory of the marine fishes of the US Virgin Islands. Zookeys 1103: 79–122. https://doi.org/10.3897/zookeys.1103.83795 [†]

Sayyadzadeh, G., F. Zarei and H.R. Esmaeili. 2022. *Glyptothorax* (Teleostei: Sisoridae) from the Middle East: an integrated molecular and morphological insight into its taxonomic diversity. Diversity 14: 884. https://doi.org/10.3390/d14100884 [†]

Taphorn, D.C., E. Liverpool, N.K. Lujan, C. DoNascimiento, D.D. Hemraj, W.G.R. Crampton, M.A. Kolmann, J.P. Fontenelle, L.S. de Souza, D.C. Werneke, M. Ram, D.D. Bloom, B.L. Sidlauskas, E. Holm, J.G. Lundberg, M.H. Sabaj, C. Bernard, J.W. Armbruster and H. López-Fernández. 2022. Annotated checklist of the primarily freshwater fishes of Guyana. Proceedings of the Academy of Natural Sciences of Philadelphia 168: 1–96. https://doi.org/10.1635/053.168.0101 [†]

Zhukov, M.Y. 2022. Geographic ranges and the hypothesis of the dispersal of the fishes of superfamily Congiopodoidea (Pisces: Scorpaenoidei) with the Antarctic Circumpolar Current. Proceedings of the Zoological Institute RAS 326: 259–273. https://doi.org/10.31610/trudyzin/2022.326.4.259 [†]

Mammals

Fontana, L. 2022. Reindeer Hunters of the Ice Age in Europe: Economy, Ecology, and the Annual Nomadic Cycle. Springer Cham, 248 pp. https://doi.org/10.1007/978-3-031-06259-9 [†]

Arbez, L., A. Royer, J.-F. Therrien and S. Montuire. 2021 [2022]. Another mention of meadow vole (*Microtus pennsylvanicus*) found in pellets of snowy owl (*Bubo scandiacus*) in northern Ungava Peninsula, Canada. Canadian Field-Naturalist 135: 329–336. https://doi.org/10.22621/cfn.v135i4.2719 [†]

Finley, S. 2022. Whaling Captains of Color: America's First Meritocracy. Naval Institute Press, 304 pp. [†]

Galán López, A., S. Costamagno and A. Burke. 2022. Osteometric study of metapodial bones and phalanges as indicators of the behavioural ecology of modern reindeer (*Rangifer tarandus*) and implications for reconstruction of paleo mobility. Open Quaternary 8: 1–25. [†]

Harding, L.E. 2022. Available names for *Rangifer* (Mammalia, Artiodactyla, Cervidae) species and subspecies. Zookeys 1119: 117–151. https://doi.org/10.3897/zookeys.1119.80233 [#]

Marquard-Petersen, U. 2022. Behaviors of High Arctic wolves in response to humans. Arctic 75: 378–389. https://doi.org/10.14430/arctic75966 [#]

Stroupe, S., D. Forgacs, A. Harris, J.N. Derr and B.W. Davis. 2022. Genomic evaluation of hybridization in historic and modern North American Bison (*Bison bison*). Scientific Reports 12: 6397. https://doi.org/10.1038/s41598-022-09828-z [†]

nature.ca

Canadian Museum of Nature
Victoria Memorial Museum Building
240 McLeod Street
Ottawa, Ontario K2P 2R1
Canada

Canadian Museum of Nature
Natural Heritage Campus
1740 Pink Road
Gatineau, Quebec J9J 3N7
Canada

canadian museum of nature
nature
musée canadien de la nature