

Eleven fossils in Search of a Provincial or Territorial Status

Introduction

Forty states in the US have an Official State Fossil. These include ten states using dinosaurs or their track ways, one using a marine reptile, seven using fossil mammals, two using fossil fish, thirteen using invertebrates and two using fossil plants. There are 10 states in total without a state fossil, but only one state, Kansas that does not at least have a state rock, gemstone or mineral.

Now ask yourself how many provinces and territories in Canada have designated a Provincial/Territorial Fossil? Surprisingly the answer is only ONE, Nova Scotia, which designated the oldest known reptile in the world, *Hylonomus lyelli*, as the official fossil of the province in May, 2002. Despite Canada's extraordinary geological heritage, no other province has taken the plunge and chosen a fossil to represent them. Below are some possible suggestions for each Province or Territory to fire your imagination. If you feel strongly about this I urge you to lobby your provincial government officials, or at least to come up with your own favourites during discussions in your local hostelry.

Alberta

Alberta has a wealth of geology stretching back into the Precambrian. The Rockies expose a series of Cambrian sediments, as well as thick, overthrust limestones and shales from the Devonian to Carboniferous periods. These include many invertebrates, some reef forming. Triassic rocks can be viewed around Jasper, and old coal workings from Crowsnest to Canmore are testament to Jurassic deposition during regional uplift, as the Rockies foreland basin developed. A suite of Cretaceous rocks fill the associated foreland basin, becoming more marine in character to the East. Deposition continued into the Palaeocene, after which little was preserved until Quaternary glacial deposits.

Two types of fossils come immediately to mind when considering Alberta's ancient life. The first is the ammonite *Placentiaceras*, which yields the opal-like organic gemstone ammolite. This mineral has been given official gemstone status by the World Jewellery Confederation, and is the official gemstone of Alberta. It is produced commercially from the Cretaceous Bearpaw Formation. The second type of fossil is dinosaur remains, with more than 40 dinosaur species having been discovered in the World Heritage Site of Dinosaur Provincial Park. Of course there are many other fossils in the province, spanning a time period from Precambrian to Quaternary, but to do them justice would require an article of their own.

Ammolite is already the provincial gemstone, and therefore a dinosaur is considered the preferred choice as a provincial fossil. Suitable candidates include *Albertosaurus* (though not definitely present in the Park) and *Gorgosaurus*, which are very similar sister taxa. Other potential choices include a variety of ceratopsians, including *Chasmosaurus* and *Centrosaurus*; *Stegoceras* (a pachycephalosaur) and the ankylosaur *Euoplocephalus*, all of which were first reported from the Park. In light of the abundance of bone beds dominated by ***Centrosaurus*** bones, this animal is nominated as the Provincial Fossil.

British Columbia

The geology of British Columbia owes everything to its location on the leading edge of the North American continent. Five separate belts define the geology, much of which was accreted as a series of terranes to the continent during subduction of the Pacific Plate. The geology is complex, often metamorphosed, and still not entirely understood, and stretches from the Precambrian to Recent in age. The Pacific rifting phase commenced with deposition of the 1.4 Billion year old Windermere Supergroup, and then continued through deposition of the thick Palaeozoic to early Mesozoic carbonate and terrigenous clastic strata now exposed in the Rockies. Associated basalts and granites are common.

Three BC geologists have put together a great website supporting their nominees for the BC Provincial Fossil. Thanks to all the work that they have done I do not propose to add any extraneous candidates to their list, beyond a possible alternative Burgess Shale fossil. Their candidates are the Permian fusulinid *Yabeina*; the Cretaceous ammonite *Canadoceras*; the Cambrian lace crab *Marella*; and the Cretaceous elasmosaur. Their website explains the rationale behind the nomination of each of the four fossils.

The Burgess Shale is probably the most famous formation in Canada, and as such the author supports the nomination of *Marella*, or failing this the carnivorous *Anomalocaris* from the same Formation, as the provincial fossil. *Marella* is one of the most abundant of the Burgess Shale fossils, and its unusual morphology was one of the triggers that sparked the questions as to the “experimental” nature of the morphology of many of the associated organisms. The story of the unique faunal explosion at this time, preserved in and around Walcott’s Quarry, has enthralled geologists and the public alike.

Manitoba

Three fifths of the Province exposes Precambrian rocks, and outcrops of Phanerozoic and Cenozoic rocks are restricted. Unique Ordovician fossils have been collected from the western shores of Lake Winnipeg, representing a variety of invertebrate clades including beautifully preserved fossil jellyfish. Recent discoveries of both the large bony fish *Xiphactinus* and associated mosasaurs have been made in Cretaceous rocks of the Pembina valley, adding to marine fauna recovered over the years. The squid *Tusoteuthis* is also common in these rocks, along with ancient birds and turtles, but the star of the show is a 43 feet long mosasaur, “Bruce” the *Hainosaurus*, on display in the Canadian Fossil Discovery centre.

The best travelled of Manitoba’s fossils is not a vertebrate, however, or even a body fossil. Visit almost any city in Canada and you will see buildings clad in Tyndall Stone, an Ordovician, dolomitic limestone mined around Garson, Manitoba. It is cream in colour, with striking, dolomitic mottling caused by the burrows of fossil shrimps (probably *Thalassinoides*), as well as other body fossils. As Manitoba’s most exported trace fossil, my nomination is of the **Tyndall Stone** as Manitoba’s Provincial Fossil.

New Brunswick

The geology of this Province is similar in some respects to that of Nova Scotia. The oldest fossil forest in Canada is located in Stonehammer Park, with almost 700 trees, most in life position. Rare insect fossils have also been recorded from the Carboniferous. Trilobites have been found around the city of Saint John, in particular large *Paradoxides* specimens, together with graptolites and other Palaeozoic

fauna. Some Cambrian limestone nodules preserve exquisite fossils, but exposures are rare. Probably of most significance are the fossils of mastodons, which have been found at Hillsborough. Similar fossils have also been reported from Nova Scotia, but there is certainly a case to be made for suggesting that the mastodon take its place as New Brunswick's provincial fossil.

However, perhaps the best candidate as the provincial fossil would be **Archaeozoon**, the first stromatolite fossil and first Precambrian fossil to be correctly described in 1890, which can be found in limestone at Green Head in Stonehammer Park, near Saint John. The cabbage shaped mounds were built up by successive mats of cyanobacteria and layers of sediment, and are beautifully exposed at three separate horizons on the coast. Modern analogues to these structures can be seen in Shark Bay in western Australia.

Newfoundland and Labrador

The majority of fossils found in this province are of Palaeozoic age, including trilobites, graptolites, brachiopods, bryozoans, corals, crinoids, cephalopods, molluscs and many more. The trilobite faunas of eastern and western Newfoundland contrast sharply in an example of faunal provincialism, because the two areas were originally in different climatic zones on opposite sides of the ancient Iapetus Ocean. Younger fossils are generally restricted to the Knob Lake District of western Labrador, which has also yielded Cretaceous insect and plant fossils. A few dinosaur bones were intersected by wells drilling on the Grand Banks.

Bell Island in eastern Newfoundland is world famous for its trace fossils, created mainly by trilobites. However of even greater significance is Mistaken Point, on the south-eastern tip of the island, which exposes the oldest complex life forms found anywhere on Earth. These animals lived at the bottom of a deep ocean, and were preserved by a series of ash falls. These are an Ediacaran biota, and have been subdivided into five groups based on morphology: spindle-shaped, leaf-shaped, round lobate, dendrite like, and radiating. By far the most common are the spindle shapes, which are unique to this locality, but have not yet been given an official scientific name. Despite this, due to its abundance, significance and rarity, the **spindle** is nominated as the Provincial Fossil.

Nova Scotia

The geology of Nova Scotia is made up of three separate land masses that came together around 380 million years ago. Originally separated by the Iapetus Ocean, crustal blocks (or terranes) were drawn together due to subduction, leading to ocean closure along the suture. The blocks expose Cambrian turbidites and Ordovician shales, with very localised Silurian sediments and volcanics. In the late Devonian a series of basins opened, and the grabens filled with volcanics and fluvial to lacustrine clastics. Few fossils were preserved.

Tectonism halted in the Carboniferous, and post rift limestones and regionally extensive evaporites were deposited. This was followed by Upper Carboniferous coal and clastic deposition, including the famous Joggins succession. Renewed extension of the Fundy Basin in the Triassic led to basins filled with pebbly sandstones, becoming aeolian upwards, overlain by shales and occasional basalts. Further terrestrial and lacustrine clastic deposition followed.

As mentioned above, this province is the only one to already have a Provincial Fossil. *Hylonomus lyelli* was declared the Provincial Fossil of Nova Scotia in 2002 by an Act of the House of Assembly. It is the oldest known reptile in the world, and its fossils were found in hollowed out tree stumps, at the famous fossil cliffs of Joggins, by Sir William Dawson in the mid 1800s. It dates back 315 million years to the Carboniferous. There is speculation that the lizard-like animal may have taken shelter in the trees to escape forest fires.

Ontario

Although some Precambrian fossils have been recorded from northern Ontario, the majority of fossils are found in Palaeozoic rocks (particularly the Ordovician) that were deposited in shallow seas. These include trilobites, graptolites, brachiopods, corals (reefs), molluscs and crinoids. Hundreds of localities have been described in the literature, including some quarries still working today. The region around Southampton is particularly well known for the Ordovician fossils that wash up on the beaches. There are also Quaternary deposits left by glaciers, in which occasional mammal bones can be found.

Probably the most stunning fossils from this province are the crinoids, which are beautifully preserved in the limestones. It is difficult to single out a particular genus, with over 40 types from the Ordovician and Devonian, but *Cupulocrinus* is fairly common and often occurs en masse. However there are other species that are considered equally deserving of Provincial Fossil status.

Prince Edward island

A fairly limited number of fossil localities have been recorded from PEI, the vast majority of which are of Permian age and have yielded poorly preserved fossils plants, notably *Walchia* and *Tylodendron* (the branching foliage and stem from the same conifer). These were described in a paper by Zeigler *et al.* Vertebrate remains have been used to date the dominantly continental deposits. A single reptile, *Bathygnathus* (closely related to *Dimetrodon*), was recorded from one locality, and may be late Permian or early Triassic, and vertebrate trackways have also been recognised. One of the tracks from Eldon was identified as *Ichniotherium*, thought to have been made by large Permian herbivorous diadectids, and the largest example known worldwide. It was found in association with some shrimp tracks called *Striatichnium*. In view of the size and preservation of the *Ichniotherium* tracks, this trace fossil has been chosen as the Provincial fossil candidate.

Quebec

The majority of the rocks in Quebec are Precambrian in age, forming part of the Canadian Shield. South-eastern Quebec exposes Palaeozoic rocks rich in fossils, including Devonian fish. Well preserved Ordovician and Silurian fossils are common in the Témiscamingue area. Mesozoic rocks are absent except inside an impact crater, as are most Tertiary rocks, although Quaternary deposits are common, and include marine sediments from periods of higher sea level.

Miquasha Park is a World Heritage Site (the only Devonian site), where the Escuminac Formation has yielded over 20 species of exquisitely preserved fossil fish including placoderms, or bony fish. These

include the “Prince of Miguasha,” *Eusthenopteron foordi*, whose limb-like fins and two-way gills-and-lungs respiratory system gave rise to the modern conception of evolution from fish to four-limbed, land-dwelling vertebrates. All in all a fitting candidate for Le Fossile Provincial.

Saskatchewan

The fossil record of this province covers 1.8 billion years. However most of the province is covered by glacial deposits, and river valleys are the only places where older rocks are exposed. Stromatolites are found in Precambrian rocks around Uranium City. Palaeozoic rocks are sparsely exposed, and host nautiloids and molluscs, though reefs are absent. They became more saline throughout this time, leading to extensive potash deposits.

Rocks from the later Mesozoic are exposed in southern Saskatchewan. Rocks from around 90 million years ago of the Pasquia Hills have yielded marine fossils including a 7.5 m long crocodile, known as “Big Bert” (*Terminonaris*), as well as sharks, fish and toothed birds. From around 80 million years ago some terrestrial deposits preserved dinosaurs, then were overlain by more marine deposits with ammonites and new species of plesiosaurs from Rosetown and Ponteix. A *Tylosaurus* was excavated from the southern shore of Lake Diefenbaker. Further terrestrial sediments were deposited from 68 to 65 million years ago, and remains of *Triceratops*, *Ankylosaurus* and other herbivorous dinosaurs have been found. A partial skeleton, “Scotty”, of the most famous carnosaur, *Tyrannosaurus*, was discovered in the Frenchman River in 1991. Many other organisms are also preserved in these rocks, including a variety of fossil mammals.

Deposition continued through most of the Tertiary, with Saskatchewan preserving Canada’s best fossil record of this time period. Much of the sedimentary record is terrestrial, with many excellent mammal remains collected. An example locality is Calf Creek, where over 70 species of mammals, around 35 million years old, have been recorded, including brontotheres, rhinos, dogs, entelodonts, horses and rodents. Deposition is not preserved from 14 to 2 million years ago, although many Ice Age species have been found including bison and mammoth.

It is not easy to single out an animal that represents the totality of the Saskatchewan fossil heritage. The popular vote would probably side with Scotty the *Tyrannosaurus*, although the Tertiary mammal fossils are undoubtedly more unique in global terms. The discovery of a potential T. Rex coprolite in 1995, at Eastend, leaves me itching to nominate this “deposited” trace fossil for immortality as the Provincial Fossil, though somehow I don’t think that the provincial fathers would see the funny side. So for now we will stick with its creator, T. Rex.

Northwest Territories

Ediacaran fossils of the late Precambrian have been found in the Mackenzie Mountains, with disk-form, tentaculate and segmented forms present in rocks over 2.5 kilometres thick. These include the oldest known multi-celled animal fossils in the world, soft cup shaped animals living on the ocean floor.

Sediments eroding from east and central regions during the Palaeozoic were deposited in seas to the west. The warm waters were host to many fish and invertebrates, including reef builders. Fossils have been collected from Devonian rocks in Norman Wells and elsewhere in the Territory, including many

brachiopods from around Avalanche Lake. The Enterprise area of the Hay River is rich in Devonian fossil invertebrates. Most of the Territory was above sea level in the Mesozoic, but the Western Interior Seaway flooded parts of the region, bringing many fish, marine reptiles, aquatic birds and invertebrates. Some Cenozoic remains are preserved, including a 50 million year old redwood found in a kimberlite pipe at the Ekati Diamond Mine.

There is no doubt that a rich fossil fauna occurs in this region, but access is challenging. The Arctic islands are also likely to host a rich fauna, but are even more difficult to access. I found less data on fossils from NWT than from any other province or territory while researching this article. In the absence of better data I would nominate the Eocene fossil forests on Axel Heiburg Island as the Territorial Fossil. Many of the redwood trees (*Metasequoia*) are unmineralised, and appear to have been mummified in the cold Arctic climate, a somewhat unique form of wood preservation. They reach 40 m in length, and other elements, such as cones and leaves, are also preserved.

Nunavut

Fossils have been collected on Devon, Ellesmere and Bathurst islands. Many of these were of Devonian or older ages, although isolated fills of Miocene sediments have been recorded, as well as some Eocene plant remains. Generally the fauna is dominated by trilobites and brachiopods, with associated corals and molluscs, but the jewel in the crown is an extinct sarcopterygian of the Devonian, *Tiktaalik*. This lobe finned fish is considered to be part of the lineage leading to the evolution of the tetrapods. This animal shares a number of characteristics with gar fish and is a classic example of a key transitional fossil, deserving of Territorial Fossil status. Its original discovery led to worldwide news coverage.

Yukon

Most fossils found in Yukon are bones from Ice Age or Pleistocene mammals, typically mammoth, horse and bison, which lived in Beringia, the largely ice free subcontinent stretching from Siberia to the Yukon. A large collection is housed in Whitehorse. Specimens of Ice Age plants have also been collected, along with fossil nests from Arctic ground squirrels. Many Quaternary sites have also yielded fossil insects, with assemblages dominated by beetles. Older fossils, such as dinosaur tracks from Ross River, and Cretaceous marine reptile remains, have been found but are sparse.

A recent discovery was a foot bone from a horse, some 30% bigger than its distant relative, the modern horse. It was found at a placer gold mine on Thistle Creek near the Klondike. Like many Yukon fossils, the bone was found frozen in permafrost. Two types of fossil camel also made the headlines, including the **Yukon giant camel**, represented by bones from Old Crow, around a million years old. This camel is very similar to *Titanotylopus* of Nebraska, and was around 3.5 m tall. The second is Yesterday's camel, *Camelops*, which has been dated to around 90,000 years in age. Choosing a camel, in this case the Yukon giant camel, would certainly create a unique Territorial Fossil.

Summary

Canada has an extraordinary geological heritage. Some of the best preserved Precambrian stratigraphy in the world was overlain by shales and limestones of the Palaeozoic. These often preserve spectacular invertebrates. The Cretaceous of western Canada hosts many of the world's best and most significant dinosaur assemblages, while Saskatchewan has yielded many of the world's Tertiary mammal species. Finally there is no shortage of Ice Age mammal remains littering the continent. It is definitely about time that Canada paid tribute to its unrivalled fossil resources through the naming of the remaining Provincial and Territorial Fossils, adding to the current solitary Provincial Fossil, *Hylonomus*, from Nova Scotia.

The nominated fossils span the spectrum of fossil life in Canada, both in terms of age and complexity, ranging from the cyanobacteria that created the stromatolites of New Brunswick, to a primitive multicellular Ediacaran. There are invertebrates such as crinoids, a crustacean and shrimp burrows, and then a mix of vertebrates including fish, dinosaurs and a mammal. The chosen fish and reptile fossil represent key evolutionary "missing links". Finally there is a tree to represent the ancient plants of the continent. The bias towards vertebrates is similar to that of the provincial fossils of the United States, and has been driven partly by the public appeal of "big fossils". The author welcomes feedback on his choices.

State	Age	Common name	Binomial nomenclature	Adoption date
Alabama	Eocene	Basilosaurus whale	<i>Basilosaurus cetoides</i>	1984
Alaska	Pleistocene	Woolly Mammoth	<i>Mammuthus primigenius</i>	
Arizona	Triassic	petrified wood	<i>Araucarioxylon arizonicum</i>	
California	Pleistocene	Saber-toothed cat	<i>Smilodon fatalis</i>	
Colorado	Jurassic	Stegosaurus	<i>Stegosaurus armatus</i>	1982
Connecticut	Jurassic	dinosaur tracks	<i>Eubrontes giganteus</i>	
Delaware	Cretaceous	Belemnite	<i>Belemnitella americana</i>	
Florida	Eocene	agatized coral (state stone)	<i>Cnidaria, Anthozoa</i>	
Georgia	Cretaceous–Miocene	shark tooth	<i>undetermined</i>	
Idaho	Pliocene	Hagerman horse	<i>Equus simplicidens</i>	
Illinois	Pennsylvanian	Tully Monster	<i>Tullimonstrum gregarium</i>	
Kentucky	Ordovician–Pennsylvanian	brachiopod	<i>undetermined</i>	1986
Louisiana	Oligocene	petrified palmwood	<i>Palmoxyton</i>	
Maine	Devonian	Pertica plant	<i>Pertica quadrifaria</i>	
Maryland	Miocene	murex snail / gastropod	<i>Ecphora gardnerae gardnerae</i>	
Massachusetts	Jurassic	dinosaur tracks	<i>Eubrontes Giganteus</i>	
Michigan	Holocene	American mastodon	<i>Mammut americanum</i>	2002
Mississippi	Eocene	Basilosaurus and Zygorhiza whales	<i>Basilosaurus cetoides</i> <i>Zygorhiza kochii</i>	
Missouri	Pennsylvanian	Sea lily	<i>Delocrinus missouriensis</i>	1989
Montana	Cretaceous	Duck-billed dinosaur	<i>Maiasaura peeblesorum</i>	
Nebraska	Pleistocene	Woolly Mammoth Columbian Mammoth Imperial Mammoth	<i>Mammuthus primigenius</i> <i>Mammuthus columbi</i> <i>Mammuthus imperator</i>	
Nevada	Triassic	Shonisaurus	<i>Shonisaurus popularis</i>	
New Jersey	Cretaceous	duck-billed dinosaur	<i>Hadrosaurus foulkii</i>	
New Mexico	Triassic	Coelophysis	<i>Coelophysis bauri</i>	
New York	Silurian	sea scorpion	<i>Eurypterus remipes</i>	1984

North Dakota	Paleocene	shipworm-bored petrified wood	<i>Teredo petrified wood</i>	
Ohio	Ordovician	trilobite	<i>Isotelus maximus</i>	1985
Oklahoma	Jurassic	Saurophaganax	<i>Saurophaganax maximus</i>	
Oregon	Eocene	Dawn redwood	<i>Metasequoia glyptostroboides</i>	2005
Pennsylvania	Devonian	trilobite	<i>Phacops rana</i>	1988
South Dakota	Cretaceous	Triceratops	<i>Triceratops horridus</i>	
Tennessee	Cretaceous	bivalve	<i>Pterotrigonia thoracica</i>	
Texas	Cretaceous	Pleurocoelus (state dinosaur 1997 - 2009)	<i>Pleurocoelus nanus</i>	
Utah	Jurassic	Allosaurus	<i>Allosaurus fragilis</i>	1988
Vermont	Pleistocene	Beluga whale	<i>Delphinapterus leucas</i>	1993

Table 2: US State Fossils

No State Fossil: Arkansas, Hawaii, Indiana, Iowa, Kansas, Minnesota, New Hampshire, North Carolina, Rhode Island, South Carolina.

Province/Territory	Age	Name	Popular description
Alberta	Cretaceous	<i>Centrosaurus</i>	Dinosaur
British Columbia	Cambrian	<i>Marella</i>	Lace crab
Manitoba	Ordovician	Tyndall Stone	Shrimp burrows
New Brunswick	Precambrian	<i>Archaeozoon</i>	Stromatolite
Newfoundland and Labrador	Precambrian	“Spindle”	Ediacaran
Nova Scotia	Carboniferous	<i>Hylonomus</i>	Reptile
Ontario	Ordovician	<i>Cupulocrinus</i>	Crinoid
Prince Edward Island	Permian	<i>Ichniotherium</i>	Reptile trackway
Quebec	Devonian	<i>Eusthenopteron</i>	Lungfish
Saskatchewan	Cretaceous	<i>Tyrannosaurus</i>	Dinosaur
Northwest Territories	Eocene	<i>Metasequoia</i>	Tree
Nunavut	Devonian	<i>Tiktaalik</i>	Lobe finned fish
Yukon	Pleistocene	Yukon giant camel	Camel

Table 2: Proposed Provincial/Territorial Fossils of Canada