ABSTRACT

During the mining of sand and gravel from glacial deposits at the Three Rivers Aggregate Companies Quarry, Slippery Rock, Pennsylvania (GPS: 41.043369°, -80.150203°), wood, moss, charcoal, fungal sclerotia, Picea (spruce) needles, Salix (willow) buds, Carex (sedge) achenes, a Viola (violet) seed, and beetle remains were recovered from a 0.2 -1.0 ft-thick silt and peat bed at a depth of 32.0 ft from the surface. Pollen (n=664) and spores (n=14) compiled from two samples in the silty peat (31.85 ft bls to 31.89 ft bls and 32.03 ft bls) include 53.3% Picea, 38.4% Pinus, 5.3% Cyperaceae, 1.9% Polypodiaceae, 0.6% Asteroideae, 0.3% Poaceae, 0.1% Cichoroideae, and 0.1% Selaginella selaginoides. Beetle remains found in the silty peat include species of Patrobus, Cytilus, Acidota, and either Enochrus or Cymbiodyta. The biota indicates a wetland environment (bog, fen, or lake shore) in a spruce-dominant forest similar to those found currently in central Canada. Two radiocarbon samples from this horizon have ages of 42,110±1280 BP (41,006 cal BC to 45,833 cal BC) (PSUAMS-8083) and 42,190±1290 BP (41,029 cal BC to 45,938 cal BC) (PSUAMS-8082).

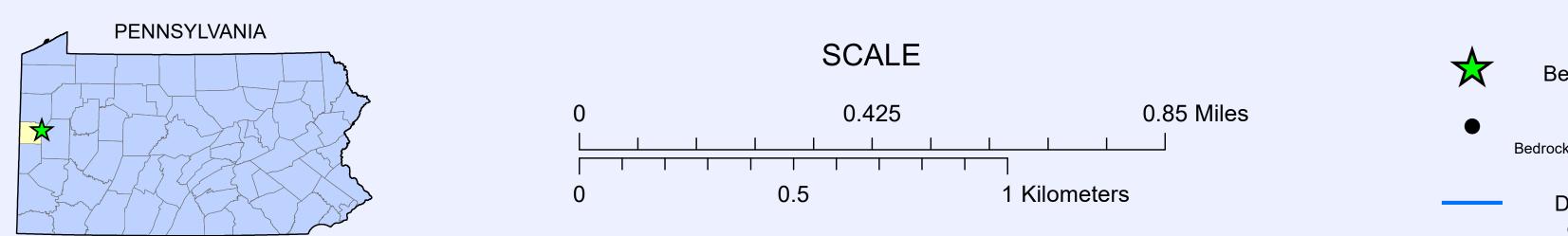
Below the silt and peat there is a 12.2 ft-thick sand that bears fine filaments of plant material. Within that sand at 39.2 ft bls, a pollen (n=307) and spore (n=8) assemblage has the composition 57.8% Picea, 32.4% Pinus, 7.0% Cyperaceae, 1.6% Selaginella selaginoides, and 0.9% Huperzia selago, and 0.3% Cichoroideae. Elytra (wing cases) of the ground beetle Blethisa catenaria, a ground beetle which lives exclusively on tundra, was also found at 39.2 ft bls. The sediment at 39.2 ft bls was deposited in a tundraspruce environment similar to that today on the North Slope of Alaska and the Canadian Arctic.

The faunal and floral changes indicate climatic warming from the lower to the upper organic horizons. The mean July temperature at 39.2 ft bls is estimated to be 11-12°C and at 32.0 ft bls 15-17°C compared to 21°C at Slippery Rock today.

Reclaimed Strip Mine

GLACIAL DRIFT-THICKNESS MAP

Area surrounding Three Rivers Aggregates' sand and gravel quarry, 773 Reese Road, Plain Grove Township, Lawrence County, PA. Modified from Reese 2021 and Schagrin 2019

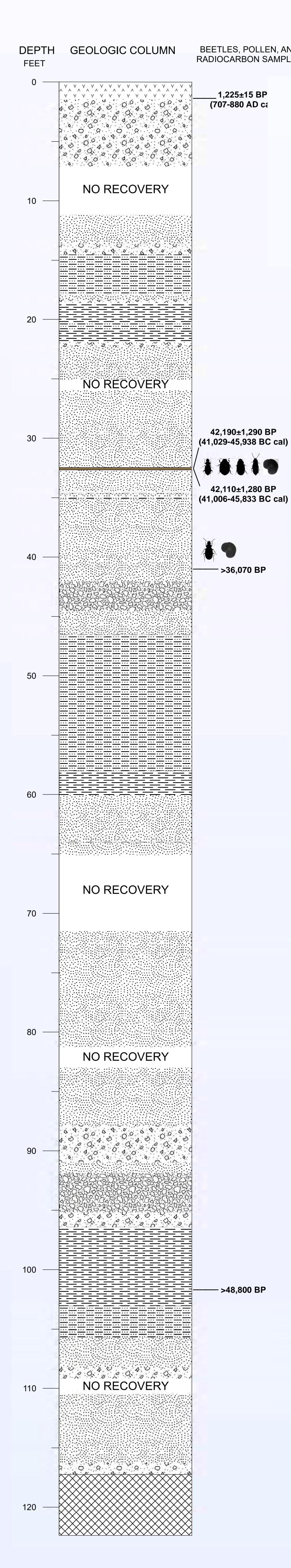


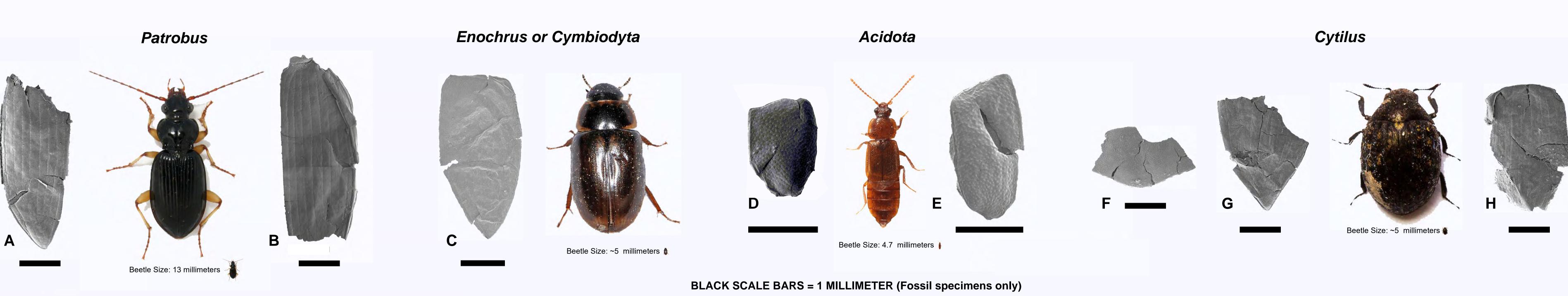
PLEISTOCENE BEETLES AND PLANTS FROM NEAR SLIPPERY ROCK, PENNSYLVANIA, FROM THE TITUSVILLE INTERSTADE (MIS 3)

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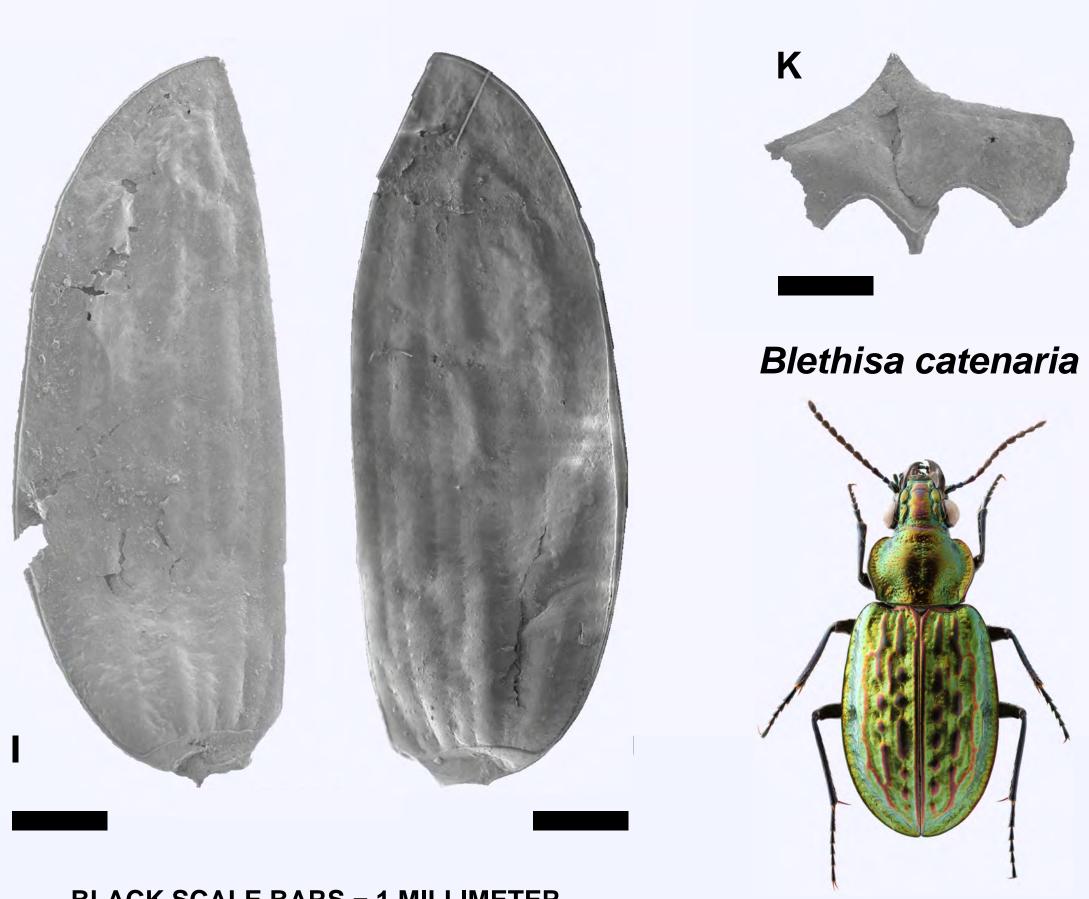
Beetle and Pollen Locality Water wells Bedrock elevation (feet) / drift thickness (feet Drift-thickness contours Countour intervals are 50 feet





(ABOVE) Scanning electron microscope images of the fossil beetles from the same species as fossil specimens). All specimens from the 32 ft bls horizon were taken from peats samples of from the spoil pile of the sand and gravel quarry. A. Left elytron of the waterbeetle Enochrus or Cymbiodyta (Hydrohilidae). D. Left elytron of a rove beetle (Staphylinidae), probably a small Philonthinae. E. Right elytron of a rove beetle Acidota (Staphylinidae). F. Fragment of Cytilus. H. Left elytron of Cytilus. H. Left elytra fragment of Cytilus. H. Left elytron of Cytilus. H. Left elytra fragment of A pronotum, probably the pill beetle Cytilus. H. Left elytra fragment of A pronotum, probably the pill beetle Cytilus. H. Left elytra fragment of A pronotum, probably the pill beetle Cytilus. H. Left elytra fragment of Cytilus. H. Left elytra fragment of A pronotum, probably the pill beetle Cytilus. H. Left elytra fragment of A pronotum, probably the pill beetle Cytilus. H. Left elytra fragment of A pronotum, probably the pill beetle Cytilus. H. Left elytra fragment of Cytilus. H. Left elytra fragment of A (Enochrus), Tom Murray (Acidota), and Brandon Woo (Cytilus). SEM images of fossil beetles taken by Adam Ianno, Pennsylvania Geological Survey. All identifiable specimens listed above were found in excavated material (Not found in core).

All of the identified genera are consistent with a well-vegetated lake margin. Generally, the assemblage is non-descript in terms of climate. The Acidota subcarinata Erichson which is an eastern North American endemic with a range from the boreal forest on the Gaspé Peninsula in southern Canada to the Eastern Deciduous Forest in the Appalachians in Georgia. It has also been recorded from the alpine zone on Mt. Washington, New Hampshire.



BLACK SCALE BARS = 1 MILLIMETER (Fossil specimens



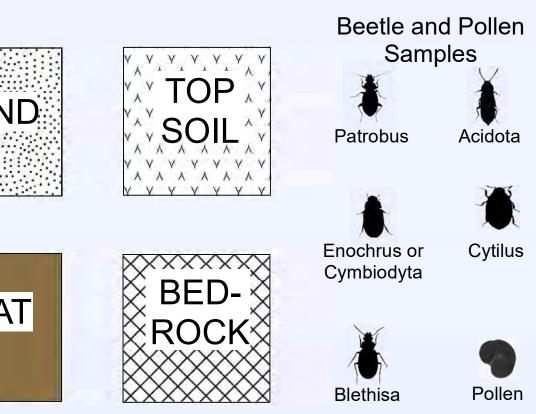
(ABOVE) Sample of peat excavated at 32 ft bls in sand and gravel mine. Radiocarbon dating reinforces that the excavated material and the core sample are from the same horizon with near identical dates. The peat horizon could not be seen at the base of the excavation as it submerged (below water table).

GEOLOGIC SYMBOLS

CLAY	DIAMICT	SAN		
	GRAVEL	PEA		

(LEFT) Geologic column of the entire glacial section constructed by nearby excavations and sonic core (Archived at Pennsylvania Geological Survey LAW073 2360). Column displays lithologies and stratigraphic position of beetle fossils palynology analysis, and radiocarbon sampling. Calibrated radiocarbon dates used IntCal20: Northern Hemisphere (Reimer et al. 2020) with the OxCal 4.4 program.

Beetle Size: ~10 millimeters



(LEFT) Scanning electron microscope images of a single specimen of the fossil beetle. Blethisa catenaria Brown. from the sand interval at 39.2 feet bls with example of a modern-day specimen. I. Left elytron. J. Right elytron. K. Unidentified fragment. Modern-day beetle images modified from photograph taken by Dr. Henri Goulet. SEM images of fossil specimen taken by Adam lanno, Pennsylvania Geological Survey. This specimen was found in the core.

(RIGHT) Modified map of the ecological regions of North America (CEC 2007) displaving recorded observations of *Blethisa catenaria* with modern-day observations in yellow and fossil observations in red. Interestingly, the only other fossil locality this species is known from in North America is Titusville, PA. This makes the observation of *Blethisa catenaria* at the Three Rivers Aggregate Quarry near Slippery Rock currently the most southernly reported fossil observation of the

Blethisa catenaria occurs in bog habitats. It is rarely collected probably because it appears to spend most of its time in saturated vegetation. It has a restricted arctic distribution occurring from the north slope of Alaska to Hudson Bay always occurring in tundra habitats. The mostly northwestern American range indicates this species was more widely distributed before the last glacial maximum.

POLLEN AND SPORE COUNT FROM CORE LAW073 2360

Sample Depth (feet below ground surface)	Picea (Spruces)			Cyperaceae (Sedges)		Cichoroideae (Flowering Plants)	<i>Huperzia selago</i> (Northern Firmoss)	<i>Selaginella selaginoides</i> (Northern Spikemoss)	Polypodiaceae (Ferns)
31.85-31.89	156	142	-	-	1	-	-	-	13
32.03	205	118	2	12	3	1	-	1	_
39.2	182	102	-	22	_	1	3	5	-

(ABOVE) Pollen and spore counts taken at the peat horizon (31.85-31.89 feet), directly below the peat horizon (32.03 feet), and at the interval where Blethisa catenaria was discovered (39.2 feet). Unlink the modern-day eastern temperate forest of today, the peat horizon has a diversity of plant species common of that of a boreal wetland such as a treed fen. The 39.2 ft interval suggests a similar environment but the presence of Blethisa catenaria constrains the environment/climate to tundra or the tree line edge of the Taiga.

MACROFOSSILS FROM CORE LAW073 2360

Sample Depth (feet below ground surface)	<i>Picea</i> needle (Spruce)	Salix bud (Willow)	<i>Carex</i> achene (Sedge)	Viola seed (Violet)	Bud Genera Unknown	Wood	Moss	Charcoal	Fungal Sclerotia	Beetle remains
31.85-31.89	1	3	3	_	1	many pieces	several	several	10	-
32.03	1	1	-	1	-	many pieces	2	many pieces	17	1
32.4	-	1	-	-	-	many pieces	-	-	2	1

(ABOVE) Macrofossils observed in and near the peat horizon. Note the addition of 2 plant species not observed in the palynology as well as fungi. Also, evidence of fire occurring during

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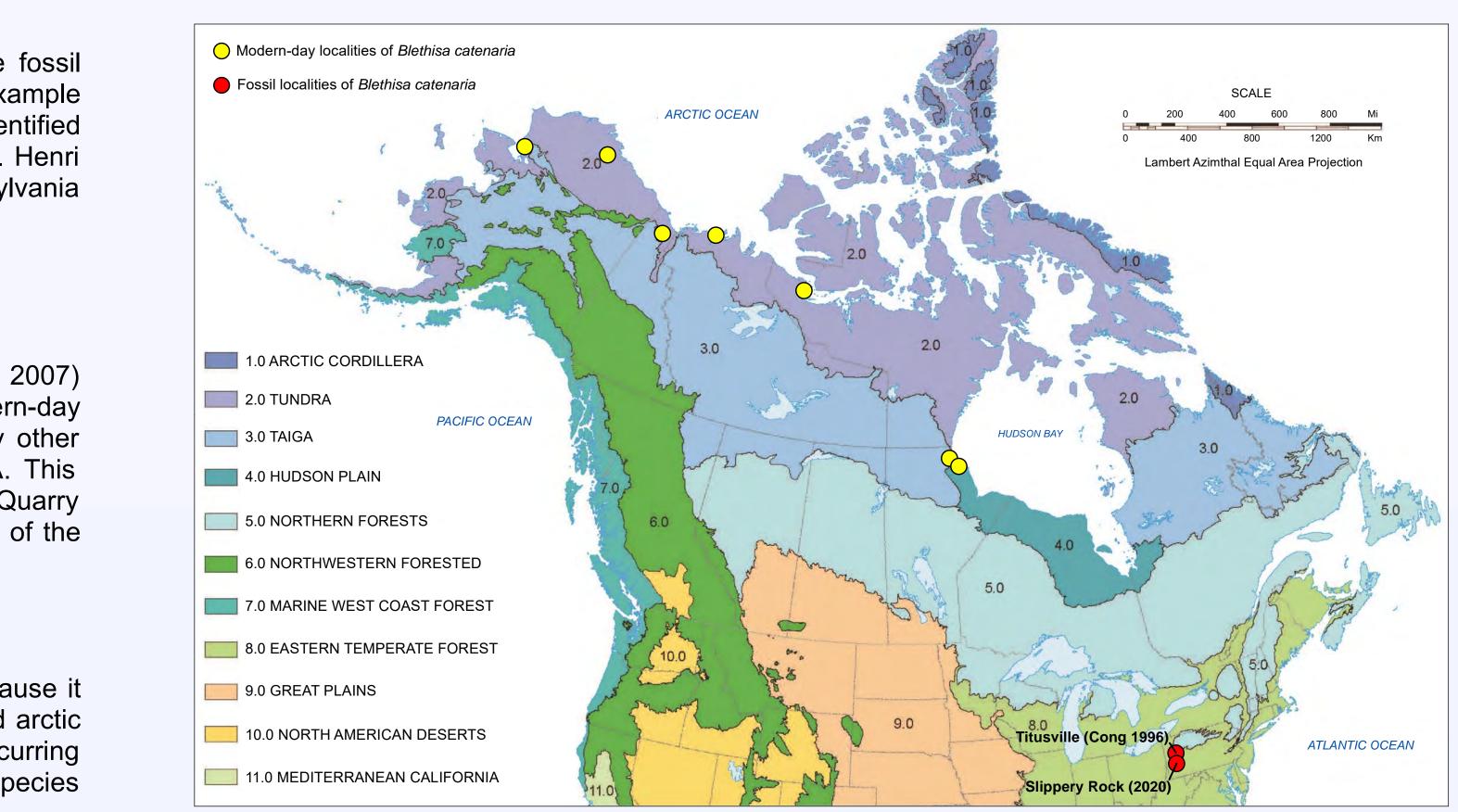
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