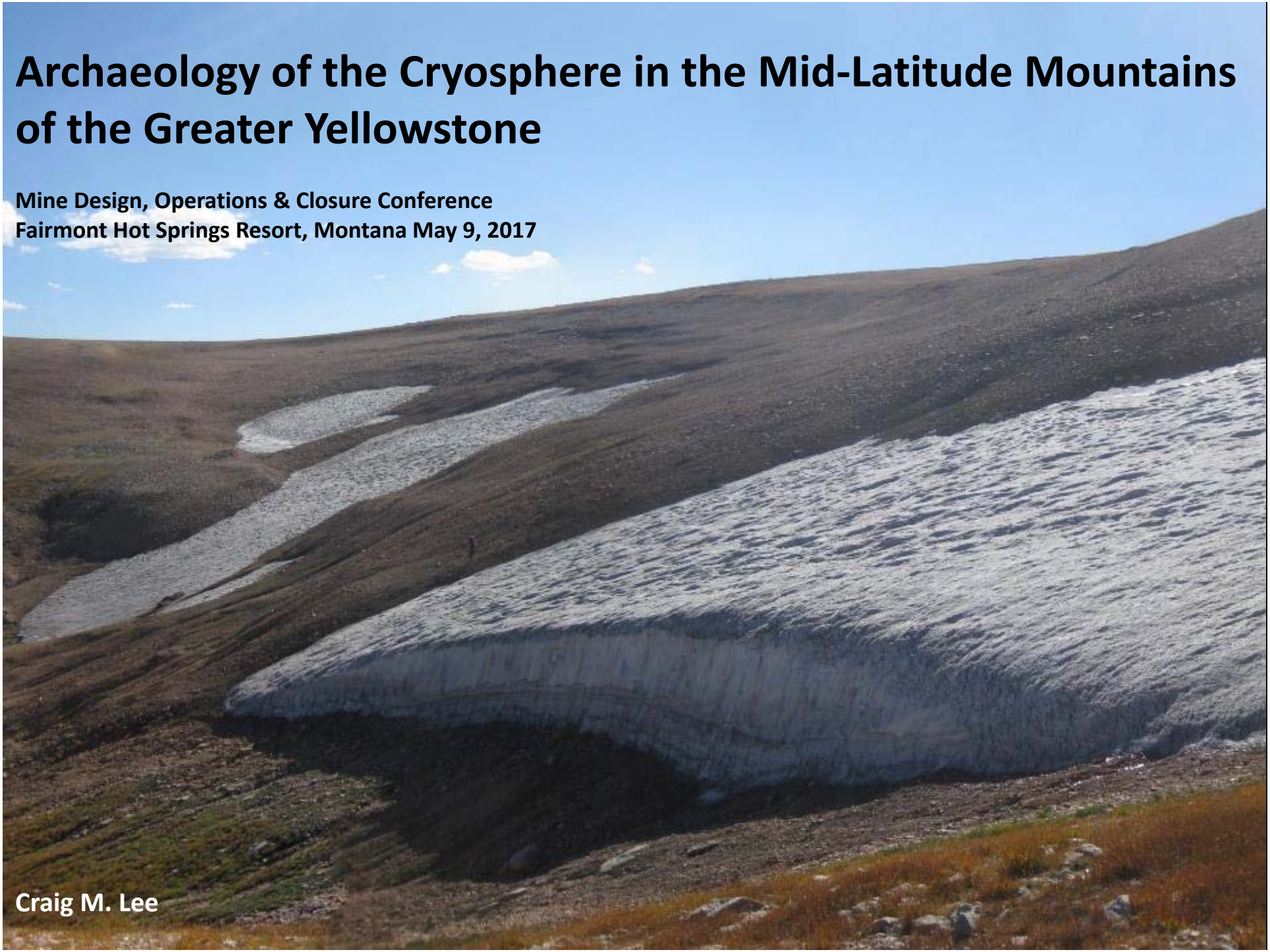
Archaeology of the Cryosphere in the Mid-Latitude Mountains of the Greater Yellowstone

Mine Design, Operations & Closure Conference
Fairmont Hot Springs Resort, Montana May 9, 2017



Craig M. Lee

Grinnell Glacier, Glacier National Park

from the summit of Mt. Gould

Mountainous parks are changing more rapidly than any other terrestrial ecosystem in the US.

Along with the disappearance of the famous glaciers, some of the more stable patches of ice and snow are also melting.

Grasshopper Glacier, Montana
1951 - 2002

Composite courtesy of Edward Chatelain

Otzi “The Ice Man” marked the first well-publicized recovery of archaeological material in association with Alpine snow and ice.

Ötztal Alps, Austria

In 1991, the discovery was not recognized as being a part of a global phenomena.

Yukon Territory, Canada

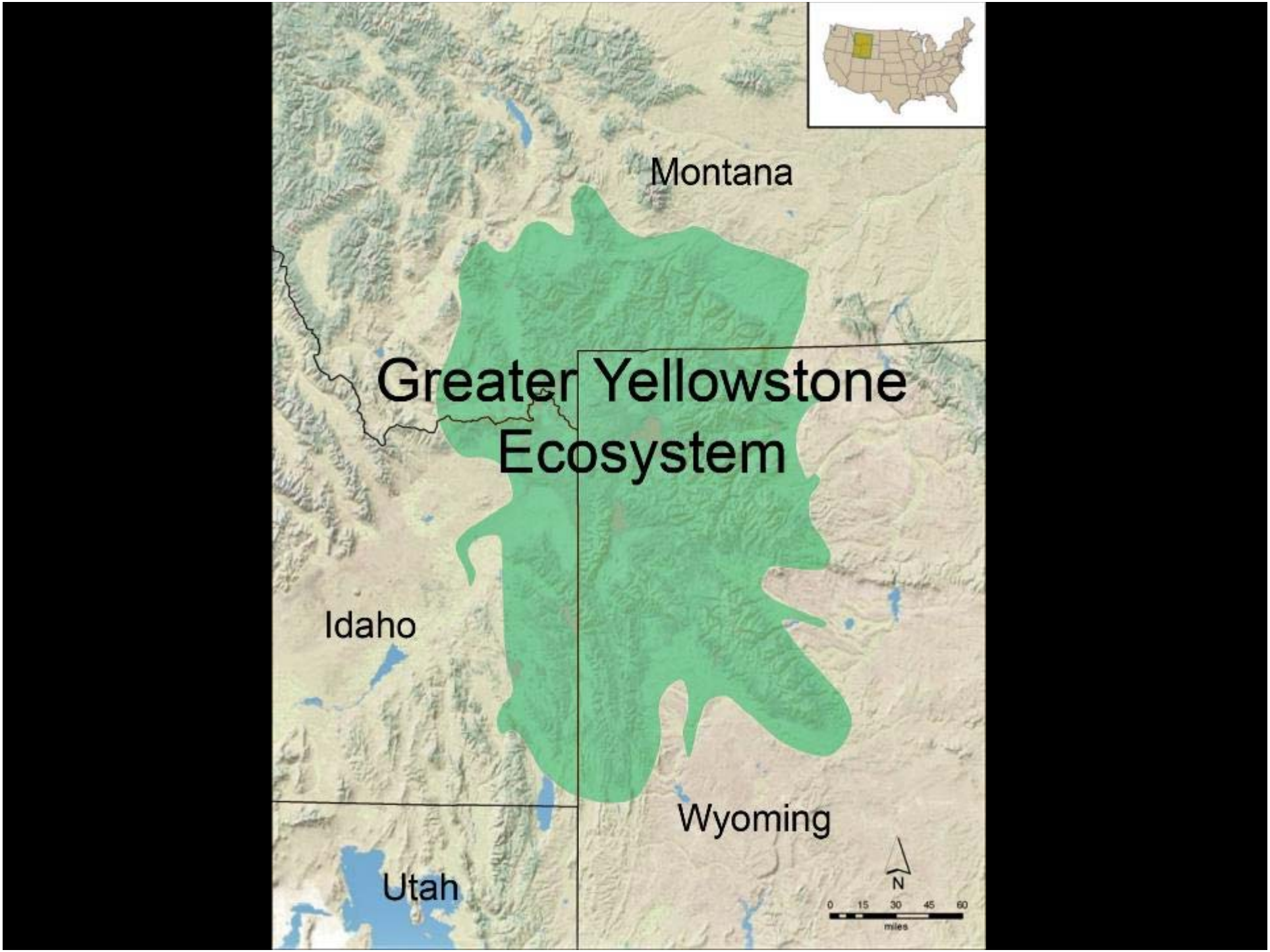
Photo: Thandlat Project

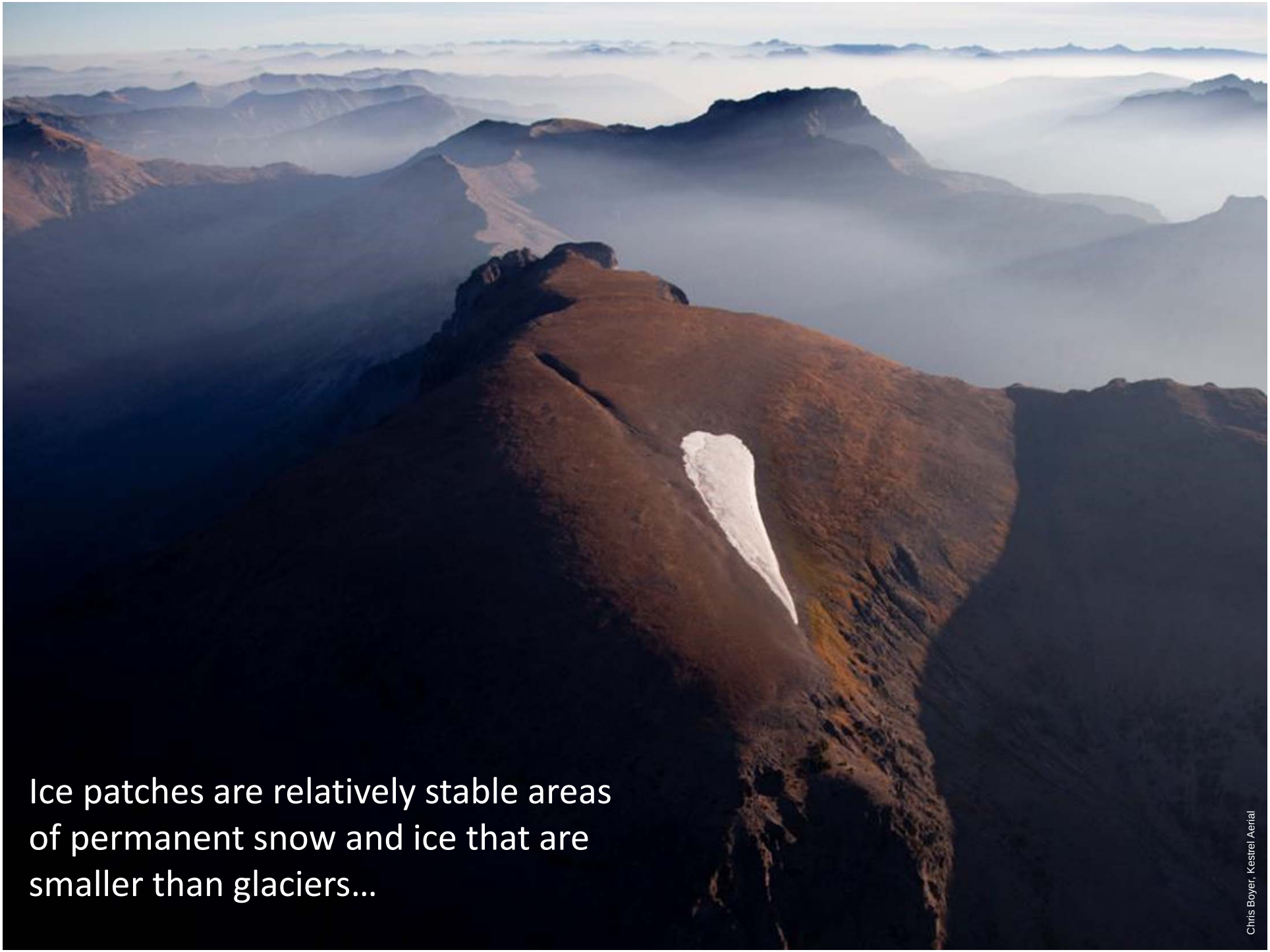
Photo: Terje Skogland

In 1997 a Yukon Government biologist found ancient caribou dung melting out of a snow and ice patch in Yukon Territory, Canada.

The paleobiological potential was exciting news to biologists and ecologists.

Yukon Territory, Canada


Montana
Greater Yellowstone
Ecosystem
Idaho
Wyoming
Utah
N
0 15 30 45 60
miles


Ice patches are relatively stable areas of permanent snow and ice that are smaller than glaciers…
Chris Boyer, Kestrel Aerial

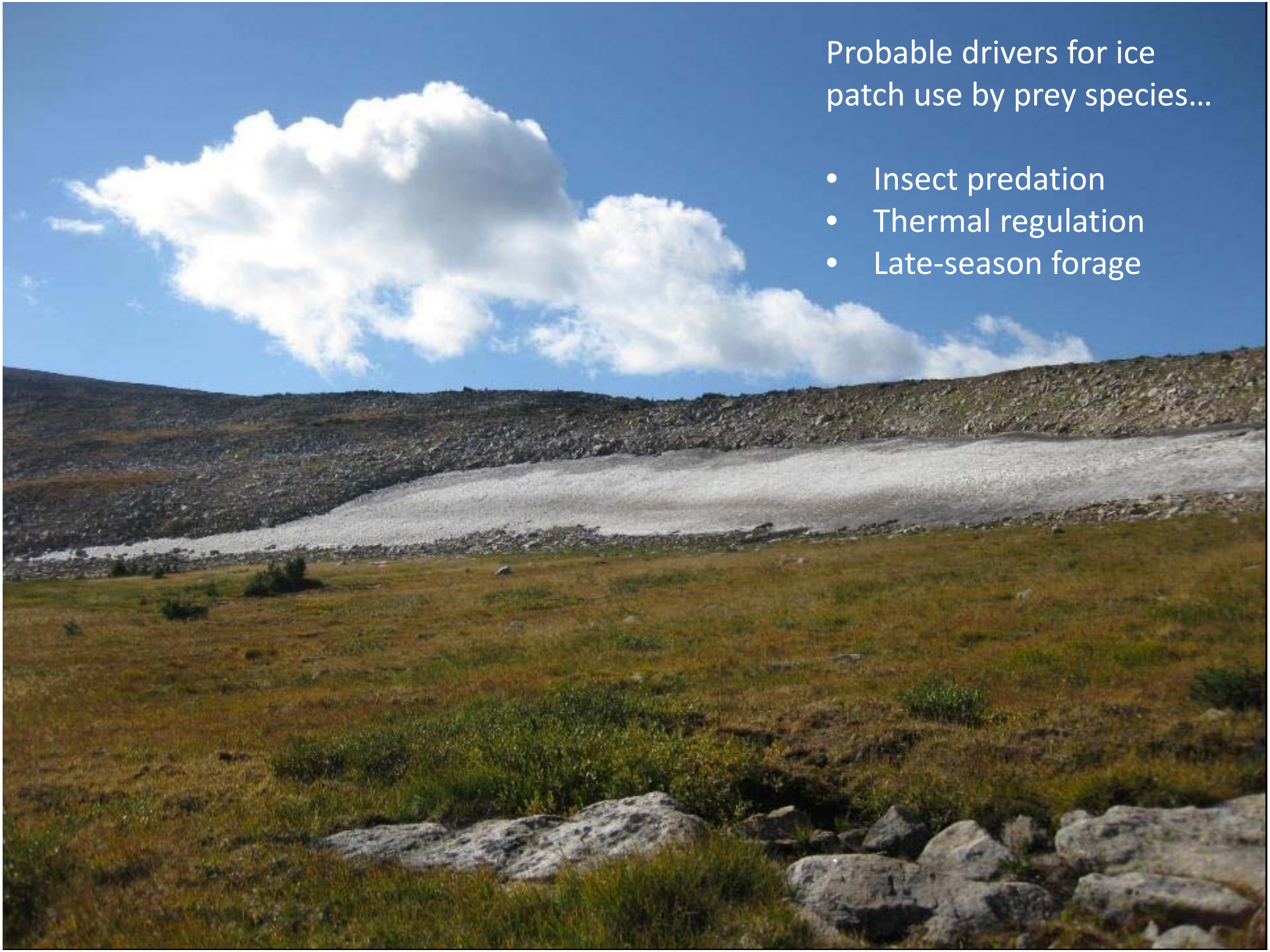

…unlike a glacier, ice patches exhibit little evidence of internal deformation or movement.
Chris Boyer, Kestrel Aerial


Ice patches can contain the usually invisible organic component of hunting systems as well as stratigraphically ordered paleo-biological deposits.

Organic artifacts are exceedingly rare or nonexistent in most archaeological sites.

They provide context for the inorganic elements that comprise most of the archaeological record.

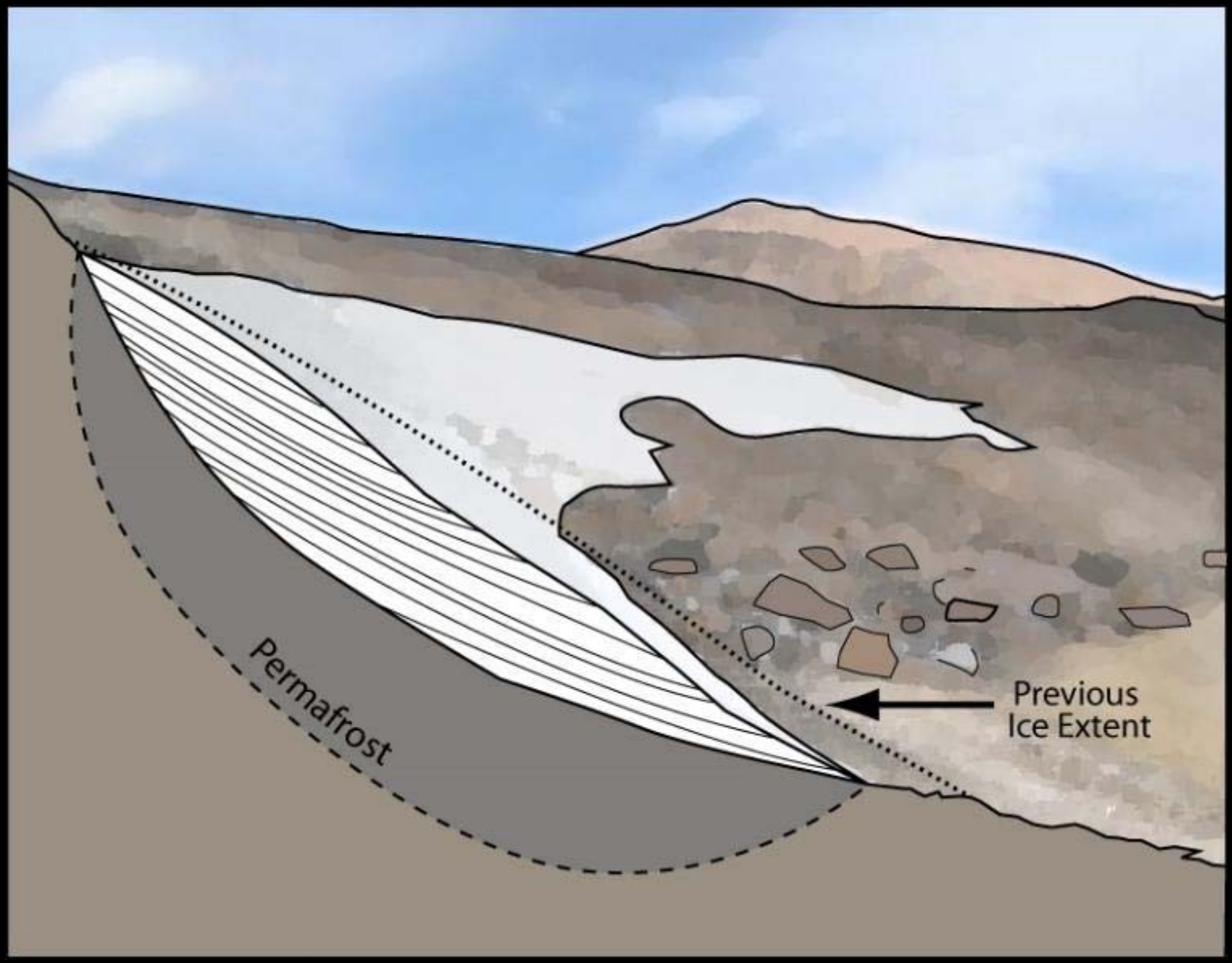
They facilitate a more complete understanding of hunter-gatherer adaptations and land use patterns.


Probable drivers for ice patch use by prey species…
• Insect predation
• Thermal regulation
• Late-season forage

Artwork by Antoine Sandoval,
Pend d'Oreille and Navajo Tribes; Animation by David Rockwell
(See www.glaciericepatch.org for animation)

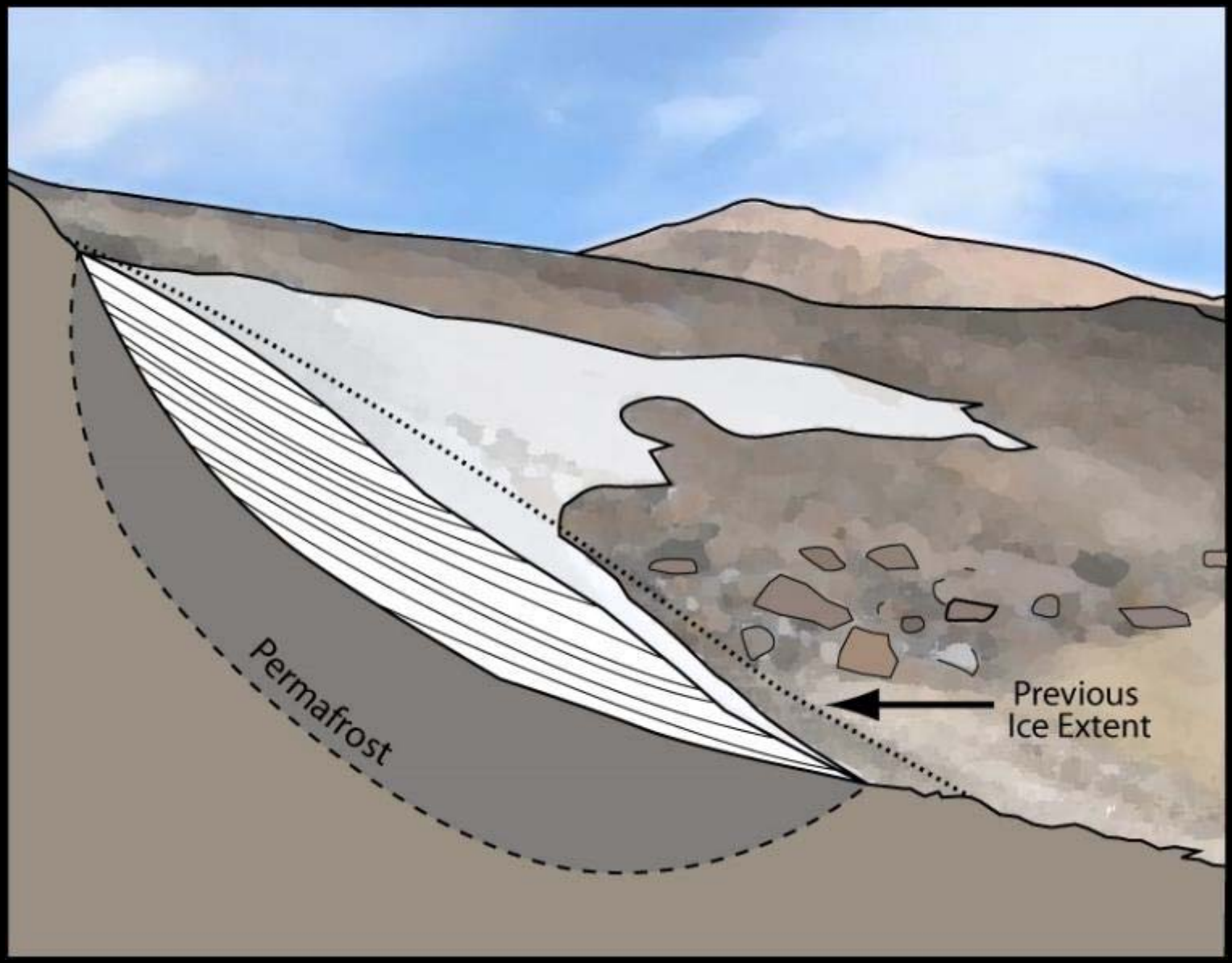
http://glaciericepatch.org/animation/HuntersKillingElkShort.html

Ice patches persist in part because of ‘lag’ surfaces that armor the underlying ice and retard melting…



Debris covered ice, Boston, Mass. August 2015

Ice patches persist in part because of ‘lag’ surfaces that armor the underlying ice and retard melting…

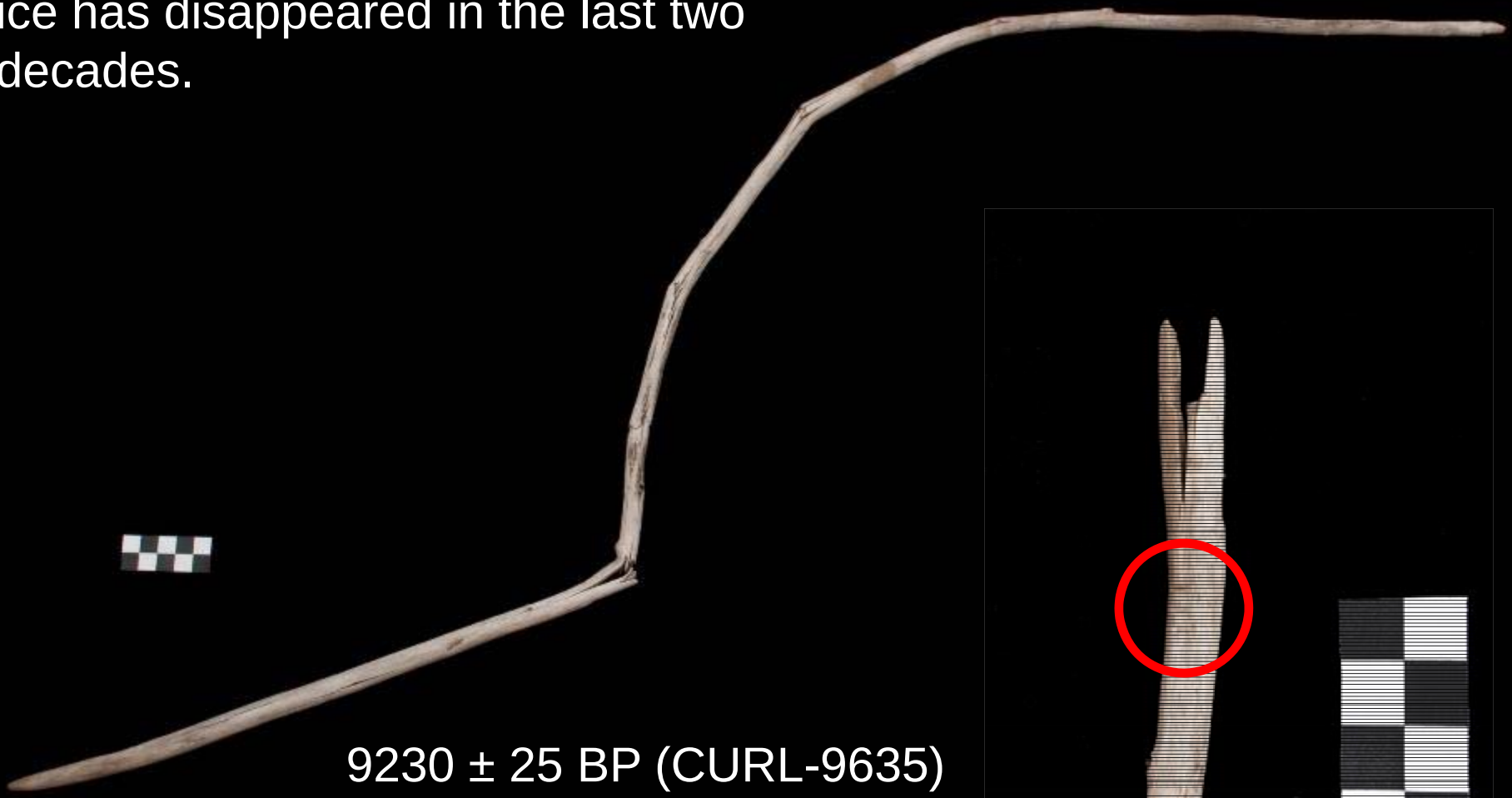



48PA3375, YELL-210553 (Shaft # 2)
Complete shaft with conical base
2900 ± 20 BP (CURL-17666)
2959-3078 cal BP

The two parallel oblique lines are inferred to be ownership or property marks.

Ethnographic observations indicate ownership marks occur on hunting weapons designed to remain in the bodies of large game.

A sobering take home…
In at least one location 10,000-year-old ice has disappeared in the last two decades.



9230 ± 25 BP (CURL-9635)
10281-10497 cal BP

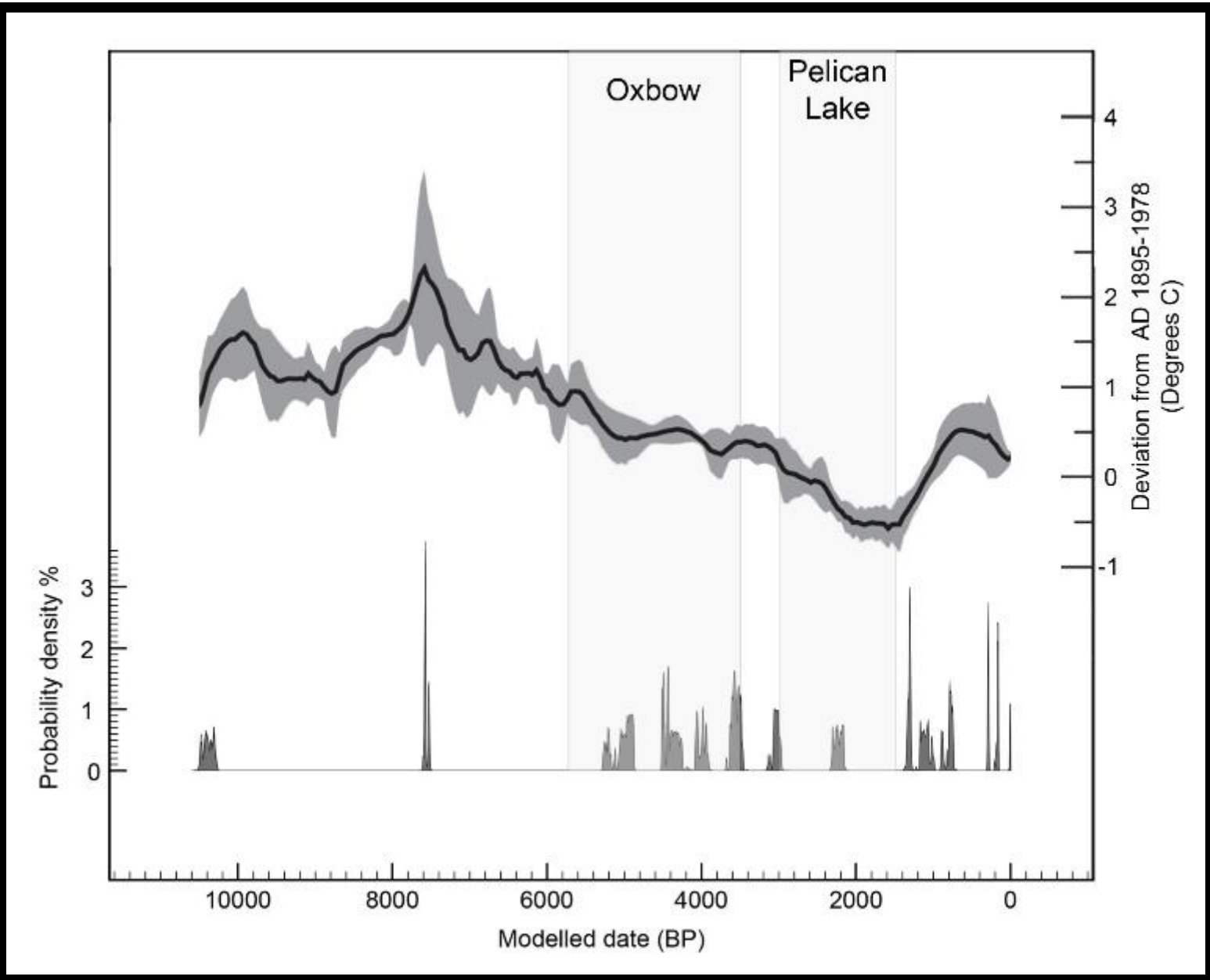
Betula sp. - Birch

Replica foreshafts made by William McConnell (pastskills.com)

Ice patches contain a record of bighorn sheep (*Ovis canadensis*) hunting.

Dates in the group at left range between 4333 and 781 calendar years B.P. (20+ skulls/fragments)

Sample Number	^{14}C Date (BP)	Median Probability (cal BP)
BCC-0727-PZ-002	879 ± 23 (NZA-55629)	781
48PA3147.5	2210 ± 25 (NZA-32961)	2231
BCC-0727-PZ-005	3296 ± 25 (NZA-55630)	3521
BCC-0727-PZ-001	3346 ± 26 (NZA-55628)	3589
BCC-0727-PZ-003	3665 ±25 (CURL-17668)	3993
BCC-0727-PZ-004	3885 ±25 (CURL-17663)	4333

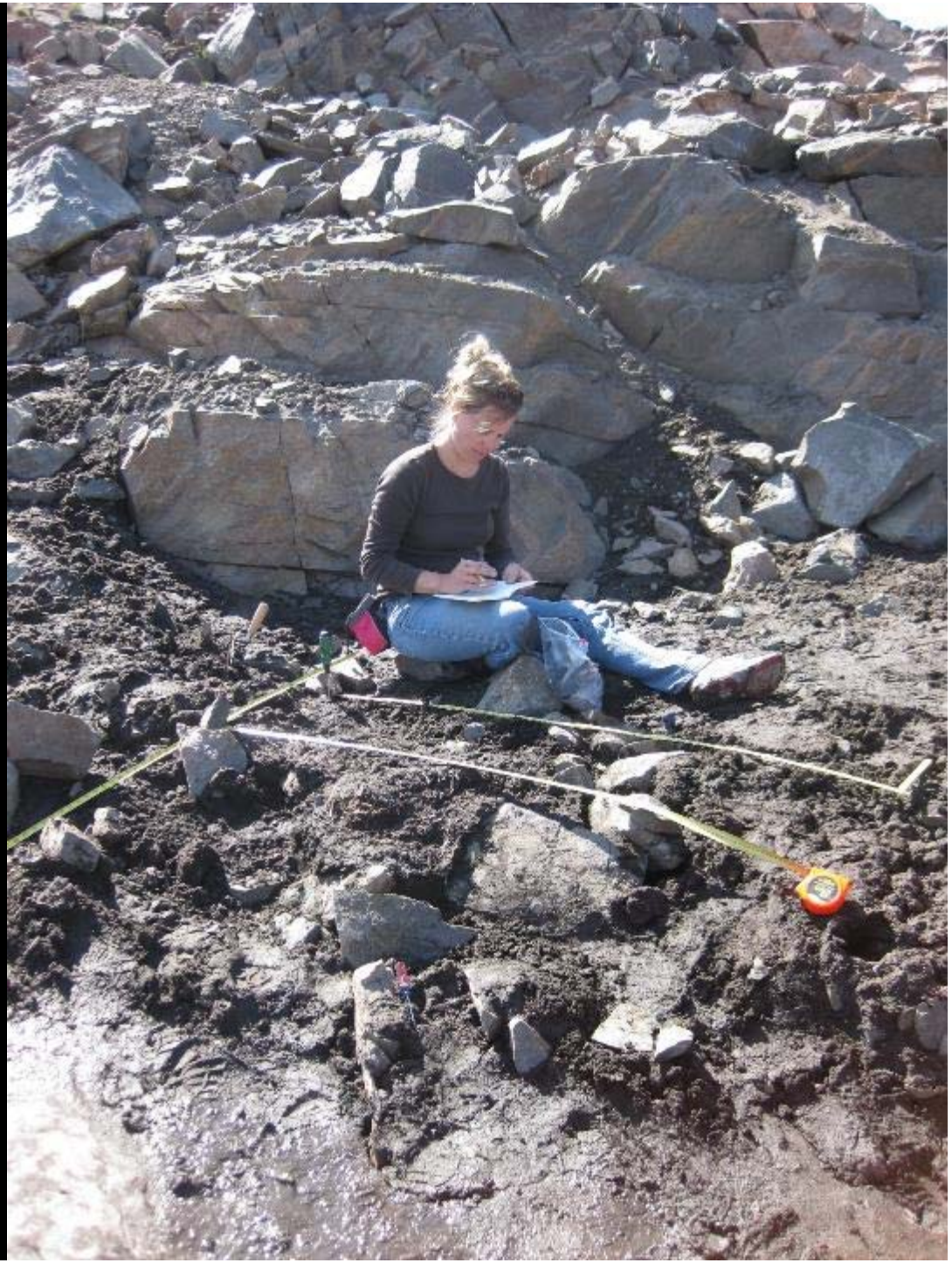


Persistent use of alpine ice patches beginning at the onset of the Neoglacial advance at c. 5400 cal BP. The breaks in the distribution may relate to taphonomic processes that affect ice patches, or periods of less intense use.

Cordage

Basketry

- Circa 1500-year-old basket
- Rods and coils were both willow (*Salix* sp.)
- Bast similar to Milkweed (cf. *Asclepias* sp.)



Stabilized awaiting replication for inclusion in a traveling exhibit.


Ice patches and the alpine are central elements of the sociocultural landscape of the Greater Yellowstone Area (GYA).

Descendant communities have a stake in educating and working with archaeologists (and others) regarding the impact of changing climate on cultural heritage and traditional ecological knowledge (TEK).

Archaeologists in the GYA are working to redress misconceptions regarding the nature of "wilderness" in the United States and the relationship between Native people and the alpine.

Features of the alpine, such as drivelines and quarries, as well as large campsites, are evidence of long-term, sustained social investments.

Archaeology can reinforce the cultural identity of Native people…

"Songs, origin stories, sacred teepees; plants, birds and animals in our bundles all come from the Rocky Mountains."

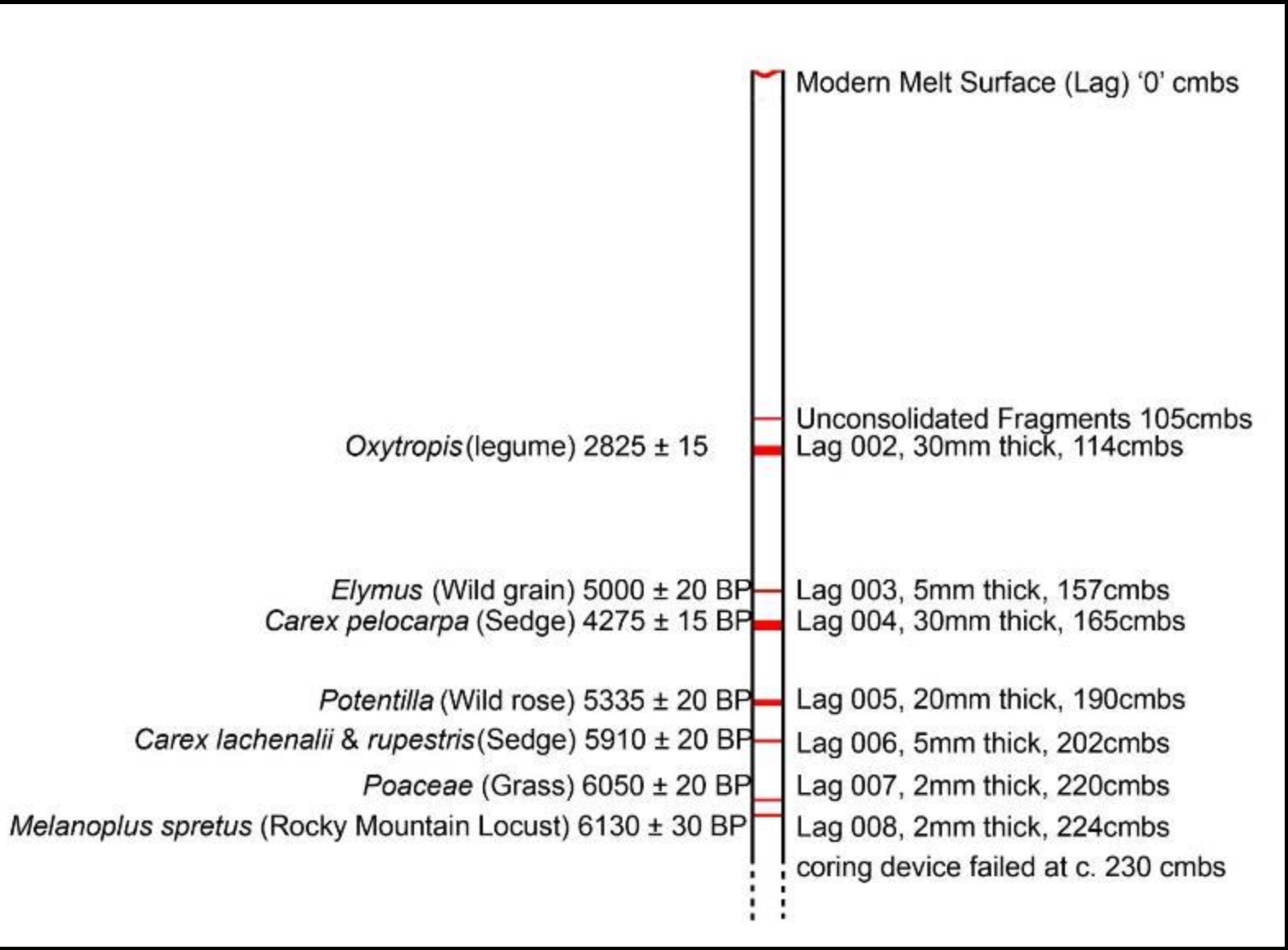
– Carol Murphy, Blackfeet

"Protection of these resources is essential for sustaining the living cultures."

–Francis Auld, Kootenai

U.S. Ice Drilling Program

Ice Drilling Program Office (IDPO) | Ice Drilling Design and Operations (IDDO)


Modern Melt Surface (Lag) '0' cmbs
Unconsolidated Fragments 105cmbs
Oxytropis (legume) 2825 ± 15
Lag 002, 30mm thick, 114cmbs
Elymus (Wild grain) 5000 ± 20 BP
Lag 003, 5mm thick, 157cmbs
Carex pelocarpa (Sedge) 4275 ± 15 BP
Lag 004, 30mm thick, 165cmbs
Potentilla (Wild rose) 5335 ± 20 BP
Lag 005, 20mm thick, 190cmbs
Carex lachenalii & rupestris (Sedge) 5910 ± 20 BP
Lag 006, 5mm thick, 202cmbs
Poaceae (Grass) 6050 ± 20 BP
Lag 007, 2mm thick, 220cmbs
Melanoplus spretus (Rocky Mountain Locust) 6130 ± 30 BP
Lag 008, 2mm thick, 224cmbs
coring device failed at c. 230 cmbs

Stabilization of slabbing area.

Emily Meike, MSU undergrad, Soc. & Anth.

Prepared “cookie”

Analysis of tree ring profiles reveals centennial variability.

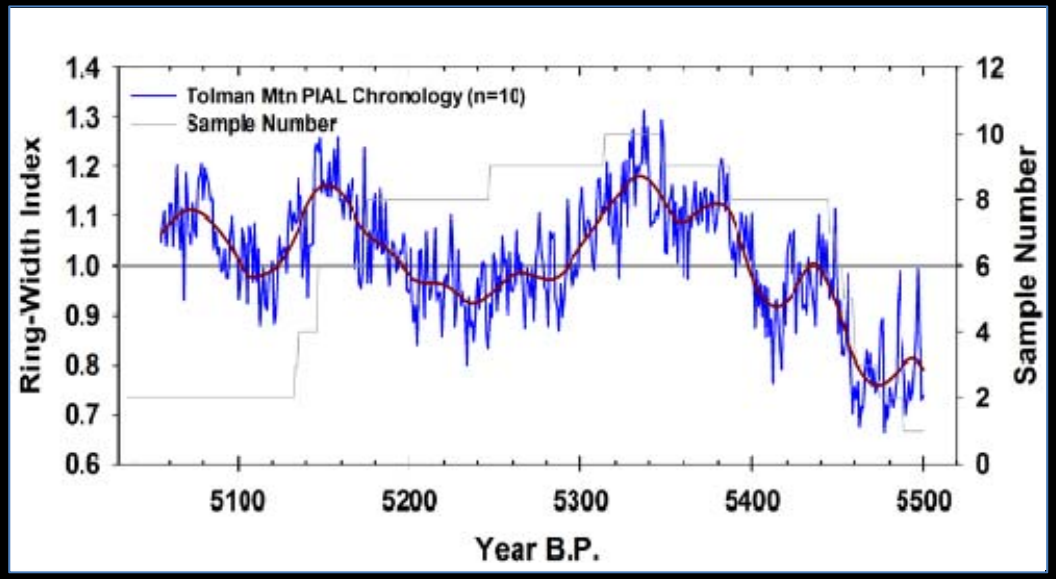
Trees range in age between 4700 and 5000 ^{14}C BP.

Greg Pederson, USGS

Sand bath

AMS ^{14}C dates on six slabs range from ca. 5000 to 4700 BP

Cross-dating of Sub-fossil Whitebark Pine Cross Sections (TOL)



Death dates of the trees and the formation of the ice patch coincides with an abrupt increase in lake levels in the region.

Summary

1) Ironically, areas demarcated as “wilderness” preserve some of the best evidence of “trammeling” around.

2) The ice patch record allows scientists to conceptualize the alpine – in ancient times at least – as an ecosystem in balance, with animals and humans alike taking advantage of a seasonally enriched biome.

3) This worldview is consistent with the beliefs of Traditional Stakeholders – Native Americana and First Nations groups.

4) Organic artifacts provide context for the inorganic elements that comprise most of the archaeological record.

5) The ice patch record is finite.

Resources for Educators & More

Glaciericepatch.org (NPS)

Frozen Pasts (on Facebook)

Visionlearning.com (Bonnie Denmark)

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Rocky Mountain – Cooperative Ecosystem Studies Unit (RM-CESU)

Buffalo Bill Historical Center – Cody Institute for Western American Studies (CIWAS)

Weber Greiser

Camp Monaco Prize