I just want to express my gratitude for being asked to share a little about this project-thanks to Mike Durglo Jr. for bringing you all here today. And to all of the partners, collaborators, and people who helped realize this project and continue to help monitor these places. I hope your work this week in understanding climate & effects help direct your future paths.

Before I speak too much about the exciting Ice Patch project begun in the park a few years ago, how many in the room know what Archeology or PaleoEcology are? Raise your hands?

What about Archeology is interesting- what does it mean to you?

Objects? Stories? Culture?
Why are people on the landscape? For Resources!! But with the presence of resources, people bring culture.

What is Culture? Shared values of a group of people—large scale such as National Parks, wildlife conservation areas (Flathead); smaller scale—community based (Native America Speaks Program; Whitefish Mountain, Events) or at family level—holiday traditions, thankfulness jars. Audience share some examples??

What are cultural resources? A cultural resource can be a building, a place, an artifact, a landscape—almost anything that “is the material evidence of human activity.” These are most thought of as tangible, but there are intangible resources too. These include Ethnographic Heritage, Archeology, Historic Structures and Buildings, Museum Objects, and Cultural Landscapes.

Why are they important? Cultural resources have the potential to connect us both with our own culture and with traditions different from our own. Glacier National Park/Flathead National Forest- and other Land Managing Agencies, are responsible for managing, protecting, and studying many different types of cultural resources.

Intangible Resources and Heritage
We can learn about cultural resources in many ways--by exploring historical and written records, as well as oral histories, or even by finding things people have left behind. Archeology is one tool the park uses to learn more about and manage cultural resources.

Archeology is actually fairly flat without consulting other resources- for example the iconic arrowhead– typically identified in nature as a stone with a distinctive shape. But we know through ethnography, museums that these tools were hafted onto a shaft, with unique markings, colorings.

When ethnographic accounts and group of associated archeological sites is on the landscape- we often think of these associations at a landscape level- the Ice- Patch Archeology project looks at individual patches- but also uses ethnographic knowledge to understand how people were moving through this area.
• One of the most exciting reasons to look at ethnography is that it infuses the landscape with so much more meaning than what is often preserved in the archeological records—and how this relates to people. Opens understanding of geology, plants (botany), wildlife, fisheries—all these cultural values.

• Many Tribes have strong connection with the area through place names, legendary sites, trails, campsites, harvesting and processing areas, archeological resources and ancestral burials. While this understanding can apply to tribal heritage, it may also apply to early history of this area by trappers or homesteaders.

Today’s maps have many place names that have tribal names and meanings—which can reveal where people were located. In addition, knowing where mountain passes are located, can help illuminate where people were traveling on ancient trail routes. Many of these trail routes are near ice patches. Similarly other comparisons of The Three Forks of the Flathead river show a distinctive heritage tied to the river system.

An Example from the archeological record—vast landscapes with shallow depressions overgrown with prairie grasses and nearby grinding stones, and grooved mauls—Possibly a cambium scarred tree. Virtually no other indication of people (stone tool debris, formal hunting tools) Perishable wood or netting decayed over hundreds of years. What was going on? Ethnographic studies may help understand processes that have hundreds or
thousands of years of heritage. Changing perceptions of the use of prescribed burns; open meadows and the connection with wildlife, and plant regeneration.
The project incorporated the field of paleoecology into its foundation due to the potential presence of preserved organic materials within the ice layers. The ice can also trap climate information such as gasses (in the bubbles) that can hold information about what the atmosphere was like. This image shows some organic materials and rock near the base of an ice core.
Before we get to the ice patches, we needed to look at many differing aspects. These include known archeological sites, climate, what kinds of plants and animals were on the landscape. The next few slides are going to share some of this information.
12,000 year old camel and horse hunting site 20 miles northeast of Glacier NP!

One of the earliest archeological sites in North America.

Traces of mammoths, camels, horses, bison, musk ox, and caribou.

WALLY’S BEACH SITE, CARDSTON, ALBERTA
The wally's beach site has components that date to the PaleoIndian Period. Other studies have shown us—

What do these animals look like-
LARGE MEALS!
Taking a walk in this area and encountering a blackbear or Grizzly gives pause. Imagine a bear height as tall as I am and 10 feet long.

With these animals on the landscape, what tools were people using?
Send around examples
Montana also has paleoindian sites—particularly the Anzik site—which is a burial.

Researchers have a variety of techniques that can be employed to analyze sites, including carbon dating (organics), protein analysis (on objects—particularly hunting), context—where an object is found on the landscape or in excavation, as well as pollen.

In this image, there is a distinctive color change and sediment change in the wall profile.
Around 8000 BP there’s a dramatic change in the environment.

See slide
Point out dramatic change 8000 years ago - warming trend.

Show prior to 12,000 super cold - climate ice age/glacial

5000- show cooling trend - this will be important in a moment.

3000- this is a warming trend
This Early Archaic Period corresponds with the climate change- with it brought new technology.
We use projectile points to understand hunting technology. During this time, the Atlatl is used for hunting. It is a tool that helps increase the length of the throwing arm and increase distance of the projectile. The shafts of Atlatl darts have been found in Ice patches in the Greater Yellowstone ecosystem.
- Temperatures fall
- Precipitation Increases
- Glaciers begin to reform in the Northern Rockies
- Climate begins a period of more frequent but less severe shifts that will not end until the Industrial Revolution

5,000 B.P. MID-HOLOCENE ALTITHERMAL ENDS
- Highest period of use of the Alpine in GNP.
- Continued use of atlatl and dart
- Use of hunting blinds and sheep traps
- Most probable time periods for the use of still existing ice patches as hunting areas.

MIDDLE ARCHAIC PERIOD 5,000 B.P. TO 3,000 B.P. LATE ARCHAIC 3,000 B.P. TO 1,600 B.P.
Target Species in the alpine included:
- Bison
- Bighorn Sheep
- Mule Deer
- Large Bison hunts were occurring in the major east side valleys
- Bison traps

MIDDLE ARCHAIC PERIOD 5,000 B.P. TO 3,000 B.P. LATE ARCHAIC 3,000 B.P. TO 1,600 B.P.
What happened with this harvest? Evidence of boiling pits have been found in St. Mary area of GNP. Here in this illustration, hot rocks were lowered into a lined pit to help cook the food. When hot rocks meet cooler water, they tend to fracture which is what this image shows.
- Bow and Arrow
- Extensive large scale bison hunting
- Large communal hunts
- Alpine areas of GNP are only used as travel routes and for religious purposes

LATE PREHISTORIC 1,600 TO THE 1800S
ICE PATCH ARCHEOLOGY THEORY

- Animals congregate on snow fields to cool down and avoid bugs
- People would have sought out this concentration of animals
- Organic materials from the hunt would be preserved in the ice

...BACK TO THE END OF THE MID-HOLOCENE ALTITHERMAL AND ICE PATCHES
We know that animals congregate on ice patches in order to escape from mosquitoes, horse flys and other biting pests. When in the middle of the patch – there is a dramatic decrease of these insects.
What is the difference between Glaciers and IcePatches- to a certain extent Stability!

Why didn’t we look at Glaciers- the ice is young- keeps moving. The outflow keeps melting and outwash will sweep organic materials away from the bottom. Very few artifacts have been found associated with Glaciers

We have learned that Ice patches- have very different development. The snow can build up in high snow years, or due to wind loading. Because they aren’t moving, they can develop and building up ice core- melt is primarily the granular snow. The ice cores have the information that we were seeking.
At the time of the park’s establishment, 150 glaciers are known. In recent decades this has dwindled to 25 glaciers. There was no count of the ice patches. This study initially selected 49 patches—using a variety of historic & aerial images and ethnographic information. That number was eventually narrowed to 25 for study. This is because of access, annual presence, slope, aspect and the presence of organic lobes visible in images.
The image above is DR. Craig Lee holding an Atlatl Dart. The curvature in the wood is due to the deformation in the Ice. The cold temperatures effectively deep freeze organic materials. The other image shows basketry/woven fibers melting out of the ice.

Other materials such as wood, bone, leaves, animal droppings- as well as clothing (leather/woven fibers), hunting items (quivers) and even human remains can also be preserved.
This project is one of the most exciting that I have ever been able to participate in. The unique aspects are the collaboration- it is critical to have a wholistic approach to these projects. Plus the project design also incorporated public awareness & Interpretation of ice patches.

We also developed a protocol for recovery of organic materials that was shared service wide. Organics can be very fragile and are known to preserve only a few years after melting out.
This website— and I will speak more about it in a moment— has a tremendous amount of information about the project.

http://glaciericepatch.org/index.html
I’m going to highlight two of the ice patches we studied- recall that there are 25 in the project.
Dates to 1000 years ago, male bison. We know about this animal’s diet based on the preservation of its teeth and enamel.
Siyeh pass was selected for ice coring. Several others were also cored in the early part of the project- the premise that the ice in glacier might have similar characteristics to Greenland/Antarctica. The hand-powered augers during the early phase kept bunching and freezing- this is due to “warm ice” a new method was developed specifically for this project.
Siyeh pass was selected for ice coring- this tool was specially developed to core ice at our mid latitudes- warm ice.
Excitement for the first core
Helping the auger go deeper- and examination of cores in the background.

There were two different pieces of equipment- ice core driller and another that melted ice. We needed both in order to go through a lag deposit of gravel- this helped us eventually reach the bottom of the ice.
This image shows the non metamorphosed snow (granular – on the left) and the metamorphosed ice core- note the layers and gravel/organics. These are called lag deposits, items that can be blown in- twigs leaves, or brought in such as animal droppings. These paleobiological specimens are important as it tells us what was growing in the area.
The coring ultimately reached 6.5 meters depth. At depth, a piece of either bighorn sheep or Mountain goat droppings dated -- 6500 yrs old.

Just before the project began- there were extremely high snow years- the melt during the duration was not as high at the project had hoped. During the study, there were no archeological material identified. There was paleobiological materials identified- wood, leaves and the Extracted lags showed - ice formed 6000 years ago- this gives us local climate information. At the base of these Ice patches, there's potential for “frozen forests” which may have research potential.

So there was lingering question- where is the Archeology?
In 2015 we had tremendous melt- and a park team was able to visit some of the ice patches from the study to see if there were any archeological materials melting out of the ice.
Staff archeologists were able to see exposures with more paleobiological materials.

Our learning doesn’t stop- in 2017 staff archeologists had an opportunity to visit the Rocky Mountain Anthropological Conference- Which had discussions of ice patch research, as well as perspectives from Canadian researchers. One of the presentations asked the researchers to take another look at lithic scatters located near ice patches- and to see if there are correlations.
- Continue to target ice patches for archeological material—particularly during high melt years.
- Develop interpretive materials (including a website) in coordination with the Confederated Salish-Kootenai Tribe and the Blackfeet Nation.

FUTURE RESEARCH AND OUTREACH
This website - which I won’t be able to show today is a tremendous resource that speaks to the collaboration on the project, accomplishments.

Particularly the video on the homepage that shares all of the collaboraters perspectives. As well as 3-D scan of the bison skull, animations, gallery.

[http://glaciericepatch.org/index.html](http://glaciericepatch.org/index.html)
The project and website highlights the shared cultural importance of mountain landscapes—
including ice patches: geology- animals- plants-fisheries and the people.

Kootenai perspective- increasingly rapid ice and snowmelt in GNP creates a critical cultural
resource issue....Protection of irreplaceable cultural resources is essential for sustaining the
living cultures.

Blackfeet perspective- Mountains are homes of powerful beings that continue to interact
with the people. The Blackfeet utilize the Rocky Mountains for fasting, hunting and
collecting of medicinal plants and animals for their bundles.

Salish and Kalispell- The elders have taught us that we must honor the land and waters, the
plants and animals, the fish and birds. We must always do our best to take care of them for
generations yet to come.

This last piece is the principle of the National Park Service Organic Act- and our mission. As
you explore the park today and in the future, this special place draws people from all over
the world.