**Glacier National Park Ice Patch Survey Report**
**September, 2010**
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**Preface**

Archaeological discoveries in high latitude and sub-alpine environments reveal that melting ice patches and glaciers expose well preserved yet fragile cultural materials. The cultural and scientific value of these fragile artifacts is immeasurable but fragile items quickly deteriorate if they are left exposed to the elements, animals, or collectors. Climate change-related phenomena are new and critical concerns for Native Americans who have ancient heritage links with what is now Glacier National Park. Glaciers and snowscapes are integral parts tribal creation stories. The alpine zones are important special areas for hunting, gathering, and ceremonial use. Important cultural plants, minerals, and animals were procured in these unique environmental settings. Recent dramatic changes brought to these alpine and subalpine areas have caused an imbalance to a natural ecological system used and maintained by tribal ancestors since time immemorial, threatening permanent loss of heritage cultural and natural resources.

Increasingly rapid ice and snowmelt in Glacier National Park creates a critical cultural resource issue that must be addressed in a timely and comprehensive manner. Thorough examination and evaluation of impacts are the first steps to address endangered cultural and scientific resources and knowledge. Cultural resource studies focused on areas newly exposed by receding ice and snow fields provide insights about prehistoric lifeways in alpine and subalpine zones, as well as essential information on ancient climates and recent changes that are critical for evaluating the historical context of recent man-made habitat shifts. In addition, monitoring of ice and snow fields and exposed artifacts is critical. Such efforts must be coordinated among Native American tribes, environmental scientists, and archeologists to ensure consideration of issues, values, synergy between different domains of knowledge, and compliance with federal laws governing stewardship of cultural resources (36 CFR Part 800, Sections 110 and 106 of the National Historic Preservation Act, Sacred Sites [EO 13007], the Native American Graves Protection and Repatriation Act (43 CFR Part 10), the Archeological Resources Protection Act, and others).

## Overall Project Objectives

The “Ice Patches as Sources of Archeological and Paleoecological Data in Climate Change Research in Glacier National Park” project will take place over a three-year period and involves a partnership between Glacier National Park, the University of Wyoming, the Institute for Arctic

and Alpine Research at Colorado University Boulder, the Confederated Salish and Kootenai Tribes of the Flathead Reservation, and the Blackfeet Nation. The project's overall objectives are

1) To work collaboratively with scientists from the University of Wyoming and INSTAAR/Colorado University, Boulder to investigate and document ice/snow patches in Glacier National Park in order to identify archeological, ethnographic, and paleobiological resources endangered by recent climate change and to recover archeological and paleoecological data relevant to global warming research.

2) To work collaboratively with the Confederated Salish and Kootenai Tribes of the Flathead Nation and the Blackfeet Nation to develop and implement culturally appropriate protective and conservation measures for sensitive cultural sites, features, and objects at risk from snowmelt.

3) To enhance cultural resource stewardship and protection at Glacier National Park through public education and interpretation about climate change impacts on cultural resources and resident indigenous communities.

4) To develop a strategy and methodology for assessing and mitigating impacts to cultural resources from glacial and snow/ice field recession that can serve as a model for other parks, agencies and entities in the United States and throughout the world.

**Field Research, 2010**

The research team met with Lon Johnson and other park officials on August 27 to finalize details for fieldwork. Field camp was established on August 28 at the St. Mary campground. The core research team consisted of:

Robert L. Kelly, PI (UW)
Craig Lee (INSTAAR)
David Schwab (CSKT, Preservation Office)
Ira Matt (CSKT, CSKT Preservation Office)
Don Sam (CSKT, Preservation Office)
Rachel Reckin (UW graduate student)

We were also joined for one or more days by Kevin Askan (CSKT), Joe Rivera (BN), John Murray (BN) and Pei-Lin Yu (NPS), John Kinsler (NPS), Alex _____ (NPS), and Frank Tyro (CSKT videography consultant). The CSKT was responsible for the GIS and video components of the project (Appendix A). Prior to fieldwork, the team consulted via teleconference on a Protocol for fieldwork, collection procedures, lab/analysis, and curation (Appendix B).

Glacier contains hundreds of ice patches. Not all of these, however, have a high probability of preserving in a recoverable state organic artifacts and paleobiological (PB) materials. Therefore, prior to fieldwork, Lee used Google imaging of GNP from multiple years to locate ice patches with a higher probability of offering such material for recovery. Lee defined 46 such points, and 3 were then added at the beginning of the field season for a total of 49. More may be defined in the future. The majority of the 49 points are located in the southern half of the park (south of Going to the Sun Road). From Google

imagery, Lee selected those ice patches that (a) are accessible on foot (ones inaccessible by foot would not have been used prehistorically), (b) that still existed in the high melt year of 2003, and (c) that offered a flat forefield (below the ice patch); patches without a flat forefield could reveal artifacts and paleobiological materials, but these objects would be rapidly transported downslope by meltwater and summer rainfall.

The majority of the field time was spent hiking to the ice patches, even those located near established trails. We photographed each patch from a georeferenced point so that it could be re-photographed in the future for comparison. The lower edge of all patches were mapped using a GPS (see Appendix A); the complete edge of smaller patches were so mapped. The team then surveyed the forefield for some 20m out from the current edge for artifacts and paleobiological materials. In addition, any stream, if present, running from the ice patch was also surveyed for 50 or more meters (depending on the gradient). All PB specimens were located using a GPS instrument, photographed (both close-up and showing the specimen's location relative to the ice patch), and (except for two modern specimens on patch 38A) collected in a labeled plastic bag. A few pieces were stabilized on sturdy plastic sheeting. All photos taken by all crew members are being compiled by CSKT.

Fieldwork was hampered by severe weather conditions; however, all but one of the targeted patches for this year were surveyed. In addition, we surveyed two other small patches that we determined were good prospects upon encountering them in the course of surveying targeted patches (table 1). In all, we were able to examine 11 patches. Work this year was furthered hampered by the fact that while 2009-2010 was a modest snowfall year, the summer of 2010 was cool, and snow did not melt back; snow was in fact falling on several days of fieldwork. As a result, all patches were larger than depicted in September 2003 Google imagery, and any materials exposed in the immediate ice patch forefields during the high melt year of 2003 were covered in 2010.

We did not locate any definite artifacts. This is to be expected as the recovery rate on ice patches elsewhere in the world is below 10 percent. We did recovery a number of paleobiological specimens; only one of these appears to be from a rooted tree. These are being identified at the University of Wyoming and several will be submitted for radiocarbon dates.

Fieldwork ended on September 7; the team had a end-of-session meeting with park officials on September 8 in West Glacier.

| Ice patch number | Approximate location | Recovery | Comments |
|---|---|---|---|
| Hidden Lake 1 8/29/2010 | Hidden Lake, near Visitor Center | None | visibility poor due to heavy snowfall on day of survey; considerable stream running from patch; patch ends partially in a stream-filled gorge; merits a re-survey |
| 15 8/30/2010 | Mad Wolf Mountain | Two PB specimens | Very large ice patch; visibility also poor due to snowfall; merits coring in future; vegetation along sides but not at top of patch; significant steam running along much of the edge |
| 19 9/3/2010 | Near Morning Star Lake | One PB, from top of ice patch | Flat forefield, very active stream running laterally a few meters from patch edge |
| 20 9/3/2010 | Near Morning Star Lake | Two PB, one possibly rooted wood | Large patch; there are small spruce trees above the patch; flat, but not wide forefield |
| 20A 9/3/2010 | Near Morning Star Lake | Two animal vertebrae | Patch not in original sample, limited albeit flat forefield |
| 21 9/3/2010 | Near Morning Star Lake | none | Patch almost gone |
| 38 9/7/2010 | Siyeh Pass | One PB | Patches 38 and 39 are a single continuous patch this year; they were separate in 2003; 38 has a steep, rocky forefield |
| 38A 9/7/2010 | Siyeh Pass | Three PB | Two additional pieces of modern wood (specimens 38A-3 and 38A-4), possibly old trail signs were located and photographed but not collected. Active stream running from patch, but wide flat forefield. |
| 39 9/7/2010 | Siyeh Pass | None | Large patch but forefield is very constrained with active stream running from patch |
| 40 9/5/2010 | Peigan Pass | Four PB specimens | On east side of pass, near established trail; steep forefield and difficult to survey |
| 41 9/5/2010 | Peigan Pass | Five PB specimens | On west side of pass, about 1000 feet below, near, but not on established trail; one piece of modern backpack noted; wide flat forefield with small active stream running from patch. |

**Appendix A**

**Confederated Salish and Kootenai Tribes Glacier National Park 2010 Research Summary**

***Introduction.*** This report summarizes the activities of the Confederated Salish and Kootenai Tribal Historic Preservation Department (CSKT) for implementation of the Ice Patches as a Sources of Archaeological and Paleoecological Data in Glacier National Park Research Project. This work is being conducted under the National Park Service's Rocky Mountain Cooperative Ecosystems Studies Unit Agreement Number H1200090004. For the project, the CSKT is under subcontract to the University of Wyoming, Dr. Robert L. Kelly, Principal Investigator. This report is broken down into four sections reflecting project responsibilities of the CSKT

***Guidelines for Research Prioritization, Field Methods and Collection Protocols.*** The CSKT staff worked closely with Drs. Kelly and Lee to target specific ice sheets for field examination and to plan access routes, logistics, and the itinerary for the field season. Through a series of email exchanges and telephone meetings, a field plan and itinerary for the 2010 field season was completed in early August.

The CSKT also participated in a series of telephone and face-to-face meetings concerning the development of a protocol for the implementation of the project. This work was conducted as part of a GNP Cultural Resource Management Group organized for this project. Of particular concern to the CSKT was that the field methodology, especially artifact and specimen collection, was conducted respectfully and with sensitivity to tribal cultural values. The staff reviewed and contributed to several versions of the protocol. The revised document was approved by the CSKT and finalized in August prior to the initiation of field work.

Tribal staff also participated in telephone conferences and reviews of a project statement concerning the treatment of artifacts that may qualify under the Native American Graves Protection and Repatriation Act by the project.

***Geographic Information System Development.*** Development of the project Geographic Information System (GIS) was initiated in July after the contract with the University of Wyoming was initiated. CSKT conducted a full review of available data and incorporated the following georeferenced data layers for the Glacier National Park GIS prior to field surveys: 1) 30 & 10 meter Digital Elevation Models, 2) GNP cultural resource site data, 3)Aerial imagery from National Aerial Photography Program (NAPP), 4)7.5 Minute USGS maps, 5)Kootenai Place Names, 6)GNP and USGS Glacier and Ice Sheet data from the NPS GIS portal, 7) Historic Trails. In addition, Google Earth images and ice sheet target locations developed by project researchers were transferred from .kml to ESRI ArcGIS format using the BEBEL protocol and then entered into the project GIS. Oblique images of all the target ice sheets showing variation over several seasons of photographic documentation were printed, organized and used in the field for identification and analysis.

On August 4, CSKT staffers Don Sam, Dave Schwab and Ira Matt met with Richard Menicke, GNP's GIS Coordinator to discuss available layers for incorporation into the GIS. Menicke indicated the USGS mapped glaciers and permanent snow features off of original 24K scale topo maps. This imagery was subsequently obtained by CSKT through the NPS portal. Year 2005 is the last season for comprehensive park wide measurements of snow and ice features. The USGS have mapped a handful of

specific glaciers since then but nothing park wide. In 1998, USGS flew the park and photographed the Glacial covered areas of GNP. From the photographs they developed their own Ortho-imagery. These data are still being finalized but they are of high value for the ice patch archaeology project because they are very high resolution and are from a particularly low snow year. The CSKT have made arrangements to obtain these data from the USGS during the fall of 2010.

Prior to the 2011 field season, CSKT staff plan to conduct research of NPS resources, GNP archives, academic sources and the Montana State Natural Resource Information System for information that could be incorporated into the project GIS. Natural Resource investigation mapping that might be obtained would include maps identifying land-type classifications, game animal calving and gathering areas, wildlife migration corridors, Tribal economic plant communities ( White Pine, Camas, Bitterroot, etc.). If necessary, these map data would need to be georeferenced by scanner or hand digitized for inclusion in the project GIS. In addition, land form analysis will be conducted using the DEM data to map slope, aspect, and curvature features as a means to assess target ice sheets for future study.

Oral history interviews and tribal archival research will be initiated in the fall of 2010 and winter and spring of 2011 to identify cultural hunting areas, plant gathering locations, historic trails systems, Salish and Kootenai Place Names, camping and gathering areas, and important hunting locations. Analysis of natural resource, landform, and tribal cultural information in the GIS will provide a foundation for researchers to identify the highest potential permanent snow and ice fields for field study in the upcoming two field seasons and will serve as a foundation for a Glacier National Park Cultural Resource Management System that will hopefully be developed with outside funding sources in the future.

***Global Position System Field Mapping.*** Tribal staff ranging from 2-4 individuals participated in all phases of the field work from late August through early September of 2010. The CSKT team of Don Sam, Ira Matt, Dave Schwab, and Kevin Askan conducted GPS field mapping during different phases of the field investigations. The primary GPS units employed were the DeLorme Earthmate PN-40 and PN-60. As a backup, a Garmin Etrex Legend unit was employed. These units have a GPS accuracy ranging from 5 to 10 feet depending on field conditions and satellite availability. Detailed USGS geo-referenced map coverages and aerial photography were downloaded into the units to provided highly accurate real time geographic locations in the field. These were helpful in distinguishing research targets in the back country.

Prior to visitation to target ice-sheets, analyses were conducted using the GPS units and integrated software to determine the most efficient and cost effective routes to the targets. These analyses combined with map research conducted by the project investigators resulted in some revised planning in the course of field work and changes from the initial plan of action.

During the field work, the team mapped routes into each of the investigated ice sheets, mapped the exterior sides and lower perimeters of the ice sheets, and individually mapped collection samples and other pertinent features identified by researchers. These data have been processed and will be incorporated into the project GIS. Map data of ice sheets will assist in monitoring changes in the target ice sheets over the next several years.

Prior to the 2011 field season, the CSKT will be acquiring additional GPS units and investigate improving GPS accuracy by use of antennas, software processing, and reference ground base stations. The goal of the new GPS units will also include satellite communications that will provide the ability to make contacts to key Tribal and NPS office personnel and staff in case of significant discoveries or emergencies in the back country.

***Interpretive Product, Digital Video, and Still Photography***. Two digital video cameras were used during the Field investigations, a Canon GL1 DV a Sony HDV high definition unit. Video interviews were conducted with the project team at several times during the course of the study. These interviews were undertaken both in the base camp and in the field. Unfortunately, inclement weather and precipitation impeded some use of the video cameras. The Canon GL1 camera was carried into the field and video was shot of the survey methods, ice sheet mapping, sample collections, terrain and conditions. Video interviews were undertaken with researchers during collection of samples. The Sony HDV camera was used for base camp interviews, landscape overview, and on one back country field trip to Siyeh Pass on September 7th.

On August 30th, Frank Tyro, director of the Salish Kootenai College Audio Visual program participated in the field work and documented the effort in with a Sony HDV high definition camera. Prior to the field tour, Tyro held several training sessions with CSKT staff on video camera techniques and operation. At total of 19 mini DV and mini HDV tapes were obtained (DV tapes = 7 , HDV = 12) .

The CSKT also documented the project using three digital still cameras, a Sony Cybershot 12.1 Mega Pixel camera, and two Olympus 10 mps cameras. A wide range of still images were captured including Ice sheet photo point identification shots, sample collection photos, individual and group survey photos, landscape shots and field crew pictures.

During the Fall and winter, CSKT staff will be busy conducting additional interviews with Tribal Elders, researchers, other project participants, and geological experts. We will also be busy cataloging all the media materials, downloading media to DVD ROM for backup and storage, sharing still imagery with project participants, and entering media information into a project media database in Microsoft Access.

**Appendix B**
**Starter Protocol for Field, Lab/Analysis, and Transport Protocols: DRAFT**
**(Curation not yet included)**
Glacier Ice Patch Archaeology Project
Started by Pei-Lin, 6/16/10

## Background

In 2010, Glacier National Park (GLAC) received climate change grant money to document, recover, analyze, and interpret cultural items that may be exposed due to melting of ancient snow and ice fields. The project, hereafter called the Ice Patch Archaeology Project, is funded through two task agreements with the Rocky Mountain Cooperative Ecosystem Studies Unit (RM-CESU). One agreement is with the University of Wyoming (UWY) with subagreements to the Blackfeet Nation (BN) and the Confederated Salish and Kootenai Tribes, (CSKT). The other agreement is with Colorado University/Boulder (CUB).

## Goals and Objectives

One of Ice Patch Archaeology Project's strengths is a the creation of a protocol for handling of artifacts that is culturally sensitive and scientifically valid. In May 2010, representatives from the park, the BN, CUB, the CSKT, RM-CESU, and UWY formed the Glacier Cultural Resources Management Group (GCRMG) as a forum for planning and communication pertaining to this major project (no formal consultations will be conducted by this group but will be referred to appropriate personnel). The first task for the GCRMG is to create a protocol that sets culturally and scientifically appropriate guidelines for the handling and collection of artifacts in the field, analysis and documentation in the lab, and transportation associated with the Ice Patch Archaeology Project. Curation guidelines will be added later in the project or developed separately. This protocol will serve as an example for future cultural resource projects at GLAC. Further, the protocols and the means used to arrive at them will be widely disseminated to other park units and the CRMG anticipates they will be useful to other park/tribal/researcher partnerships for cultural resources-related projects.

Below are initial protocols agreed-upon by the GCRMG. Note that safety, communication, and backcountry practices are not covered by this protocol. All parties agree that documentation containing locational or highly sensitive cultural information shall be kept in password-protected files, and hardcopies in secure, limited access facilities.

## Field Protocols

All crews shall be accompanied by a supervisor.

Newly discovered items shall be mapped as accurately as possible (preferably with a GPS unit to sub-meter resolution). Items shall be photographed *in situ* and a sketch map created if there are multiple

items or other need to document site structure. A photographic log will document the date, location, compass bearing, photographer, and a brief description of the item.

Because the focus of this project is organic/perishable items, lithics, features, or other non-organics shall be documented and left in place unless the crew supervisor judges that the item is at high risk of loss through theft/collection (e.g., Clovis spearpoint). Documentation shall include GPS location data, photography, and sketch map for GLAC to follow up in subsequent visit.

The following characteristics may indicate an offering: x, y, and z. Discoveries of potential offerings shall be mapped and left in place pending a decision to offer tribal elders an opportunity to view them in place. However, if these items are in immediate danger of looting or other loss, they may be collected after documentation.

Animal scat or other items that are deemed non-cultural will be treated as paleobiological samples and will not require culturally sensitive handling protocols.

Collected cultural items are expected to be very fragile and potentially of high spiritual and/or cultural value. These items shall be handled with care and respect (additional language here?)

For discoveries of items that may be subject to the Native American Graves Protection and Repatriation Act, please follow steps outlined the Memorandum of Agreement (attached).

**Lab/analysis Protocols**

Items shall be kept in secure laboratory spaces.

For cultural items, analysis shall be non-destructive except where approved by the GCRMG. Destructive analysis of cultural items will likely require full tribal consultation; the GCRMG shall determine whether to continue to that point.

For non-cultural paleobiological items, laboratory analysis shall be non-destructive where feasible or minimize the sample to be destroyed. No cultural concerns are noted for these items.

Items shall remain 'under study' status for no longer than three years after the time of recovery unless otherwise specified by the GCRMG.

**Curation Protocols** will be determined by the Cultural Resources Management Group

The GCRMG shall determine the best location for long-term curation of cultural items.

Note: at the end of the project, all non-cultural samples, collections, and copies of records, data, photographs, and other documents resulting from the work will be delivered to the appropriate repository official at GLAC.

**Glossary of Terms** (to be developed)

Hidden Lake 1.

Patch 15.

Patch 20.

Patch 21.

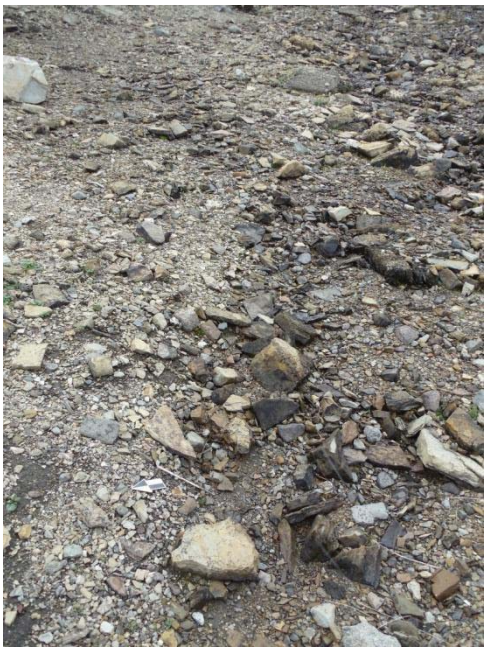
Patch 20A.

Patch 40.

Patch 41.

Patches 38 and 39.

Patch 38A.



Example of in situ photograph. Patch 41, object 5 (lower left, to right of north arrow).