Expansion of an archeological tool; building regional-chronologies of spruce tree growth on the Kuskokwim River, Alaska.

Purpose and relevance to the research focus area: The purpose of this project is to build master and regional spruce tree-ring chronologies (tree ring-width data where a common signal is present) along the Kuskokwim River flood plain. Ultimately, these riparian tree-ring chronologies will be used to help reconstruct historic environmental conditions as well as allow for the cross-dating of wooden remains from western Alaskan archeological sites. An additional goal of this project is to examine the current and historic human use of driftwood in the region in an attempt to model driftwood availability versus use on the Kuskokwim river. Financial support from the Hopkins Fellowship will contribute to funding travel to the Kuskokwim River to extend tree-ring coverage along the river, sample driftwood disks and record additional data related to driftwood transport and its use by people.

Description:

The proposed project is part of ongoing research lead by C. Alix, G. Juday and K. Brewster aimed at understanding human use of driftwood as a resource in the Arctic. The larger study investigates several dimensions of the driftwood cycle in Alaska including cultural value and human use, "production", transport and delivery, and the dating and sourcing of driftwood (Alix 2004, 2005, 2006; Alix and Brewster 2002, 2004, 2005). The combined effort seeks to develop multiple tree-ring chronologies that would enhance the ability of archeologists to date wooden remains from Arctic sites. Researchers must build multiple regional-chronologies from living trees (an expansive archive of tree-ring width measurements from a given system or region) to allow cross-dating of floating chronologies measured from driftwood and archaeological wood. Cross-dating is the tracing of identical time periods from one tree to another by means of comparing ring width patterns. It is based on the tendencies of trees to reflect events that have effected their growth (ie climate variation, disturbance etc) in the thickness of their annual growth rings (Fritts 2001). Variations in ring thickness allow researchers to reconstruct past climates when trees are responsive to climatic variability (i.e. changes in temperature or precipitation) or other environmental variables (like floods, pathogen outbreaks, or late season frost events).

Since two main river systems, the Yukon and the Kuskokwim, contribute the majority of driftwood to the coasts of Alaska and Bering Strait (Giddings 1941, 1952), it is essential to build tree-ring chronologies along each of these rivers. Alix et al are presently establishing master and regional chronologies for white spruce (*Picea glauca*) along the Yukon River and have sampled a small portion of the Kuskokwim River (roughly between Sleetmute and Devil's Elbow). As part of my graduate research, I am analyzing these Kuskokwim tree-ring cores which provide coverage of approximately 23% of the associated riparian forest. In order to provide a more complete picture of tree-ring growth patterns along this major driftwood producing river, it is necessary to increase sampling distribution. This will be accomplished during the 2007 field season by sampling trees and driftwood between Sleetmute and Tuluksak (near treeline) (See Figure 1).

Pioneer dendrochonology work on the Yukon and Kuskokwim rivers (Giddings 1941, Oswalt, 1954) as well as Alix and Juday's ongoing analyses of Yukon River tree-rings indicate the existence of overarching growth patterns as well as regionally specific growth signals in riparian spruce trees. It is not known, however, if the Kuskokwim cores will provide regionally specific signals and if so, how different these signals will be from those found on the Yukon River. It is indeed possible that a signal will be shared between the two river systems resulting in interior Alaskan riparian master chronologies that would not be river specific but rather related to Alaskan ecosystem boundaries. The type of signal present depends upon what climatic or disturbance events are most affecting (causing anomalous ring-widths) spruce growth in this system. I will search for answers to these questions by building tree-ring chronologies along the Kuskokwim River for both white and black spruce (*Picea glauca* and *Picea mariana*). If there are common environmental conditions that are responsible for the different growth patterns in white spruce, I expect that similar signals will be present in black spruce populations as well.

Comparing growth responses in both tree species will help determine if there are common responses to similar conditions (e.g., temperature, precipitation, floods, frost events, etc.), or if certain conditions impact a given species more or less than the other (such as pathogen infestations). This will narrow the search for the underlying impacts of environmental conditions on tree-growth.

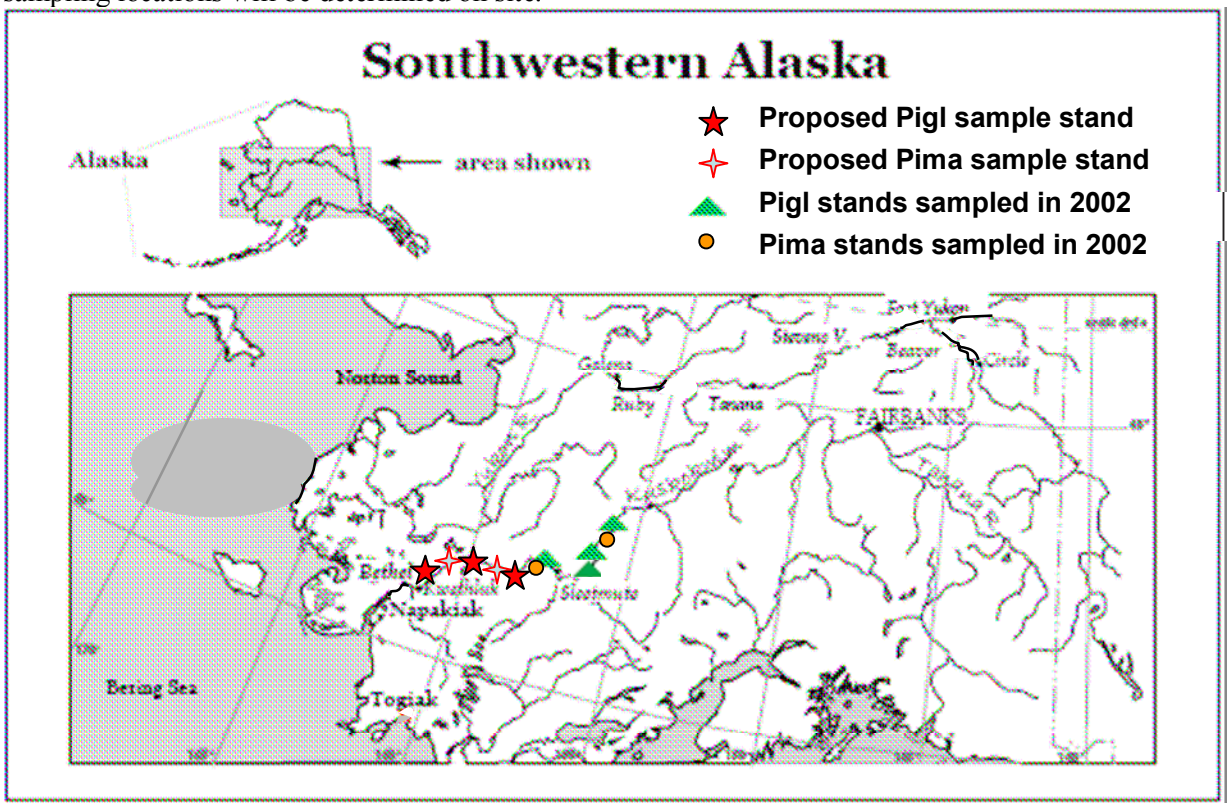
As the ultimate goal of this research is to provide archeologists with a more precise tool for cross-dating wooden artifacts, it is also important to examine how people currently and traditionally have used wood in this region. Traditional ecological knowledge from local residents may also shed light on some of the questions about historic local climate and disturbance events that could be affecting tree growth. I will draw from oral history data collected by Alix and Brewster in 2002 to prepare questions to ask local residents during this summer's field season. My goal is to model the use of driftwood along the Kuskokwim River in relationship to the relative abundance of the resource. I will use data from six individual interviews of people from various villages along the river to help determine the historic and current use of wood, procurement techniques and how wood-use has changed over time. This data will also provide valuable insight on past environmental conditions and disturbance events which I will use to augment or verify known environmental data from nearby stations and compare those results to the tree-ring signals.

Procedures:

Field Sampling: I will sample live spruce stands and driftwood accumulations on the Kuskokwim River between Tuluksak and Sleetmute from July 9th through July 19th, 2007. I will stage in Aniak and travel along the river by boat, selecting five separate sample sites (three white spruce, two black spruce) no less than 25 km apart. Between 17 and 25 trees will be cored at breast height (137cm) on each site to account for individual variance and provide an adequate picture of the mean growth response in each stand. This additional sampling will augment the existing data (four white spruce and two black spruce stands) collected on the Kuskokwim by Alix et al in 2002 to provide data from a total of seven white spruce and four black spruce sites (approximately 187 individual trees sampled). Additionally, I will sample four natural driftwood deposits from the banks of the Kuskokwim, collecting ten quality samples from each site.

Lab procedures/analysis: I will measure the ring-widths from each tree core using a laser micrometer and then examine the emergent patterns of growth. Using collective and site-specific growth patterns, I will build master and regional chronologies. During this process I will use a standard statistical program (COFECHA®) to provide high confidence in year-to-year correspondence of the live tree cores (Fritts 2001, Nash 2002). Next I will compare a variety of environmental data with the tree-ring chronologies looking for high correlation in order to determine which environmental variables are most affecting tree growth. Normalized tree-ring series will be correlated (Pearson) with continuous environmental variables of temperature, precipitation, and river discharge of nearest stations. Correlation coefficients (r) that meet the 95% confidence level (depends on the number of years compared) will be identified. Additionally, I will attempt to cross-date Kuskokwim driftwood samples and trace their regional origin in order to determine the success of applying this technique to a series of Kuskokwim regional-chronologies. Subsequently, I will apply the cross-dating technique to driftwood samples collected along the Alaska coast (Alix 2005) that have so far shown no matches to Yukon / Tanana River regional-chronologies or to the Long Kobuk Tree Ring Chronology available on the tree ring databank (Giddings 1952; Graumlich and King 1997). I will transcribe the interviews from 2002 and use the relevant data along with observations from the 2007 field research to model driftwood use along the river. I will also identify and compare observed local climate conditions to ones gathered from weather stations to help determine how regional conditions impact growth signals. The analysis of this research will be documented and included in a master's thesis and dissertation in May, 2008. Tree-ring widths and associated data will be made available to the public through the Bonanza Creek Long Term Ecological Research (BNZ-LTER) network as well as the International Tree-Ring Data Bank. Interviews will be archived in the Rasmussen Library at UAF. This data will contribute to the growing collection of Alaskan riparian ring-width data, allowing for more successful cross-dating in the future.

Figure 1. Existing and proposed sampling locations on the Kuskokwim River. White Spruce (*Picea glauca*) is abbreviated Pigl. Black Spruce (*Picea mariana*) is abbreviated Pima. 4 Pigl stands and 2 Pima stands were sampled in 2002 (Alix and Brewster, 2002). I propose to sample an additional 3 Pigl and 2 Pima stands. Proposed locations are estimated to display distances between stands. Precise sampling locations will be determined on site.



Please include an itemized budget and budget justification being as detailed as possible:			
Description	**Amount**	**Source of Funding**	
Airfare (Roundtrip from Fairbanks to Aniak)	$532.00	Geist Fund	
Guide Services (Including boat/equipment rental and fuel)	$4,400.00	Geist Fund	($958)
		Wood Products Grant*	($1,942)
		Hopkins Fellowship*	**($1,500)**
Supplies (lab and field equipment)	$75.00	Geist Fund	
Provisions (Food and water)	$175.00	Geist Fund	
Amount requested from AQC (max $1500)	**$1,500**		
TOTAL Project:	**$5,140**		

*Funds pending approval

Budget Justification:
I am requesting $1,500 from the David and Rachel Hopkins Fellowship to offset the cost of hiring a guide. Costs are described below.

- Airfare for one round trip ticket from Fairbanks to Aniak ($532).

-In order to most safely and efficiently collect tree-cores, driftwood and personal interviews it is necessary to travel along the river with an experienced guide who is familiar with the river, the forest and the local communities. Cost of guided services from LaMont Albertson of Aniak is $550 per day (total of $4,400 for eight days). The guide services include boat rental, experienced boat operator and data collection assistant, additional equipment use (chainsaw, safety and camping equipment) and fuel (~$5.00/gallon). This price per day reflects rates of boat rental in the region.

-Supplies include $75 for sandpaper, coremounts (necessary for core preparation), shipping tubes, chainsaw blades, and batteries for camera and GPS.

-Provisions or food is estimated at $17.50 per day for 10 days.

Other fund sources: My salary for the field season will be paid for through funding from the Integrative Graduate Education and Research Traineeship (IGERT) sponsored by the National Science Foundation (NSF). I have been awarded $1,740 from the Geist Fund which will pay for airfare, supplies, provisions and a portion of the total cost for a guide. I have requested $1,942 from the Alaska Wood Products Grant to cover the remaining cost of guide services.

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