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Team Building on Dangerous Ice: A Study in Collaborative Learning

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This paper describes how a team of local river travelers and academic researchers documented the shifting ice conditions on an interior Alaskan river, learned from each other and from shared experiences on the ice, and created products that represented this learning.

From 2004 to 2012, with funding from the National Science Foundation and led by Knut Kielland and William Schneider, the Dangerous Ice Project investigated winter ice conditions on the Tanana River in Interior Alaska. Like other rivers in Interior Alaska, the Tanana River exhibits changing winter ice conditions, from overflow to thinning ice and open leads. Travelers who get caught in these situations can be in trouble, ranging from the inconvenience of getting out of overflow to suffering the effects of exposure, or in the worst cases, drowning or freezing to death. The Tanana River and the sections chosen for intensive study were selected because we knew from personal experience that they were unpredictable and dangerous, and we wanted to understand them better.

To accomplish this, we fostered a partnership between academics (social and natural scientists) and local river travelers and built a broad framework for interpreting natural phenomena and human understanding derived from a variety of perspectives. We use the term "local river travelers" to refer to members of the research team whose primary orientation and expertise comes from years of traveling in summer and winter on the river in the course of activities important to their culture and lifestyle. We also use the term "local knowledge," but note similar terms such as "traditional knowledge" and "indigenous knowledge" because they all emphasize the theme of community-based knowledge of conditions and transmission of this information to community members over generations (Usher, 2000; Cruikshank, 2005; Ellis, 2005; Huntington, 2005; Bell and Harwood, 2012).

Many of the scientific principles we chose to investigate came from questions raised by local river travelers (e.g., How can there be open water at sub-zero temperatures?) Questions of mutual interest to all team members provided a basis for cross-cultural and cross-disciplinary exchange of ideas and information. Shared experiences over many seasons, application of scientific principles, as well as group discussions and critiques of presentations, refined and reinforced learning across knowledge systems.

BACKGROUND

Because the road system in Interior Alaska is very limited (and often non-existent), the frozen rivers, lakes, and snow-covered backcountry become temporary winter highways. Subsistence activities related to hunting, trapping, woodcutting, and traveling to other communities or to the road system typically entail travel on some sections of river ice. Activities associated with resource extraction, such as logging and mining, often rely on river travel for the transport of equipment and the temporary construction of roads. The rivers are also used by the general public for winter recreation.

Fall freeze-up and spring breakup pose particular problems for travelers since ice stability varies greatly at these times. Seasoned travelers recognize that the Tanana River is subject to sudden changes that create unsafe ice conditions, but much of the general public does not recognize the danger signs. Drowning is a major cause of death in Alaska, and a fatality in the community of Tanana during the study period was a poignant reminder of this fact (Klint, 2012). The Dangerous Ice Project developed out of both this recognition of how dangerous the river is and the realization that this subject lent itself to the expertise of both local river travelers and scientists.

PROJECT DESIGN

Project implementation included identification of segments of the Tanana River for study, recruitment of river experts and scientists, and winter fieldwork to document and discuss ice conditions (Fig. 1). The stretches were chosen because they are the most heavily used travel routes and therefore most important to people living and working on the river.

The Tanana River flows by Fairbanks, Alaska's second-largest city, and is a popular winter recreation area for snowmachiners, dog teams, skiers, and walkers. A few subsistence users also travel this corridor. Many of these users, especially those new to the area, have little experience with or common knowledge of winter ice travel, nor do they necessarily know whom to ask for information and advice. This section of the river contains many areas of

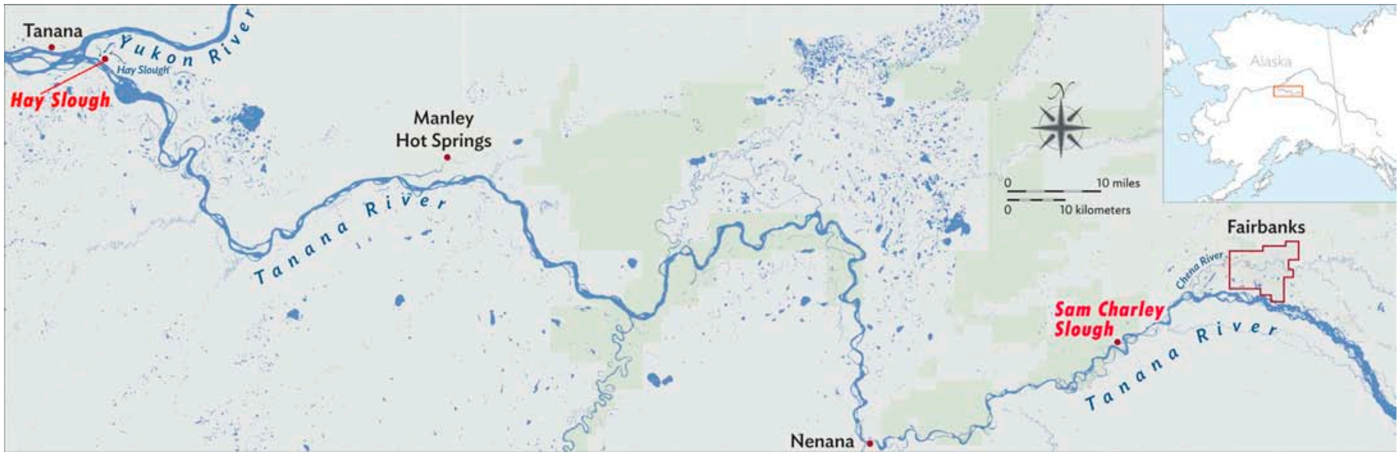

FIG. 1. Map of the Tanana River from Fairbanks to Tanana, Alaska. Map by Dixon Jones.

groundwater upwelling that contribute to thin ice or open water.

The section of the Tanana River between Manley Hot Springs and Tanana is traveled by residents of both villages for subsistence and visiting between communities, and by those in Tanana as a way to reach the road system that ends in Manley Hot Springs. For these villagers, transportation and subsistence are the major reasons for river travel as opposed to the more recreational uses in Fairbanks. Unlike Fairbanks, Tanana has a community of people with a history of knowledge of the river ice conditions. Unfortunately, there is also a tragic history of accidents on the ice, some leading to death.

Collectively, team members represented a broad knowledge base gathered through year-long travel for hunting, fishing, wood gathering, barging, and scientific fieldwork. The teams for each segment consisted of scientists, oral historians, and local river experts. The local experts were chosen for their knowledge of and experience with specific parts of the Tanana River. Many of them were Native Alaskan Athabascans, who brought generations of experience in the country.

CONDUCTING THE RESEARCH

The field research typically began with local river travelers identifying areas of dangerous ice conditions. In the course of their winter activities, these travelers were in a good position to observe a variety of river conditions. This approach meant they took us to places where they went in the course of subsistence activities, as well as to places that they had heard about from others in their communities (as in “this is the place Junior Moses went through the ice”). The usual approach was to plan a day trip with five to eight participants traveling by snowmachine. The local river travelers decided when and where we stopped to examine salient ice conditions or to re-check sites we had visited before. Once at the location, we made a GPS record and set up the video camera to record the discussion (Fig. 2). Photographs were also taken at each site.

Site descriptions often included mention of possible contributing factors that influenced the compromised ice (such as changes in air temperature or water level, or the presence of wind-blown silt or overflow) and more detailed descriptions of hydrological processes (such as upwelling or erosion).

The videotapes were digitized, and pertinent audio and video clips of the discussions at each location were placed on the Dangerous Ice Project Jukebox website, along with photographs of features (www.jukebox.uaf.edu/dangerice). The accumulation of site recordings and revisits during any particular year and over the course of the eight-year project produced an extensive archive of information keyed to date, location, and conditions at the time of the visits.

The recordings reflect what we learned about ice, but also reveal the range of contributions made by team members commenting at each site. Safety considerations and subsistence activities were often the way people talked about how they learned about ice and how they stay safe as they go about living in the country.

In our original project design, we had thought the website would serve much like a lighthouse, warning travelers of the specific locations of dangerous ice. In some cases this is possible, but unfortunately the river has proven too variable for many generalizations. For example, a section of river might remain “problematic” during several weeks in mid-winter, but then would freeze up and be considered perfectly safe the rest of the year and even in subsequent years. Shifting currents and river channel configurations, upwelling rates, weather, and snowfall are some of the variables that influence the dynamic nature of the river ice cover.

The continually changing conditions were a clue to us that we needed to try to summarize and illustrate general phenomena that we had seen over the course of the project. The website record provided images and descriptions that we could use to illustrate the conditions. A booklet, *On*

FIG. 2. Karen Brewster videotaping Sam Demientieff in Yukon Slough on the Tanana River, with Neil Scannell looking on, 23 March 2011. Photo by Knut Kielland.

FIG. 3. Open water in Sam Charley Slough at –35˚C, 2 February 2006. Photo by Karen Brewster.

Dangerous Ice: Changing Ice Conditions on the Tanana River (Schneider et al., 2013), proved the better venue to highlight these findings. The booklet emerged out of local river travelers' desire for a product emphasizing safety tips for the general public. It evolved from there to include recognition of dangerous conditions, and when possible, explanations of scientific principles at work. Reviewing drafts of the booklet together helped to refine descriptions and raise new questions. Eight years of field trips together had created a common base of experience upon which to draw. The booklet also has been a solid first step by all team members to report meaningful results back to the communities where we worked. An electronic copy of the booklet is available for anyone to access on the Dangerous Ice Project Jukebox website (www.jukebox.uaf.edu/dangerice).

CROSS-TEAM LEARNING

Talking about shared experiences, generalizing about types of ice conditions, and linking scientific principles to observed conditions reinforced the group's understanding and fostered what we are calling "cross-team learning." This led to further appreciation of each other's contributions to the project, and in some notable ways demonstrated how different approaches were informing, expanding, and reinforcing each of our understandings of the ice. As we explored how to present information, we wanted to avoid the trap of distilling it into a narrow analytic framework that could distort the variety of ways our participants learn about and know the ice conditions (Cruikshank, 1998; Nadasdy, 1999; Ellis, 2005). We were looking for ways that information was shared, considered, and incorporated into each other's thinking about ice.

For example, local river traveler Sam Demientieff often talked about a phenomenon he called, "low flow erosion," in which water flowing under the ice undercuts a riverbank even at low water levels. When trying to explain this in brief text for the booklet (Schneider et al., 2013:17), Schneider and Brewster struggled with how to depict accurately the phenomenon Demientieff was describing. This led to multiple conversations with Demientieff asking for clarification. The repeated discussions among the three finally led to our understanding and solidified learning.

Another example of this cross-team learning focused on frequency of open stretches of water even when the air temperature was very cold (e.g., −35˚C) (Fig. 3). During a field excursion to Sam Charley Slough, notorious for poor ice conditions, we posited that upwelling of groundwater could erode the ice from below, creating an open area. Geophysicist Martin Jeffries and ecologist Knut Kielland explained how a low water level would facilitate upwelling of warm water that would erode the ice before its heat was dissipated. Subsequent measurements of upwelling rates and groundwater temperatures revealed the validity of the phenomenon (Jones et al., 2012, 2013). The principle of heat transfer through different substrates (water, ice, and snow) helped us to understand this site, and the principle became something the whole team learned to recognize at other locations.

A further example of this mixing of science and local knowledge related to the frequently heard adage "stick to the traveled trail," which led to an experiment to measure ice thickness at various distances from established trails. As expected, the ice under compacted snow on a trail was much thicker than the ice next to the trail covered by undisturbed, fluffy snow, because packed snow has a greater density and conducts heat more readily from the water below. This condition favors ice growth but can be reversed by a new snowfall. The science behind this phenomenon is well documented (for example, in ice road construction; Sturm et al., 1997), but the application of this principle to a locally important condition made the science personally relevant to our team members. This relevance was demonstrated poignantly by Charlie Campbell, from the village of Tanana, when he remarked how the principle helped explain his experience crossing Banddana Creek in late spring on the Tanana-Allakaket Trail: "The trail held us up, as long as we stayed centered on it. If we strayed from the center line, we would start to get that sinking feeling, even though the surface to the side appeared to be at the same height as the packed part of the trail" (pers. comm. 2013). This example neatly illustrates the synergy that developed between team members incorporating science and local experience.

Another example of cross-team learning came from team members' observations of river changes throughout all seasons. They observed that processes at work in one season will impact conditions in the next. Early in the project, Demientieff, who also frequently travels by boat on the Tanana River in the summer, speculated that an ice jam at breakup a few years before had redirected the Tanana River's main channel and influenced ice conditions the next winter downriver at Chena Bluff, where a sizable hole emerged. This prompted biologist and fellow summer boater, Dave Norton, to research historic aerial photographs, satellite imagery, topographic maps, and more recent Google Earth images to show the evolution of changes to the river and conclude that the ice jam was only one of a number of culminating factors that led to a shift in the Tanana River channel. Together, Demientieff and Norton provided an explanation of how human activities and natural forces combined to create the current condition. They linked experience, research, and seasonal observations to explain the changes, demonstrating again the value of cross-team learning. (For imagery and discussion by Demientieff and Norton see: http://jukebox.uaf.edu/site7/tanana-and-chena-river-channel-changes-slideshow.)

APPROPRIATE COLLABORATION OF LOCAL AND SCIENTIFIC KNOWLEDGE

We began with the premise that local river travelers were in the best position to identify and locate dangerous ice and that they should guide investigators to these places. We emphasize that this approach is not unique (Huntington et al., 2009, 2010; Druckenmiller et al., 2010; Gearheard et al., 2010, 2013), but neither is it common, and it demands that the scientists orient their research to local team members' needs and questions and respond to the local data set developed. The results are highly relevant information about localized areas, and in our case, rich descriptions of the ice dynamics that people live and work with each winter.

A team approach involving scientists and locally knowledgeable community members working together can produce contributions that extend beyond what they might have produced alone. Two key ingredients are a personal investment in the research and a recognizable contribution and connection to the findings of the project from all team members. Successful collaboration also demands a positive working relationship between team members to help ensure that the work proceeds during stressful times in the field. The Dangerous Ice Project team members worked on equal footing and saw benefits from each other's approaches and knowledge.

WAYS OF SHARING KNOWLEDGE

Beyond finding ways to collaborate, it is important to find ways to share information at each step of the research from design to implementation to analysis to final products. On the ice, scanning upstream and downstream, each team member was taking in far more than could be captured in a photograph or video, and the conditions prompted discussion of what people were seeing at the time and had seen on earlier visits to the site. Follow-up discussions on shore were then based on common experiences from our time out together. The work of describing conditions and safety tips for the booklet provided yet another setting for refining and building on what had been seen and discussed together on the ice. The "common basis of experience" (Huntington et al., 2011:438) was an essential factor that facilitated learning from each other.

Beyond the now mandatory requirement to share research results with all communities where research is undertaken, there is an implicit responsibility to ensure that the results are presented in a form that is understandable and relevant to local audiences. A significant challenge in all collaborative projects is to find areas of common interest where knowledge can be shared and then to design appropriate formats to return information to the community (Wenzel, 1999; Huntington et al., 2011).

To this end, the Dangerous Ice research team created the *On Dangerous Ice* booklet for a general audience and the Dangerous Ice Project Jukebox website, gave a public presentation entitled "On Dangerous Ice: Rules for Navigating River Ice" (5 February 2014), and facilitated the publication of two newspaper articles that featured the work (Rozell, 2010; Mowry, 2013). We believe that the project successfully addressed the challenge of incorporating multiple ways of knowing without compromising them.

EVALUATION

The scientific results of the Dangerous Ice Project are highly significant for local community members because they provide explanations for what people observe and know from experience and they have practical application (Crate and Fedorov, 2013). However, since we focused our field investigations primarily on issues identified by local river travelers, as opposed to posing a question that science has not answered, the research results are less "new" in terms of discovering general principles (see Pinder and Jones, 1969; Sturm et al., 1997).

Throughout the project, we said that the most important measure of success would be whether the information improved safety. We do not have direct evidence of this, however the *On Dangerous Ice* booklet was so popular with the public that we quickly ran out of the 500 copies we had printed and distributed for free. As described, we do have indications that there was transference of observational knowledge and understanding of scientific principles of ice dynamics. We consider this cross-team learning a success.

CONCLUSION

Although a large number of studies have used local knowledge, particularly in light of climate change, the recent International Polar Year (IPY), and federal mandates to include indigenous populations in research (Interagency Social Science Task Force, 1984; NSF and BASC, 2004), it remains critical to broaden the context for studying collaboration to give investigators a richer base to draw on in assessing opportunities for their particular projects. Collaboration is an ongoing "negotiated" process, with many intervening variables (Korsmo and Graham, 2002). These include community concerns, local expertise, logistics, financial remuneration, social interaction, history of and relationships with project team members, cultural protocols, and scientific interests. But, all these considerations aside, collaboration is basically a relationship, not a checklist. It requires sensitivity at each step of the project (Roburn et al., 2012). Therefore, the more extensive the exposure to the range of studies, to issues faced by team members, and to their responses and the nature of their rapport, the better the chance of modeling ways to achieve local collaboration and cross-team learning. The Dangerous Ice Project provides an example of how our team navigated a collaborative research project of mutual interest to all participants and how we learned from each other.

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