# Qualitative Participatory Mapping of Seal and Walrus Harvest and Habitat Areas:
## Documenting Indigenous Knowledge, Preserving Local Values, and Discouraging Map Misuse

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## ABSTRACT

*In the Bering Strait region of Alaska decreasing sea ice and increasing development are driving environmental and policy changes that significantly impact federally recognized tribes, which depend on marine resources for cultural, economic, and nutritional reasons. Kawerak, Inc., an Alaska Native non-profit tribal consortium, conducted participatory ice seal and walrus harvest and habitat mapping in collaboration with nine of the region's federally recognized tribes. Participants were concerned that maps could misrepresent marine mammal mobility, limit future harvest area flexibility, increase outside regulation of harvest activities, generate conflict between communities, and attract commercial activity. This paper addresses these concerns through a technique called qualitative participatory mapping, which preserves local voices and priorities. This technique helped communicate and convey respect for traditional knowledge while lowering the probability of map misuse or misinterpretation. This work evaluated project results in terms of Elwood's dimensions of empowerment, which indicated the largest gain in capacity building, and more moderate gains for procedural and distributional empowerment.*

*Keywords:* *Alaska Native, Bering Strait, Climate Change, Community-Based Natural Resource Management, Indigenous, Marine Mammals, Participatory Mapping, Qualitative Methods, Traditional Knowledge*

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# INTRODUCTION

## Mapping as a Tool to Incorporate Resource-Dependent Communities into Management

In the Bering Strait region, Indigenous tribes defend their traditional ways of life, including hunting and fishing over extensive terrestrial and marine areas. As in other places, technocratic government resource management and increasingly powerful commercial interests make this an ongoing struggle. Technocratic policy making promotes expert-based decision-making, and communities have limited influence. The technocratic model does not recognize local expertise, the role of values in policy-making, or the extent of scientific uncertainty (Fiorino, 1990; Lane, 2005). Although a considerable body of scholarship describes the value of Indigenous knowledge (e.g. Berkes, 1987; Menzies, 2006; Ray et al., 2012), as well as the importance of community participation in resource management (e.g. Tsing, Brosius, & Zerner, 2005; Western & Wright, 1994) in Alaska, Indigenous resource users regularly have their knowledge dismissed as anecdotal. As such, many tribal organizations are now documenting traditional knowledge and use with scientifically recognized methods such as GIS mapping.

Participatory GIS (PPGIS) aims to empower communities, incorporate diverse participants, build management skills, and transfer power to non-elite resource users (Parker, 2006; Sieber, 2006). GIS skill transfer can lower the digital divide, enabling more people to produce and use data (Kwaku Kyem, 2004). Communities can use GIS projects to document and legitimize their existing knowledge, develop and answer their own management questions, and generate locally useful information. GIS use helps communities present their knowledge using the language of science, which is respected by funders and policy-makers (Elwood, 2002; Ghose, 2001). Maps can transform resource management perceptions and drive decision-making processes, and Indigenous communities have successfully used mapping to claim land and to achieve self-governance (Sieber, 2006; Tobias, 2009; Wainright & Bryan, 2009). Maps are also visually engaging and accessible to community members of diverse backgrounds (Ghose, 2001).

PPGIS critics have argued that as marginalized communities need decision-making power, they should advocate for more inclusive policy-making, rather than producing maps for existing technocratic processes (Sieber, 2006). Empowerment depends upon changes in power relations, and some worry that defending community views in technical language may imply that local knowledge and values are inferior (Ghose, 2001; Kwaku Kyem, 2004). Many types of local knowledge cannot be represented spatially, and may end up excluded from GIS-driven decision-making processes (Elwood, 2002). Additionally, as GIS software is expensive and technical, it may be unsustainable, require considerable outside assistance, promote top-down planning, and exclude many community members from decision-making at the local level (Kwaku Kyem, 2004; Wainright & Bryan, 2009).

In addition to concerns about GIS's technical nature, there are also concerns about the representational capacity of maps. Fox (2002) notes that maps are static and reductionist representations that may be incompatible with the complex and dynamic nature of local resource knowledge, may transform community environmental perceptions, and may reify dynamic resource use. Additionally, mapping for land claims generally presents Indigenous land use organized around Western style property rights, which can lead to conflicts within or between communities, cause privatization of collective land, and complicate traditional use patterns (Fox, 2002; Wainright & Bryan, 2009). Dividing territory is a political act that frequently conflicts with Indigenous approaches to land use and community relations (Wainright & Bryan, 2009). Finally, mapping makes sensitive information, about resource distribution and resource use, visible, which can increase outside

commercial interest or government regulation (Fox, 2002; Wainright & Bryan, 2009).

When Kawerak, Inc., the Alaska Native non-profit tribal consortium for the Bering Strait region, initiated a mapping project to defend Bering Strait Indigenous marine use from expanding industrial activities, many seal and walrus hunters shared the concerns described above. In order to address these concerns as well as the impending marine development, we created a strategy for qualitative participatory mapping. In this case study we describe, in detail, our approach to qualitative participatory mapping. We then evaluate the results in terms of the PPGIS literature.

## The Need for Indigenous Mapping in the Bering Strait Region

Climate change is significantly affecting the Bering Strait region as well as the greater Arctic (Solomon, 2007). Indigenous residents and Western scientists alike have noted dramatic declines in the quality and quantity of Arctic and sub-Arctic sea ice (e.g. Krupnik, Aporta, Gearhead, Laidler, & Kielson Holm, 2010; Kwok et al., 2009; Metcalf & Krupnik, 2003; Stroeve et al., 2008). Decreases in summer sea ice cover have led to dramatic increases in ship traffic and development in the Arctic (ACIA, 2004). For example, while only 4 ships transited Russia's Northern Sea Route in 2010, 71 ships transited in 2013 (Lavelle, 2013). Between 2008 and 2012, traffic through the Bering Strait more than doubled, and multiple companies are moving forward with plans to extract the extensive oil and gas reserves in Arctic waters that are just becoming accessible (National Geographic, 2013). Ice loss and increasing industrial activities may threaten the massive ice seal and walrus migrations that pass through the Bering Strait annually. Ice seals and walruses have been important foods for local Indigenous communities in both traditional and contemporary times (Ahmasuk, Trigg, Magdanz, & Robbins, 2008; Marine Mammal Commission, 2009). Marine mammals not only provide food security, they are culturally preferred, healthy foods, and harvesting and preparing marine mammal foods is a source of identity and an important family activity (Gadamus, 2013).

Non-local policymakers have responded to ice loss and resulting development with risk assessments, research and policy proposals, and Endangered Species Act (ESA) listings or listing considerations for walruses and all four species of ice seals (e.g. ACIA, 2004; Murray et al., 2012; National Marine Fisheries Service, 2010, 2012a, 2012b, 2013; U.S. Fish and Wildlife Service, 2011). Several policy processes incorporate mapped data, including a U.S. Coast Guard study of vessel routing through the Bering Strait (U.S. Coast Guard, 2010) and movements by conservation groups to identify important marine areas, including marine mammal habitat (e.g. Ayers et al., 2010; Laughlin, Speer, & Brigham, 2012; McConnell, Brigham, Laughlin, & Speer, 2013).

Environmental changes, accelerating industrial activities, and Arctic policy proposals generated outside of the region have alarmed many Indigenous Bering Strait region residents. Kawerak's Ice Seal and Walrus Project (ISWP) was developed in response to these concerns, in order to produce maps and data to support informed, defensible local engagement in policy processes. In the following section, we describe our mapping process in detail, with a special focus on the choices we faced and how we used local values to drive research decision-making.

# PROJECT OVERVIEW

Kawerak, Inc. works with 20 federally recognized tribes to provide various services, including research activities and policy advocacy. Kawerak has research staff that design and conduct projects, such as ISWP, through the Social Science Program of our Natural Resources Division. ISWP's overall goal is to document traditional knowledge of ice seals and walruses, including subsistence use and habitat areas and the cultural importance of these species, so that tribes and Kawerak have the information needed to design and promote

*Figure 1. Participating communities*


policy recommendations that protect these species and Indigenous use of them.

Nine tribes in the region participated in the ISWP, based on a combination of geographical location (a distribution across the region) and Tribal Council interest in participating (Figure 1). All nine participating tribes passed formal resolutions supporting the project. Kawerak works through Tribal Councils because it recognizes their authority in matters of culture, tradition, and subsistence. The Ice Seal Committee, Eskimo Walrus Commission, and the conservation group Oceana were also project partners.

## METHODS

Our approach, qualitative participatory mapping, aims to develop locally-relevant information that can support tribal policy making. As mapping can be problematic for some, community concerns are sought out and addressed from the beginning of the process (Table 1).

As many organizations do not understand qualitative or participatory methods, we describe in detail how community input drove ISWP research. We start by describing the participatory method we used to document and address community concerns, tailor habitat documentation to traditional knowledge, and add topics of local interest. We then discuss our sampling scheme, the development and implementation of interviews and focus groups, and our qualitative coding strategy. We describe spatial data collection, strategies to ensure project defensibility, and our participant review process.

### Participatory Research Design

Participatory research design visits were held in 7 of the 9 participating communities in order to meet with tribal governments (Tribal Councils) and hold community meetings. During the de-

*Table 1. Steps in qualitative participatory mapping*

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|---|
| 1. Document and address local concerns about mapping through participatory research design |
| 2. Focus on local, rather than outside, information needs |
| 3. Use qualitative methods and a purposive sample of experts to more accurately document and convey traditional knowledge and local values |
| 4. Follow an iterative process that includes participant and tribal map review |
| 5. Engage policy-makers and to promote maps use as a component of, not a substitute for, community participation in decision-making |
| 6. Complement, rather than replace, advocacy |

sign phase of the project, one community was inaccessible due to transportation issues, and in the other, the Tribal Council was unavailable to meet. The project was also presented for input to project partners the Ice Seal Committee and the Eskimo Walrus Commission. All meetings included a presentation describing project basics, specific questions on research design (for example, "What kind of traditional knowledge do you want us to document?" "What would you like us to map?"), and an open discussion on community concerns related to the project and to ice seals and walruses. Copies of draft topics generated by project staff were given to participants for feedback. Notes from community and Tribal Council meetings were coded in Atlas.ti and analyzed in order to help develop the final research topics (Table 2).

## Concerns

*It's hard to map hunting areas because they change. As animals move, so do hunting areas. Ice, weather, and human activity can all affect hunting areas. –Savoonga participant*

During participatory research design, some community members expressed concerns about the mapping project (Table 3). Many worried that the static nature of maps could misrepresent fluid habitat and subsistence use areas, or inspire inflexible regulations. Marine mammals are extremely mobile, migrating thousands of miles annually, and marine mammal distributions can vary dramatically from year-to-year, depending on ice conditions, wind, currents, tides, and human-generated noises. Correspondingly, subsistence use areas change with marine mammal distributions, as well as ice

*Table 2. General interview topics developed through participatory research design*

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|---|
| • Seal and walrus subsistence use areas (lifetime)<br>• Seal and walrus habitat: specific areas and general characteristics<br>• Important ecological areas<br>• Seal and walrus population size and health<br>• Seal and walrus seasonality, migration, behavior, feeding, and other traditional knowledge<br>• Environmental changes and their effects on seals, walruses, and hunters<br>• Environmental conditions affecting seal and walrus hunting: ice, wind, weather, currents<br>• Traditional methods of respect while hunting, methods for avoiding loss, sharing<br>• Community management ideas<br>• Safety for marine mammal hunters<br>• Community concerns: disturbance, pollution, regulations<br>• The importance of seal and walrus hunting<br>• Seal and walrus related policy suggestions |

*Table 3. Mapping concerns and solutions*

| Concern | ISWP Solution |
|---|---|
| Marine mammal subsistence harvest areas are variable. Use areas are extensive and flexible. Communities fear maps may limit future harvest flexibility. | Document lifetime use without separating out shorter time periods. Document subsistence user narratives to provide context for maps. Advocate for local representation in decision-making. |
| Static maps misrepresent marine mammal mobility. | Map by season. Describe variability through qualitative interviews. Use blurred map boundaries to indicate variability. Accompany public maps with traditional knowledge narrative. |
| Maps may increase regulation by drawing attention to subsistence uses. | Document local management traditions. Advocate for local representation in decision-making. |
| Maps may attract commercial interest to marine hotspots. | Participant review to "scale-up" public maps and obscure the exact location of hotspots. |
| Mapping overlapping use areas may generate inter-village conflict. | Aggregate data from all communities for the most public maps. Participants can remove sensitive areas from public maps during review. |
| Mapped data may be used by policy-makers as a substitute for community participation. | Advocate for local representation in decision-making and promote maps for community, rather than outside, use. |

conditions, boat technology, and fuel prices. Participants also wanted to ensure that maps were not interpreted out of context, or used as a substitute for community participation in environmental decision-making.

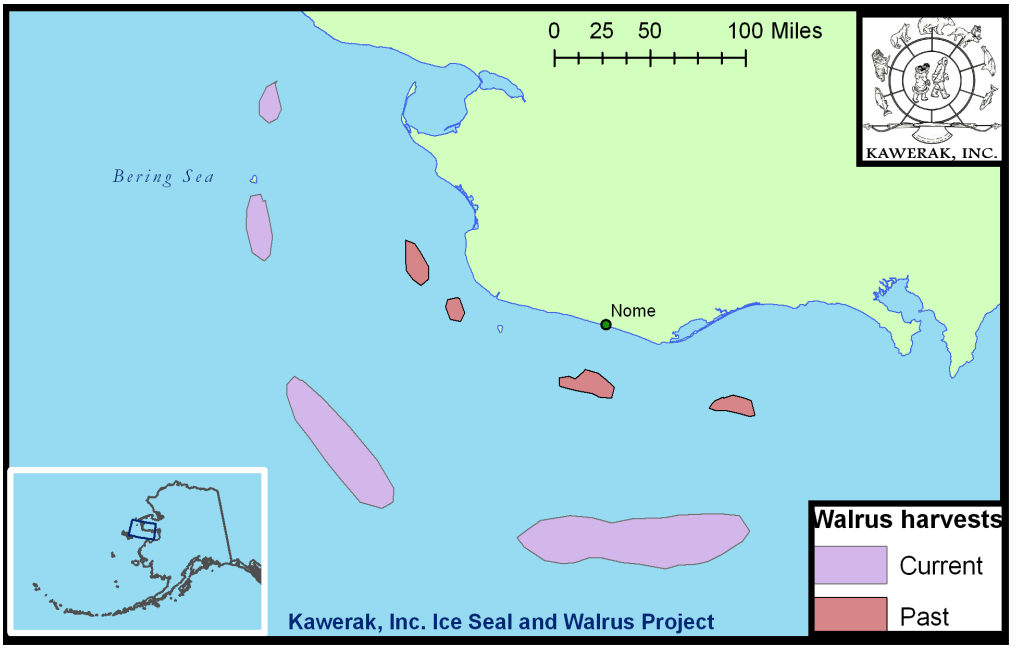
Although participants raised important concerns about mapping, many tribes realized that not mapping and not engaging policy decisions is also risky, as existing use patterns might be completely ignored in policy making and industrialization might proceed unfettered. As noted by Fox (2002) "you are either on the map or you run the risk of being gnawed away. It is not possible to protect an unmapped area" (p. 74). As such, there was still strong participant and tribal support for mapping. By documenting tribal concerns early we were able to devise steps to address these concerns and ensure the project reflected community goals (Table 3).

## Tailoring Habitat and Harvest Documentation to Traditional Knowledge and Local Values

Draft habitat questions mostly directed participants to draw areas on the map: feeding areas, breeding areas, calving areas, and pupping areas. During the participatory design phase, community and tribal council members discussed important habitat features that the research team had not considered in depth: prey, disturbance, and ice conditions. They also discussed variability and change in marine mammal distributions and environmental conditions, as well as concerns that recent ESA listing processes did not consider direct observation of seals and walruses or their historical behaviors. To incorporate this input, we developed questions on marine mammal feeding habits, responses to various kinds of disturbance, responses to changing ice conditions, and historical behaviors such as large walrus haul outs in unexpected places. We decided to map habitat by season, in order to convey the variability and movement that occurs as seasons change.

We also designed harvest mapping around participant input. A recent trend in Alaska is to separate harvest areas by time periods. For example, by distinguishing between lifetime use, which can cover very large areas, and use in the past year or ten years, which may be less extensive (e.g. Braund & Associates, 2010). Another trend is to map subsistence use intensivity, which ranks use, generally by the number of interviewees using any given area (Tobias, 2009), in the hopes that distinguishing different

*Figure 2. Map showing an example of how one hunter's distance to walrus harvest areas is increasing over time due to deteriorating ice conditions*




classes of use will make maps more relevant to policy-makers (e.g. Braund & Associates, 2010; Smith, Gofman, Kliskey, Alessa, & Woelber, 2012). After collecting participant feedback, we decided to map lifetime use areas, and not sort out use at shorter increments. Additionally, we decided to map seal and walrus harvest extensivity (Tobias, 2009), or total extent of use, without adding measures of intensivity. There were two main reasons for the decision to map lifetime use: 1) participants indicated that marine subsistence was variable and use areas were increasing, rather than decreasing, over time due to deteriorating ice conditions, increasing human disturbance, and improved boat motors (Figure 2); and 2) participants were concerned about the response burden of making people map multiple versions of their harvest areas, especially given project goals of documenting traditional knowledge narratives on topics of local and academic interest. Overall, participants worried that isolating a few years of harvest would under-represent the extensive areas used for subsistence, an issue noted in other Indigenous communities (e.g. Brody, 1981). As such, we asked participants to map all the areas where they had harvested seals and walruses over their lifetimes, and then asked if any of these areas were now unused. We mapped harvest extensivity rather than intensivity because participants noted that all areas used for harvest were important, and most felt uncomfortable attempting to rank these areas. While some areas may be used less frequently, harvests from those locations are a crucial part of community well-being. Marine mammal distributions vary annually, as well as daily during the hunting season, and hunters may end up in very different areas depending on when they go hunting, the ice and weather conditions, and the condition of the boat and crew. Separate maps were created for each season, in order to convey seasonal subsistence patterns.

## Adding Topics of Local Interest

During the participatory design phase, elders repeatedly requested we document marine mammal hunting safety. In springtime, hunters in small boats travel dozens of miles through moving ice, in highly variable environmental conditions, to harvest seals and walruses. Elders worried that many young hunters do not have the experience needed to stay safe because of commitments to school or other reasons. As such, they requested we document traditional knowledge of safety from our expert project participants, and distribute it to young people. After pilot testing, we developed questions on a variety of topics: preparing to go out hunting, predicting bad weather, aggressive animals, and dangerous ice, currents, tides, and wind.

Elders also requested we document traditional forms of respect for marine mammals. Traditionally, a complex system of beliefs dictated human-animal relationships. Today, older traditions mix with more contemporary strategies derived from personal values and other sources such as Western religions. Elders were interested in documenting traditional and modern forms of respect for two reasons: 1) to articulate local management traditions to non-local managers; and 2) to ensure that traditional values are passed on to youth, including those who might not learn them at home. Preliminary discussions led to a series of questions on cultural traditions of respect, taboos, reciprocity, and methods for avoiding waste.

## Sample

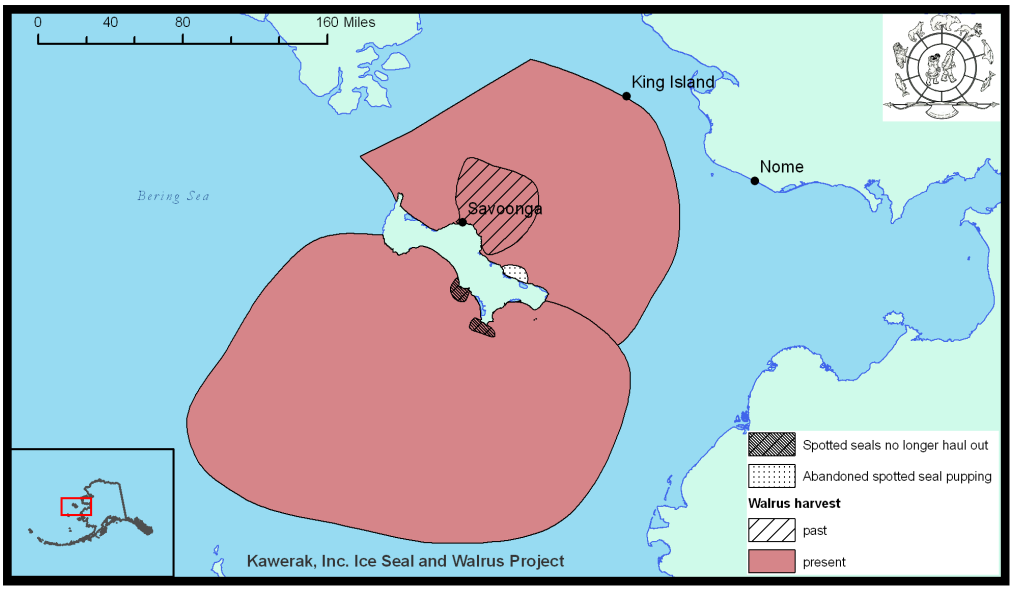
Traditional knowledge research requires the use of purposive samples, as traditional knowledge is not distributed evenly throughout a population, but rests most intensively with local experts, the people who are most engaged with specific aspects of environment or culture (Chalmers & Fabricus, 2007; Tashakkori & Teddlie, 1998; Wengraf, 2001). Subsistence use in Alaska Native communities is likewise unevenly distributed; research by the Alaska Department of Fish and Game shows most subsistence food, by weight, is harvested by about one third of households in a community, and that this pattern holds across diverse communities (Wolfe, Scott, Simeone, Utermohle, & Pete, 2010).

In total, a purposive sample of 82 local experts (6-14 per community) participated in interviews and focus groups. Local experts were recommended by their Tribal Councils and by other local experts. Experts are defined as experienced hunters and elders who regularly harvest seals and walruses, or, for elders, had done so when they were younger. Additionally, a few women with extensive experience processing marine mammals and preparing marine mammal foods were included. Local experts are recognized by their peers and by the community as subject experts. All experts identified through Tribal Councils or peers were invited to participate.

## Semi-Structured Interviews as a Tool to Preserve Participant Perspectives

In order to preserve participant perspectives, we conducted the mapping interviews in a semi-structured format. Semi-structured interviews are flexible and allow interviewees to introduce new topics and the interviewer to add follow-up questions (Bernard, 2006; Slocum, Wichart, Rocheleau, & Thomas-Slayter, 1995). They are also the best method for discovering knowledge undocumented in the literature as they allow for greater participant control over the information they share (Auerback & Silverstein, 2003). For these interviews, the defensibility of information is not determined by the numbers of experts who express any given observation, but instead by the quality of the participants and the interview process. The interview guide, interviewer skill, and trust and rapport between participant and interviewer drive interview quality (Tobias, 2009). We created two semi-structured interview guides: one that focused on mapping, and another that focused on non-mapped traditional knowledge. We designed both interview guides around the research topics that emerged from

*Figure 3. One example, from Savoonga elders, of observed changes due to disturbance*




the participatory design process, modified them according to suggestions from Kawerak colleagues, and pilot tested them with an active hunter and with an elder. Both guides were used in all communities, with minor modifications to tailor the protocols for each community's unique situation.

Conducting the mapping portion of the interviews in a semi-structured format allowed participants to contextualize their answers, as it was often difficult to translate direct experience into shapes on a map. Having a semi-structured interview guide that focused on non-spatial traditional knowledge was also essential, as the habitat components that emerged from the participatory design process were often better suited to qualitative description than to mapped representation. For example, experts only mapped a few places that were abandoned due to disturbance (e.g. Figure 3), but were able to describe, in detail, their observations of seals and walruses reacting to different kinds of disturbances.

## Interviews and Focus Groups

We conducted a mix of interviews and focus groups. In the first three communities, we held mapping focus groups using the mapping interview guide. The most knowledgeable local experts were also interviewed separately using the traditional knowledge interview guide. As focus groups proved unwieldy for mapping the level of detail needed, we conducted individual interviews in the remaining six communities. These interviews used a combined interview guide that included both the mapping and traditional knowledge questions.

Some researchers prefer focus groups for documenting qualitative traditional knowledge, as they allow experts to come to a consensus and reduce the chance of competing knowledge claims complicating later analysis (Huntington, 1998). Tobias (2009) argues that group interviews can be ineffective for detailed land use mapping. For this project, we tried focus groups but individual interviews were more effective. First, the mapping protocol was highly detailed, covering five species, four seasons, and topics of subsistence use, habitat, and environmental

change. It was difficult to cover the necessary material or to document sufficient detail during focus groups. Second, hunters had different use areas, distinct observations, and, for one topic, competing perspectives. As such, individual interviews best preserved this diversity. In order to address differing knowledge claims, we made charts that preserved distinct observations and perspectives, conveying the diversity of views (see Gadamus et al., submitted). Finally, a number of participants felt more comfortable speaking one-on-one and commented that groups could be dominated by one person. Focus groups are useful in instances where detailed mapping is not involved, and in the case of this project, some participants were energized by the presence of other hunters and were able to work together to remember shared observations and experiences.

## Collecting and Processing Spatial Data

We pilot tested computerized mapping, where we projected a digital marine chart open in ArcGIS on a whiteboard, had focus group participants draw on the whiteboard, and digitized in real-time. This proved difficult, as it disrupted rapport with participants, made some elders uncomfortable, and was hectic for the researcher. As such, after testing this method in Elim and Savoonga, we used paper maps and digitized respondent input afterwards.

The majority of focus group mapping was done on mylar placed over paper NOAA marine charts and USGS 1:250,000 and 1:63,000 topographical maps. Because we were mapping many details for five species across four seasons, we went through an average of four maps per focus group mapping session. As a result, for one-on-one interview mapping, we had experts draw directly on 11 by 16 inch printouts of the same marine charts and topographical maps (as opposed to creating multiple mylars per person). This made it easy to use multiple maps for each person, and this size was simple to scan and georeference later.

On each map, all features were numbered and relevant notes were recorded on a mapping form. Each feature was assigned a unique ID based on the community, the interview or focus group number, the map number, and the feature number. At the conclusion of each day of interviewing, all information from the mapping forms was entered into an Access database.

All maps were digitized in ArcGIS 9.3. During digitization each feature's unique ID was entered into the geodatabase. Then, selected information from the Access database was imported into ArcGIS and joined by that ID to the attribute table. This resulted in a geodatabase that can be queried by community, species, season, activity, or marine mammal prey species. The Access database, which is kept in a protected location at Kawerak, records the identity of each interview participant, so all information can be traced to its source, for greater defensibility, follow-up with interview participants, or other purposes (Tobias, 2009). The geodatabase does not contain identifying participant information and protects confidentiality.

## Qualitative Analysis

Qualitative methods are a rigorous, systematic means of organizing and interpreting text and other non-numerical data (Bernard, 2006). Interview transcripts are analyzed by categorizing and organizing the narrative information from respondents (Miles & Huberman, 1994). This approach preserves respondents' words and perspectives, while finding patterns and generating theory from the text (Glaser & Strauss, 1967). To generate our texts, we recorded and transcribed all interviews and focus groups with local experts. Transcripts were then coded in Atlas.ti using a mix of deductive codes, which are pre-determined categories, and inductive codes, which are generated directly from the local expert narratives (Friese, 2012; Marshall & Rossman, 1995). Most deductive codes addressed themes, such as disturbance, that were generated during participatory research design. Inductive codes were generated directly from the texts. For example, many local experts described

*Table 4. Ensuring defensibility using criteria from Tobias (2000)*

| Measure | Kawerak Process |
|---|---|
| **Integrity**: Link map features to local expert source | Access Database and ID code |
| **Reliability:** Can the same thing be produced again? | Well-documented methods, local expert trust, multiple opportunities for community review |
| **Validity**: Are maps representing what they claim to represent? | Clear questions, no pressure to answer, trust, community review, transparent methods |
| **Accuracy:** Is the point on the map the actual location? | Good local expert map reading skills, repeated mapping of same places by different local experts, local expert review |
| **Representativeness:** Was the sample appropriate? Are data saturated? | Tribal Council sample oversight, data generally saturated, tribal and local expert review |

the factors, such as the weather, that influenced seal and walrus response to disturbance, so we created the code "Disturbance_factors." Coded information was organized into narratives, tables, and charts for habitat related topics. For a more detailed description of our qualitative methods applied to habitat determination, see Gadamus et al., submitted.

## Local Expert and Tribal Review

We mailed maps and qualitative data summaries for each community, as well as a paid return envelope, to all participating local experts and Tribal Councils. Project staff also held a review meeting in each community, where interested local experts, as a group, reviewed and corrected maps and discussed map implications. A few sensitive, fine-scale subsistence use or habitat areas were displayed as part of larger polygons, so that non-local commercial interests would not locate these areas (Tobias, 2000). Communities were also able to remove sensitive information from any publically available maps.

We produced two map products. The first, a local map atlas, displays the maps for each community, and was reviewed and approved by all participating tribes (Kawerak 2013a). This book is intended for use at the local level, and its distribution has been limited to tribes, Kawerak staff, and a few select agencies that agreed to strict terms of use. The second is a publicly available data synthesis for the region that Kawerak produced in collaboration with Oceana (Oceana & Kawerak, 2014). For the public data synthesis, community data were aggregated to the regional level and combined with information compiled from other sources. Kawerak and Oceana hosted a workshop where selected local experts from each participating community reviewed and edited data synthesis maps. The draft data synthesis was also sent to all tribes in the region, as well as to selected local experts and Kawerak staff, for review.

## Defensibility

A major goal of this project was that products produced would be defensible, and that the information not be discounted as anecdotal or otherwise deficient. For the qualitative portion of our research, we followed standard qualitative methods (e.g. Bernard, 2006; Glaser & Strauss, 1967; Miles & Huberman, 1994). For the use mapping, we followed criteria developed by Tobias (2000) (Table 4).

# DISCUSSION

## Empowerment

Elwood (2002) describes three major dimensions of empowerment relevant to PPGIS (Table 5). In this section, we evaluate the ISWP in terms of Elwood's dimensions.

*Table 5. Elwood's (2002) dimensions of empowerment*

| |
|---|
| **Distributive change:** Greater access to decision-making, goods, or services (tangible change). |
| **Procedural changes:** "Social and political processes shift such that the contributions of citizens or community groups are granted greater legitimacy, or that their knowledge and needs are incorporated into decision-making processes" (p. 908). Increased "authority and legitimacy" (p. 908) for diverse views. |
| **Capacity building** "Expansion in the ability of citizens or communities to take action on their own behalf" (p. 909), new skills, community-based knowledge production. |

## Capacity Building

ISWP's greatest contribution to empowerment is in community-based knowledge production. Many tribal governments may not have a clear picture of local marine resource use, which largely occurs at the family level. The local map atlas and the Bering Strait Marine Data Synthesis provide detailed information at both the local and regional levels. Additionally, we produced community books on hunting safety and on traditions of respectful marine mammal hunting, manuscripts on traditional knowledge of habitat and local management traditions, a participatory vulnerability analysis, an assortment of policy comments, and a document of research-based policy recommendations (Gadamus, 2013, Gadamus & Raymond-Yakoubian, submitted, Gadamus et al., submitted, Kawerak, 2013b, Kawerak, 2013c, Kawerak, 2013d).[1] These products will allow tribes to create and defend evidence-based policy recommendations.

The ISWP did not build local GIS capacity. Project GIS was conducted by the first author, a Kawerak staff member from outside the region. Tobias (2009) and Fox (2002) both note that having defensible maps that are technically correct and meet their intended purpose justifies hiring outside technicians. This corresponded with our experience, where we had tribal experts share their knowledge, but as researchers, we provided the technical expertise to document, process, and present it defensibly. GIS capacity building was not a part of this project but could be built into future projects if requested by communities. The ISWP did build local research capacity, as local research assistants were hired in each community, and two interns, a transcriber, two long-term research assistants worked for the project in Nome. All of these staff members were tribal members from the region.

## Distributive Change

The long-term distributive change sought by Kawerak and Bering Strait region tribes is better representation in natural resource decision-making, as well as policies that protect local marine use. Although federal agencies are directed to consult with tribes before making decisions, this rarely happens. Apart from the ISWP, Kawerak staff have parallel, ongoing efforts to increase agency commitment to tribal consultation (Raymond-Yakoubian, 2012). Specifically, in the realm of Bering Sea fisheries and government agency research activities, staff have been working to have traditional knowledge and community experts included in management, policy, and research. Staff have also worked on the development of agency consultation policies and procedures to ensure inclusion of tribal concerns and ideas. This kind of change is a long-term process. Although the locally relevant products produced by the ISWP will certainly help Kawerak and tribes in the ongoing struggle for decision-making power, no major transfers of power occurred during the project period. Several policy decisions, such as a proposed Coast Guard ship routing scheme, were congruent with comments submitted by ISWP staff, and a multi-organization environmental policy document (McConnell et al., 2013) displayed and described local use patterns submitted by ISWP staff. As such, ISWP submitted comments may have helped align some policies in the region with tribal

preferences. At time of submittal, Kawerak staff have plans to meet face to face with agency staff and decision makers to share map products, instruct them on their use, and to encourage community involvement in decision making. Kawerak will use the project policy summary document (Kawerak, 2013d) in an ongoing effort to affect marine shipping related policy.

### *Procedural Change*

The procedural change sought by Kawerak and tribes is recognition of Indigenous rights to traditional harvest areas and ways of life and greater respect for traditional knowledge. Again, this is a major, long-term struggle that incorporates diverse activities at Kawerak as well as among the tribes of the region. Kawerak has a Natural Resources Division devoted to understanding and advocating for traditional resource use. The goal of the ISWP was to support this struggle by defensibly documenting traditional knowledge. The maps produced by the ISWP also provide a defensible record of marine use areas for 9 communities. ISWP staff have submitted, and will continue to submit, research-based policy comments to multiple federal agencies and staff regularly present project results at academic, policy, and community venues in order to bring greater attention to Indigenous use and knowledge in the region.

Although Ghose (2001) and Kwaku Kyem (2004) have noted that GIS use can cause discussions to become overly technical, thus devaluing local knowledge, excluding less formally educated community members, and promoting technocratic policy-making, this was not the case for the ISWP. Our use of a purposive sample of local expert seal and walrus hunters ensured that the relevant perspectives were included. Pairing qualitative results with maps preserved local voices and perspectives. In most cases, we found that it was more efficient to provide map context using participant narratives than to try to represent all knowledge through maps.

## Compatibility of Maps with Traditional Knowledge and Use

Some PPGIS scholars have noted that maps, with their firm boundaries, static features, and reductionist representations, can be a poor representation for Indigenous knowledge and use (Fox, 2002; Wainwright & Bryan, 2009). Although local experts participating in the ISWP discussed map limitations, they found the maps we produced to be reasonable representations of marine use. We paired all maps with traditional knowledge narratives that provided context and noted map limitations. Recognizing map limitations promoted interesting discussions of marine mammal habitat use as well as local harvest patterns. Using maps in conjunction with local expert narratives has inspired conversations with policy-makers and conservation groups about spatial variability and directional changes in marine resources and Indigenous resource use. While both Fox (2002) and Rundstrom (1995) expressed concern that mapping "destroys indigenous conceptions of space" (Fox, 2002, p. 66) and suppresses Indigenous geographical knowledge, we saw no indication that fixed maps were changing hunter or elder "conceptions of space". Participating local experts drew knowledge from personal experience and questioned maps that did not match their observations.

## CONCLUSION

Participatory GIS is described as a high-stakes tool with the potential to empower communities to claim resource management power, or to cause disaster by fitting complex local use and knowledge into a reductionist platform and promoting technocratic management at the expense of local knowledge. We developed a technique of qualitative participatory mapping that can help communicate and convey respect for traditional knowledge while lowering the probability of map misuse or misinterpretation. While much of the PPGIS literature evaluates projects in terms of community empowerment,

we find empowerment is often a long-term goal that is difficult to accomplish over the duration of a mapping project. Communities face short-term challenges that must be addressed on a regular basis, and the PPGIS literature should also credit the short-term policy victories that may improve community well-being or prevent future losses of existing resource use. Additionally, PPGIS projects may play out very differently in Indigenous settings, as Indigenous communities have a long history of occupying territory and using resources in ways that are distinct from Western paradigms of property ownership and resource management. For this reason, Indigenous communities may face greater challenges in communicating their land and resource use in a manner compatible with maps. Additionally, PPGIS in Indigenous communities will take place in the context of ongoing struggles for the right to self-governance and traditional territories and ways of life.

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## ENDNOTE

1. To access products, visit http://www.kawerak.org/socialsci.html

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# APPENDIX

## Local Experts

**Diomede:** Arthur Ahkinga, Alois Ahkvaluk, John Ahkvaluk, Jerry Iyapana, Patrick F. Omiak Sr., Frances Ozenna, Ronald Ozenna Jr., Edward Soolook, Robert F. Soolook Jr.
**Elim:** Wallace J. Amaktoolik Jr., Eric F. Daniels Sr., Fredrick L. Daniels, John Jemewouk, Elizabeth H. Kotongan, Kenneth L. Kotongan, Paul Nagaruk, Sheldon Nagaruk, Victor J. Nylin Sr., Charles F. Saccheus Sr., Charles F. Saccheus Jr., Joel Saccheus, Ralph J. Saccheus, Russell M. Saccheus Sr.
**Koyuk:** Georgianne Anasogak, Johnny Anasogak, Oscar D. Anasogak Sr., Clifford B. Charles, Kenneth W. Dewey Sr., Merlin Henry, Franklin Hoogendorn, Kimberly Kavairlook, Esther R. Kimoktoak, Patrick Kimoktoak, Sophie Milligrock, Roger Nassuk Sr., Ruby Nassuk
**King Island:** Wilfed Anowlic, Jimmy Carlisle, Hubert Kokuluk, Joseph Kunnuk, John Penatac Sr., Vince Pikonganna, John I. Pullock
**Nome:** Austin Ahmasuk, Daniel Angusuc, Roy Ashenfelter, Bivers Gologergen, Albert Johnson, Frank L. Johnson II, Stan Piscoya
**Saint Michael:** Joe Akaran, Martin Andrews, Victor Joe, Nicholas Lupsin, James Niksik Sr., Damien A. Tom, Albert A. Washington
**Savoonga:** Arnold Gologergen, Larry Kava, Kenneth Kingeekuk, Chester Noongwook, George Noongwook, Morris Toolie Sr., Raymond Toolie, Clarence Waghiyi
**Shaktoolik:** Axel Jackson, Edgar M. Jackson Sr., Van Katchatag, Franklin Paniptchuk Jr., Reuben Paniptchuk, Hannah A. Takak
**Stebbins:** Allen M. Atchak Sr., Gabriel J. Bighead, Albert J. Bogeyaktuk Sr., Hermes Dan, Kellen Katcheak, Theodore Katcheak, Peter P. Martin Sr., Alexis Matthias, Isaac Nashoanak, Morris L. Nashoanak Sr., Ryan Nashoanak Sr., Anthony Niksik, Leonard L. Raymond Sr., Joseph Willie.