DEVELOPING COMMUNICATION TOOLS FOR RESOURCE MANAGEMENT IN WESTERN ALASKA: AN EVALUATION OF THE WESTERN ALASKA LANDSCAPE CONSERVATION COOPERATIVE COASTAL PROJECTS DATABASE

By

Nicole Warner, B.S.

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APPROVED:

Dr. Sarah Trainor, Committee Chair
Dr. Joshua Greenburg, Committee Member
Dr. Peter Fix, Committee Member
Dr. Peter Fix, Chair, *Department of Natural Resources Management*

Abstract

Science communication is an essential component in decision-making for resource management in Alaska. This field aids in bridging knowledge gaps between scientists and diverse stakeholders. In 2014, the Western Alaska LCC developed a database cataloging the current coastal change projects in order to facilitate collaboration amongst researchers, managers, and the surrounding communities. In order to better inform similar outreach projects in other LCC regions, this MNRM project entailed an evaluation of this database between April and September 2016 and comprised a ten-question phone interview with the database participants and other involved personnel. Results from this evaluation can help refine the database to better suit its users' needs in the future, and it can also inform the creation of similar tools in other LCC regions.

This project evaluated the use and usability of the Western Alaska LCC Coastal Change Database. First, I review coastal change and its impacts on Western Alaska. Next, I explore how institutions can respond to these changes and what resources they can use, including decision-support tools. I then provide examples of different decision-support tools (both in academic literature and in Alaskan projects) and discuss methodologies for evaluating their use. Interview results are then reported.

The evaluation of the WALCC Coastal Change Database indicated that the tool was mostly used to enhance general understanding of the research occurring in the region. Respondents were less likely to use it for time-intensive tasks such as collaboration. Respondents also indicated that a place exists for tools like this database to flourish, but they need 1) persistent outreach, 2) a dynamic design, and 3) immediate benefits for users' time. In the future, regular updates and frequent outreach could improve the database's usability and help maintain its credibility.

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1. Introduction and Project Background

Alaskan ecosystems continue to be a frontier for studying the effects of climate change and its impact on human systems. In Western Alaska, the effects of a rapidly changing landscape are readily seen at both a local and landscape scale, and the volume of research in response to them has proven difficult to track. This uncertainty applies not only to the need for more baseline data (such as coastal modeling, storm monitoring, and other parameter studies) but the application of said data in future decisions. Several institutions in the region (including the Western Alaska Landscape Conservation Cooperatives, the US Geological Survey, the National Oceanic and Atmospheric Administration, and the national Science Foundation, among others) have invested significant time and resources into coastal research, and thus, have acquired a great amount of data already towards these goals. The amount and persistence of such research cannot be denied; however, the actual utilization of said data has yet to be explored in full. The next big challenge for this region is now synthesizing this knowledge in ways that reach a multitude of stakeholders in transformative and collaborative ways.

a. Western Alaska and Coastal Change: What It Is, Why It's Important

Alaskan shores have much to offer in natural resources, both in sheer quantity (with over 44,000 miles of shoreline) and quality in terms of biodiversity (Brown et al, 2014). Alaskan coasts are complex interfaces between terrestrial and marine ecosystems, and they are imperative pieces to both landscapes in socio-economic terms as well. Local communities rely on their coasts for access to subsistence resources as well as transportation, tourism, and commercial fisheries.

Warming temperatures in the northern hemisphere have melted glaciers and sea ice, resulting in an increased volume of freshwater entering the sea. This, in conjunction with the expansion of seawater in rising temperatures, has led to a rising sea level in the Pacific (Sea Level Rise and Storm Surge, 2016). The loss of sea ice impacts Western Alaskan coasts especially hard; as shore ice acts as a protective barrier between the ocean and the shoreline (Murphy, 2017; Sea Level Rise and Storm Surge, 2016). Thawing permafrost also has been shown to drain into the soil and increase porosity, which in turn makes it easier to erode when hit by harsher waves (Murphy, 2017; Sea Level Rise and Storm Surge, 2016).

Coastal erosion poses a major threat for coastal communities in Western Alaska. The effects of such erosion have already been documented in villages such as Shishmaref, where a 2013 storm stripped away 60 feet of the village's shoreline in a single storm (Murphy, 2017). Coastal erosion threatens the stability of buildings, roads, and systems for water, waste, and food (Blier, et al. 1997; Bronen & Chapin, 2012; Cochran, et al. 2013; Murphy, 2017).

Changes in storm patterns and climate shifts have also led to more storm surges (Francis, Hare, Hollwed & Wooster, 1998; Murphy, 2015; Sea Level Rise and Storm Surge, 2016). This led to increased seasonal flooding that threatens freshwater supplies and sanitation lagoons. Such events have already required Golovin residents to relocate to higher ground, and these examples are likely to multiply; already six Alaskan communities are planning partial or total relocation, and 160 are threatened by climate-related erosion according to the US Corp of Engineers (Murphy, 2017; Sea Level Rise and Storm Surge, 2016). This in turn strains access to subsistence resources and reveals the lack of precedent behind community relocation in these areas (Blier, et al. 1997, Brown & Knapp, 2015).

Coastal changes impact the region's biological systems severely. Several key species in Western Alaska have seen major shifts in recent years, including groundfish, baleen whales, sea

otters, and salmon (Blier, et al. 1997; Francis, et al. 1998; Witherell, Paulzke & Fluharty 2000). Already, the loss of sea ice has opened new oceanic migration pathways for humpback and fin whales (NOAA Fisheries West Coast Region, 2015). Prey availability continues to be an area of concern as warming temperatures lead to cascading effects within the ecosystem, as exemplified by the decrease of pollock in the diets of seabirds and endangered species such as Stellar sea lions (Francis, et al. 1998, Witherell, Paulzke & Fluharty, 2000). Changes in atmospheric pressure can also lead to shifts in ocean circulation, which in turn impacts nutrient cycling in these areas (Blier, et al. 1997; Francis, et al. 1998). The resulting shifts in primary production can cause a reallocation of prey abundance and zooplankton blooms (Blier, et al. 1997). Ocean acidification not only threatens important food sources like copepods, but it disrupts the chemistry in vital growth habitat for major commercial species such as salmon (Brock, 2016). Changes in habitat may lead to the reallocation of feeding and breeding grounds and thus influence the distribution of key species (Estes, Smith & Palmisano, 1978, Francis, et al. 1998).

These shifts have major implications for the communities that rely on these ecological systems for support. Commercial fisheries already implement gear restrictions to help reduce by-catch, but the concerns regarding exploitation and the strain on marine populations may limit catches even further (Witherell, Paulzke & Fluharty, 2000). Sea ice depletion threatens access to hunting grounds, and access to key sources of protein via marine mammals will likely become more restricted as these species struggle with prey availability. Changes in the terrestrial landscape also influence the potential development in the region and the resources (biological and otherwise) available. Warming temperatures lead to permafrost thaw and thermokarst lake depletion, which in turn threatens local soil quality, vegetation abundance, and ice road construction (Cochran, et al. 2013, Francis, et al. 1998). A shift to warmer climate also implicates an increase in tundra fires,

which might lead to a change in lichen abundance and a subsequent strain on caribou populations (Jandt, Joly, Meyers, & Racine, 2008).

b. Response to Changes: What Institutions Need To Use Information

Coastal change has only been preliminarily documented in Western Alaska, usually near communities (Murphy, 2017). Current research tends to focus on expanding on this data to properly inform management decisions. Already, research in communities such as Kivalina and Shishmaref has illuminated the gaps in policy regarding community migration and how resources might be reallocated to better support these efforts (Bronen & Chapin, 2012).

Research projects in the area continue to flourish and gather data on the social and ecological changes occurring in the region. Recently, research efforts have also begun to explore how to effectively use this data within a decision-making context (Knapp and Trainor, 2013). Applying this information into policies and tangible actions has proven to be more difficult, and the push for solutions shows gaps in the process, especially in involving indigenous knowledge and communities into stakeholder proceedings (Cochran et al, 2013).

c. Decision-support tools

Decision-support tools are data-analysis aids that are growing in prevalence in response to changing landscape. While they go by many names in the literature, these tools are becoming increasingly important as their role is evolving. The mere transport of knowledge is insufficient for informing relevant policy; synthesizing, translating, and generating data for and from multiple stakeholders will be more fruitful. According to the academic literature, these tools tend to be most

successful when directly applicable to a region, supplied with the proper data in complementary formats, and developed by experts and relevant users together (Dilling and Lemos, 2010; Bagstad et al, 2013). In Alaska, many of these tools are progressing through their development to be available to the public. However, there is little evidence that their use or usefulness has been evaluated.

In general, the literature agrees on what a decision-support tool aims to accomplish. The definition is fairly broad but also fairly consistent. Some examples include:

- A product to "integrate the insights of different disciplines for different purposes…to turn these insights into effective policy-support" (Oxley et al, 2004)
- A tool to "integrate the insights of the decision-maker with information-processing capabilities in order to improve the quality of decision-making" (Falcao & Borges, 2005)
- "Tools that integrate ecology, economics, and geography to improve decision-making" (Bagstad et. al, 2013)
- Systems that "assists decision makers in choosing between alternative beliefs or actions by applying knowledge about the decision domain to arrive at recommendations for the various options" (Sanchez-Marre et al, 2008)
- A tool to "provide information and analysis of specific problems or issues to assist in the integration of information for decision makers, and as an education resource" (Ticehurst et al, 2005)

However, the literature doesn't unanimously refer to these tools as "decision-support tools" in particular, and even when they do, the term is often replaced with something more specific to the project at hand (such as "decision-support-systems" or "boundary objects"). Occasionally "decision-

support tools" may be addressed but never explicitly defined within the context of the research, possibly under the assumption that an explicit definition is unnecessary or would be redundant. These tools can be simple in nature or part of a complex network that aims to directly support decision-makers ("decision support systems", or DSS). Some of these tools work specifically to model quantifiable services and present them in an accessible way to managers and other end-users of the resources. Others also attempt to incorporate research and policy models into their analyses to explicitly connect research to policy decisions; these systems (generally in reference to computer modeling software) can approach more complex problems at multiple scales and thus allow for more intense analysis (Oxley et al, 2004, Poch et al, 2003; Sanchez-Marre et al, 2008).

Decision-support tools, while helpful in some cases, can be moot or fail to live up to their potential in others. If the tool is created without the involvement of the end-users, the tool can fail to help the users who could benefit most from it (Feldman and Ingram, 2009; Meynard et al 2002). If knowledge production is coming from a relatively homogenous source, the tool may not engage its intended audience, thus reinforcing the passive role that excludes end-users from the very tool meant to help them. Involving the anticipated users (Feldman & Ingram, 2009) into the tools' development from the beginning can mitigate this (Ticehurst et al, 2008; Bagstad et al, 2013). When these tools aim to connect tools from different disciplines (especially scientists and stakeholders), their intermediary nature can lend to the literature referring to them as "boundary objects" as well (Feldman and Ingram, 2009, Poch, Comas, & Sanchez-Marre, 2003). Figure 1 provides examples of decision-support tools that have been published in academic literature.

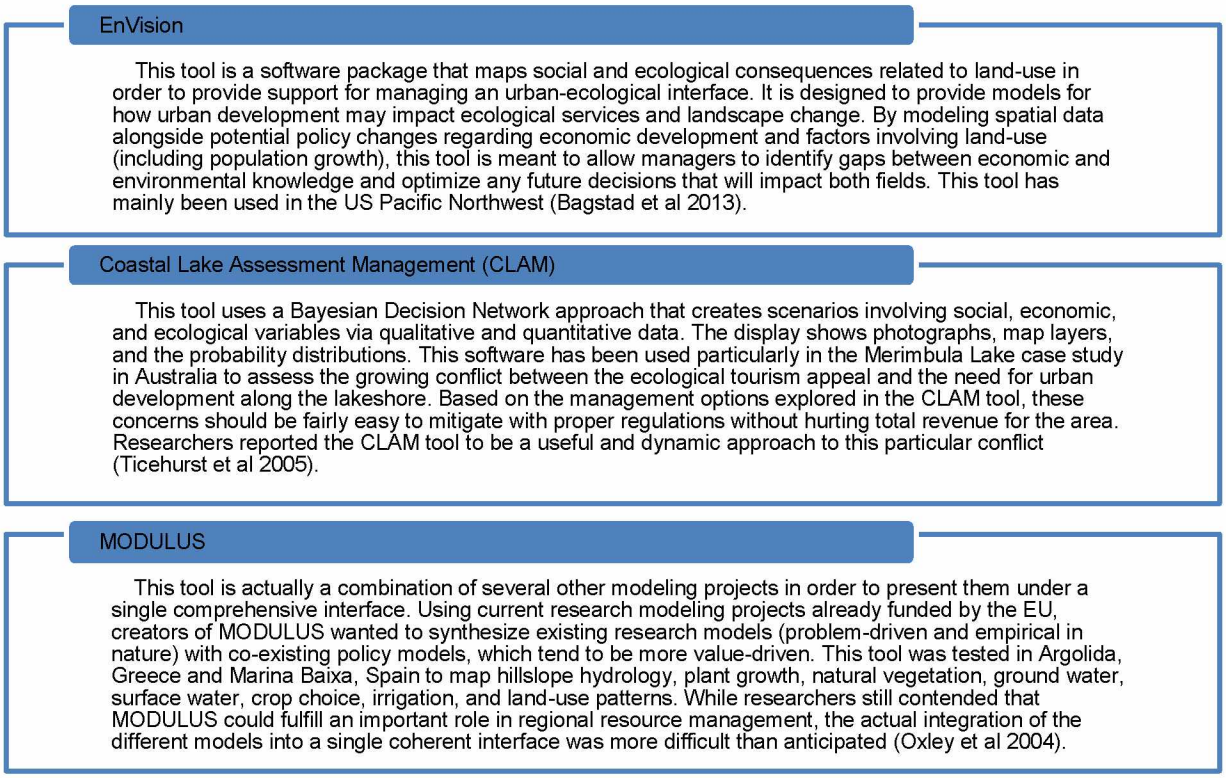

Figure 1. Examples of decision-support tools in academic literature. These three decision-support tools (EnVision, CLAM, and MODULUS) are some of the many tools introduced and evaluated in academic literature.

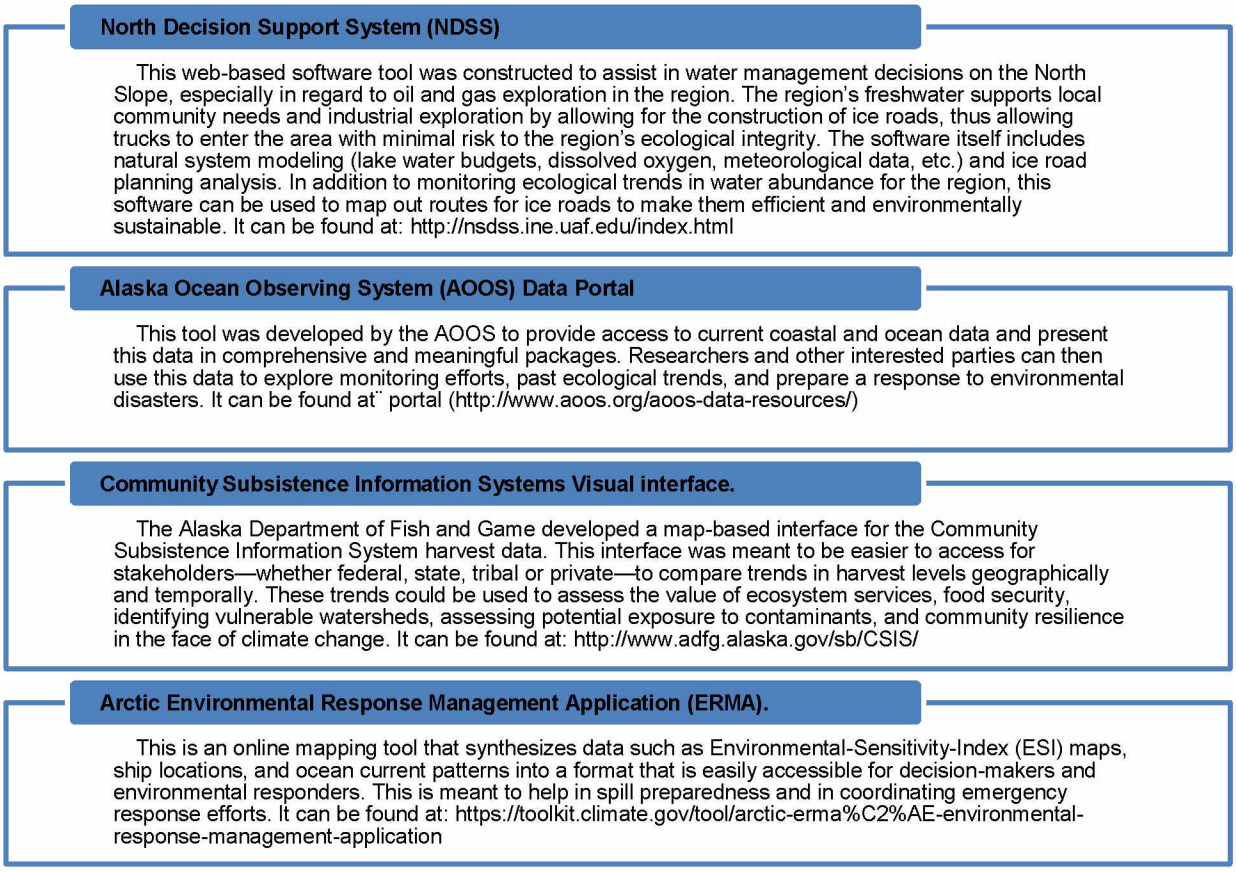

Figure 2. Examples of decision-support tools in Alaska. These tools are locally-produced and maintained. Most are not presented in academic literature, and many have yet to be fully evaluated.

While there seems to be plenty of evidence that these tools are relevant to environmental issues at hand, finding actual tangible results from their use is difficult. Part of this can be attributed to the nature of decision-support tools in general; many achieve their goal of synthesizing empirical data, but incorporating this information into policy-making processes is not always documented by data and thus harder to connect to the tool itself.

Descriptions or assessments of many of decision-support tools (especially the ones listed specific to Alaska) are not published in peer-reviewed, academic journals. (Figure 2) That may be because the tools were developed for end-users as the final audience rather than academic mediums. Many of these projects are relatively new (within the past ten years) and must adapt to pertinent changes of policy (like protected areas or regulations) or evolving concerns (such as drilling in the Arctic or decreasing oil reserves). Additionally, many of these tools are just past the preliminary stages of development and require further study on their ability to integrate multiple data models into a cohesive unit for end-users. Further study is also necessary to properly integrate policy models and scenario planning into these tools in a credible and easily accessible way. To do this, these tools will have to be flexible in order to accommodate the enormous amounts of data necessary, remain relatively simple in their interface, and also respond to ever-changing regional needs.

d. Why evaluate these tools?

When conducting research about the application of decision support tools and in their design, evaluation is generally the last step of the process; however, it also one of the easiest to neglect. Evaluation allows researchers to see the effectiveness of their work and its products in the realm of informing policy and decision-making in natural resource management. Regardless of how thorough the development process is, even the most diligent research can have gaps between theory and practice (Bellamy et al, 2015). Monitoring, testing, and ultimately evaluating these research efforts allow their developers to identify where it fails to meet their objectives and what can be done to correct this. This allows researchers and policy-making bodies to prove that these

efforts were worth the time and funding to develop; taking responsibility for the efforts' success (or failure) can help direct future studies and projects more effectively (Guijt, 1999; Bellamy et al, 2015; Conley & Moote, 2002). In a landscape where the abundance of funds and time is always in question, the ability to prove that a tool is a worthwhile investment is a critical step. This also ensures that the tool itself truly supports decision-making and allows for feedback that allows for adaptive management to ensue (Allen, 1997; Douthwaite et al, 2003).

e. Considerations for evaluating decision-support tools

Methodologies for evaluating decision-supports tools tend to be customizable and flexible. They have to adjust to the tool in question in order to accommodate the variety of data, stakeholders, and applications that the tool entails. While recent literature asks whether a standardized method may be possible, most agree that even if it were, such a method would either be incomplete or much too inclusive to be implemented efficiently (Allen, 1997; Conley & Moote, 2002). Tailoring the evaluation to individual tools allows the evaluators to approach the tool more effectively.

The methodologies depend on three main factors: 1) who evaluates the tool, 2) the motivations behind the evaluation, and 3) what resources are available to the evaluating party.

Who: The balance between objectivity and familiarity is an ever-present struggle when conducting evaluations. An evaluation conducted by a neutral third party (or "expert review") can help combat bias, but it can also lead to a lack of trust between the researcher and the relevant community (Lynam et al, 2007). Evaluations conducted by someone tied to the project (whether it

be someone familiar with the project or involved in its development) can allow for changes to be made quickly and suited to the tool's audience, but can lead to a loss of outside perspective that could help develop the tool for a broader audience (Conley & Moote, 2002).

Motivations. Different stakeholders may have differing motivations to conduct an evaluation in the first place. Whether it be to connect the tool more directly to policy-making processes, support the views of advocates or critics, assure funders of their investments, or modify the project's input and output to be more accurate, the evaluation may require effort to get the appropriate information (Conley & Moote, 2002).

Available resources. The amount of time, funding and manpower also helps determine how the evaluation itself will take place. Some evaluations involve in-depth interviews or questionnaires; others assess the tool through the lens of a case study; others use quantitative data such as downloads and page hits (Crona & Parker, 2002; Lynam et al, 2007; Guijt, 1999). Traditional methods involve using statistical analyses to correlate project characteristics and outcomes, but these generally require large sample sizes and are difficult to incorporate the complex and dynamic nature of collaborative efforts (Conley & Moote, 2002). The actual methods and their intensity will ultimately depend on the scale of the evaluation and the nature of the issues at hand. Existing literature separates these into three categories: measuring tangible outcomes (regularly quantified and numerical indicators), measuring participant perceptions (interviews and surveys), and participant observation (where the evaluator is part of project itself). Evaluations can be conducted after the tool is implemented, or it can also be incorporated into the tool's design to make it "inherently evaluative", especially if the tool is developed via participatory means through stakeholder involvement (Allen, 1997; Lynam et al, 2007; Conley & Moote, 2002).

While not all evaluations develop a list of criteria, some in-depth assessments create them to better report on the tool's usefulness. These criteria depend on the scope of the assessment, the nature of the evaluation (self-evaluated or an external source), the mode of analysis (whether it be on-going monitoring, a case study, or official review), and the information required (quantitative or qualitative data) (Lynam et al 2007). While most evaluations are best served by tailoring criteria to them individually, there are a few common criteria that apply depending on what discipline the evaluation focuses on (Conley & Moote, 2002; Mysiak et al, 2005).

The evaluation criteria usually include:

- Feasibility and adequacy of data sharing
- Accessibility to stakeholders
- Use of stakeholders in development phase
- Quality of data (quantitative and qualitative)
- Ease of use
- User satisfaction
- Accountability and transparency
- Equitability of power relationships between users

These criteria can help determine whether a tool can include cultural perspectives alongside quantitative data, encourage communication and co-learning, and incorporate data into decision-making processes (Bellamy et al, 2015; Mysiak et al, 2003; Macias, 2010; Sullivan, 2002).

Despite the consensus on the importance of evaluation in the realm of natural resource management, the actual implementation of it is surprisingly sparse. The constraints of time, funding, and precedent complicate the reality of evaluating decision-support tools. The evaluation that takes place often has several shortcomings; they can fail to assess the tool from social and ecological disciplines, lack clear goals or outcomes to measure, or comprise of broad overviews that act more as a "snapshot" of the tool's use rather than an in-depth study (Lynam et al, 2007; Bellamy et al, 2015). This is especially true for decision support systems, many of which are "evaluated" via case studies.

While evaluations are generally conducted with the hope of identifying the connections between the tool's use and decision-making, it can be hard to prove the causality between the two. Combined with the need for clear objectives that aren't always available, the difficulty of identifying measurable goals, and the time-intensive effort needed to capture different stakeholder perspectives over time, determining the effectiveness of a tool through such evaluations has many challenges (Lynam et al, 2007, Bellamy et al, 2015, Mysiak et al, 2005).

2. Evaluation of the WALCC Coastal Change Database

This evaluation project focuses on the WALCC Coastal Change Database (CCD). This database was created in 2014 when members from the Western Alaska Landscape Conservation Cooperative (WALCC) and the Alaska Center for Climate Assessment and Policy (ACCAP) assembled a list of all known coastal projects in Western Alaska. They accumulated the information on these projects (including the investigators, the funding sources, the main objectives, and links to additional information) into a single tabulated database in Microsoft Excel. In accordance to WALCC

project categorization protocols, they grouped the projects under either landscape-geophysical systems, oceanographic systems, biological systems, or human systems.

The CCD had two objectives: 1) catalog all known projects into a single space for future reference, and 2) create a tool that can help stakeholders identify where research is concentrated, where more information is needed, and how to contact other potential collaborators for their projects (Brown et al, 2015).

The tool's ability to synthesize information in potentially transformative ways (and thus potentially influencing the outcome of future research projects) lends credibility to its potential as a communication tool in Western Alaska. It has the potential to introduce this catalogued information in a manner where its readers can interpret and utilize per their own needs. It acts as a "boundary object" by existing as a nexus between different stakeholders and between stakeholders and scientists (Feldman & Ingram, 2009, Poch, Comas, & Sanchez-Marre, 2003). Its potential influence over future collaborations or research decisions can also qualify it as a decision-support tool.

2012 Coastal Hazards Workshop. This project would be incomplete without mentioning the 2012 Coastal Hazards Workshop hosted by Alaska Ocean Observing System, the Western Alaska LCC, and USGS Alaska Climate Science Center. Participants included coastal residents, university researchers, and agency managers on a local, state, and federal scale (Meehan et al, 2012). These workshops served as the springboard for this database as it initiated an online call for information to help identify ongoing projects in the region (Brown & Knapp, 2015). Participants also identified their information needs for Western Alaska. These key needs were categorized under ocean-to-shore processes, nearshore processes, and bathymetry (Meehan et al, 2012). These included needs such as:

- collect vertical data tied to tidal benchmarks

- increase tidal gauges
- utilize community observations for storm surge and tide heights
- evaluate existing models of nearshore processes (including physical, chemical, and biological components)
- enhance bathymetry efforts

Creators of the WALCC Coastal Change Database tracked whether the projects in the database matched these recommended needs. Only a third of the database's reported projects aligned with those needs, with most of them (24 of the 35 matching projects) falling under the ocean to shore process category (Brown et al, 2015).

After two years of public exposure, the WALCC Coastal Change Database requires an evaluation. This evaluation will explore whether it met its objectives: 1) cataloging coastal projects in the Western Alaska LCC area, and 2) serving as an effective decision-support tool. The results of this evaluation can also inform the design of future projects created for similar purposes in other LCC regions.

This evaluation will aim to answer the following questions:

1. How was the database used since its creation?
2. What challenges does this database face as a science communication tool in Western Alaska?
3. How can this evaluation inform the creation and use of science communication tools in this region in the future?

3. Methods

Using publicly available online resources (including the Coastal Change Project Database, the State of Alaska directory and the WALCC website), I compiled the names and contact information of the principal investigators listed in the database. I expanded this list to include individuals involved in natural resource management in Western Alaska, whom I identified using public directories, scientific publications, and professional social media such as LinkedIn. These included the WALCC steering committee members, researchers from universities, members of local organizations, State of Alaska employees (such as biologists, project managers, technicians, etc) and tribal council members.

I reached out to each individual via email with a description of the project, directions to where to find the database, and a request for their feedback on it in the form of a phone interview to help evaluate the database. If I did not receive a response within the next two weeks, I send another follow-up email. I repeated this process once more, with a total of three emails to each contact. A total of 134 people were contacted, and 17 interviews were completed.

I contacted individuals who agreed to an interview via phone. Depending on the respondent's familiarity with the database, they could answer one of three scripts: one developed for people who had experience with the database, one developed for people with no experience with the database or its contents, and one for people who opened the database during the interview.

Interviews were recorded, transcribed, and analyzed for common themes and patterns. These themes became the codes used for further analysis, including 1) *goals and incentives to use the database*, 2) *accessibility and formatting*, 3) *accuracy and relevance of contents*, 4) *problems and*

5) suggestions for database's future improvement, and 6) *collaboration in Western Alaska and its challenges*. After reorganizing responses under these respective categories, I then searched for the most common trends in each, again using my evaluation criteria as reference.

WALCC Coastal Change Database Evaluation Criteria. The effectiveness of the database as a decision-support tool was evaluated based on the objectives of the WALCC Coastal Project Database, as listed in the accompanying report. These are as follows:

- Foster better coordination about coastal change in Western Alaska
- Help practitioners and scholars learn from another
- Identify information gaps in management needs

These are the foundation for the criteria that were used to evaluate the database's effectiveness in meeting these goals. They also parallel objectives used in the literature to evaluate decision-support tools, such as (Lynam et al, 2007):

- Support communication and learning between users
- Make venue adaptable for different users
- Produce useful information for decision-making

For the database to achieve its goal as a communication tool for the Western Alaska LCC, it must satisfy these goals to some degree. This evaluation is designed to determine whether this database

met expectations in regards to its use. To determine this, the information provided in the evaluation should answer some of the following questions:

- Was the database accessed and used to enhance a user's work in Western Alaska?
- Does the database encourage collaboration between different users?
- Is the database useful for assessing management needs and information gaps in Western Alaska?

These questions can be expanded even further to elicit some simpler and more concrete answers. These questions include:

- Is the information in the database perceived as credible and complete?
- Does it respond to a need in the region?
- Is it perceived as being simple to access?
- Is it perceived as being easy to understand?
- Is it perceived as being simple to use?
- Did anyone use the database to enhance his or her own understanding of research in the area?
- Did anyone use the database in a way that influenced their own work?
- Did anyone use the database to pursue new collaborations?
- Are there elements of the database that need improvement?

These questions provide a foundation for the criteria used to evaluate the database. Simplified, these become:

- Perceived accuracy of database contents
- Database relevance
- Frequency of use
- Results of use (ex. collaborations, enhanced general understanding, etc)
- Accessibility
- Perceived ease of use

Interview Analysis. After listing the cumulative responses to each question in Microsoft Word, I examined the results for trends and themes that matched my evaluation criteria. I first selected any responses that matched my five code categories: *goals and incentives to use the database*, *accessibility and formatting*, *accuracy and relevance of contents*, *problems and suggestions for database's future improvement*, and *collaboration in Western Alaska and its challenges*. After reorganizing responses under these respective categories, I then searched for the most common trends in each, again using my evaluation criteria as reference. These codes are as follows:

1. *Goals and incentives of database usage*
    I. Expanding general knowledge on projects in the area
    II. Searching for specific topics or attributes in current research
    III. Searching for potential collaboration
2. *Accessibility and ease of use*
    I. Technical access (ex. finding the database, availability, etc)
    II. Ease of use (design and formatting)
3. *Accuracy and relevance of contents*

I. Perceived accuracy of source material by users

II. Relevance as cataloging tool (e.g. having projects all in one place)

III. Relevance as collaboration tool

IV. Concerns over relevance as a static tool

4. *Problems and suggestions for database improvement*

I. Add other data

II. Improve formatting

III. Update consistently

IV. Improve outreach methods

Interview answers were organized under their respective codes in Microsoft Word and then re-assessed for any noticeable patterns.

4. Results

I compiled 134 total contacts as potential interviewees. Of these, 62 of these were principal investigators listed in the Coastal Change Database as of October 1st, 2016. The rest were found from sources such as the Western Alaska LCC steering committee (as found on the website), the State of Alaska directory, the University of Alaska website, the Coastal Village Relief Fund website, the SeaGrant website, and referrals from other respondents who wanted to help contribute to the project.

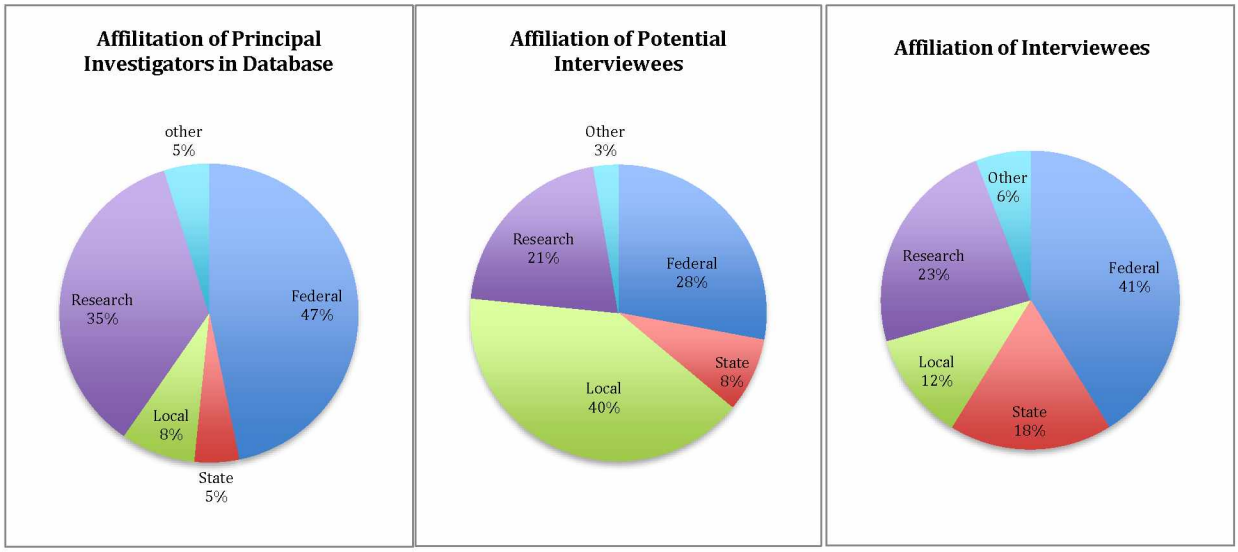

Figure 1. Affiliation of principal investigators in the database, potential interviewees, and final interviewees. The database was primarily comprised of scientists affiliated with federal agencies and research institutions. Affiliation was determined by the authority of their organization (for example, a federal scientist working in research would be categorized under "federal", not research.) The "other" category includes regional observations networks such as the Alaska Ocean Observing System. Organizations such as AOOS are connected to state or international partners, thus not fitting neatly into any of the other categories. The final list of potential interviewees was supplemented in the attempt to augment underrepresented categories. The affiliation of the interviewees closely matched the database.

Out of 134 total contacts, 34 responded, and 27 offered to provide an interview. Seven contacts explicitly declined an interview, citing either inexperience with the database and or time availability as the reason. Ten respondents initially offered an interview but lost contact before the process was completed. Several entries in the database had incorrect or expired contact information in the database (n=15) and did not have any other contact information readily available online. These expired contacts accounted for 24% of the contacts listed in the CCD.

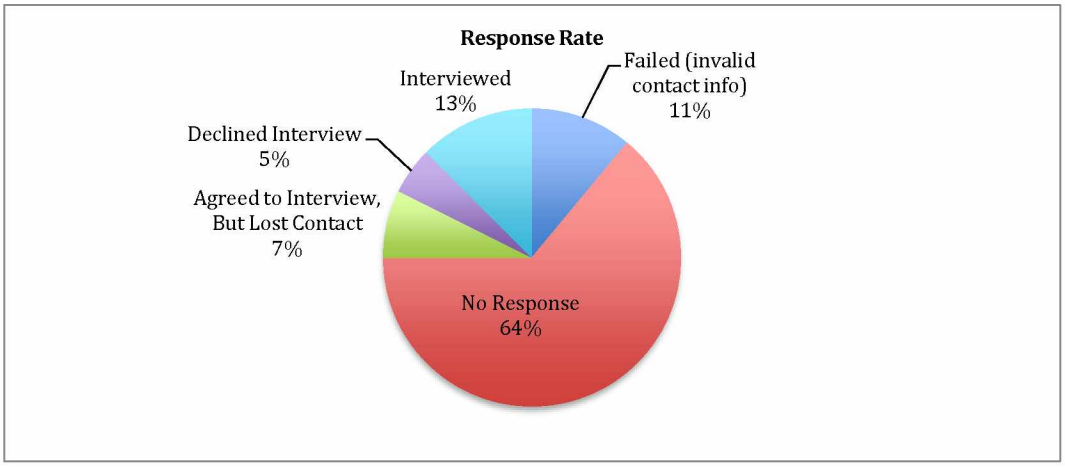

Figure 4. Interview response rate. 25% of all contacted potential interviewees responded to my outreach, with 13% actually giving an interview.

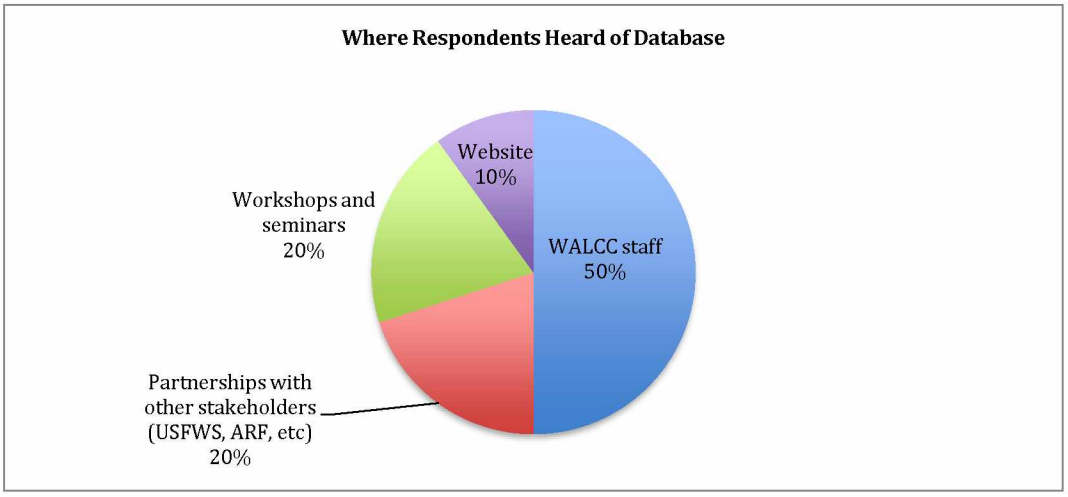

Figure 5. Where respondents heard of the database. When asked whether they had heard of the database prior to the interview, over half of the respondents stated that they had heard of the database from another source in the past (n=10). Six of these respondents had actually opened the database prior to the interview.

Despite knowing of the database, many only had a vague idea of what the database was, and only a few had been involved with it since the database's launch in 2014. Half of the respondents knew of the database from a member of the WALCC staff. The exact sources ranged from WALCC

coordinators to WALCC steering committee members to the creators of the database itself. Other respondents remembered the database from its introduction via coastal workshops and seminars.

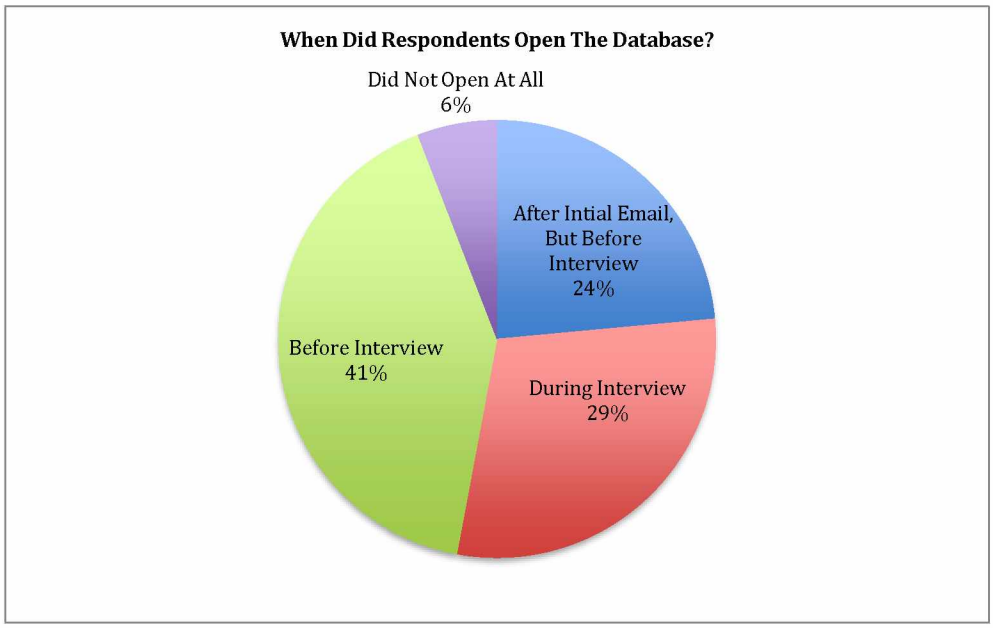

Figure 6. When did respondents open the database? Only one respondent did not have a chance to look at the database in time for the interview. Seven respondents (41%) opened the database before learning about the evaluation. Four of them (24%) opened it after the initial outreach email, but before the interview. Five respondents (29%) opened the database during the actual interview.

When asked why they opened the database, 53% of respondents answered that they were trying to get an idea of what research was being done in the region at the time (n=8). However, this was often not the sole motivating factor. The second-most reason cited in interviews was an interest in looking for potential collaborators. Other reasons for exploring the database including following up on requests from coworkers, comparing funding sources, identifying data gaps in ongoing research, and familiarizing themselves with the database in order to help with the evaluation interview. These occurred at similar frequencies (13%, n=2).

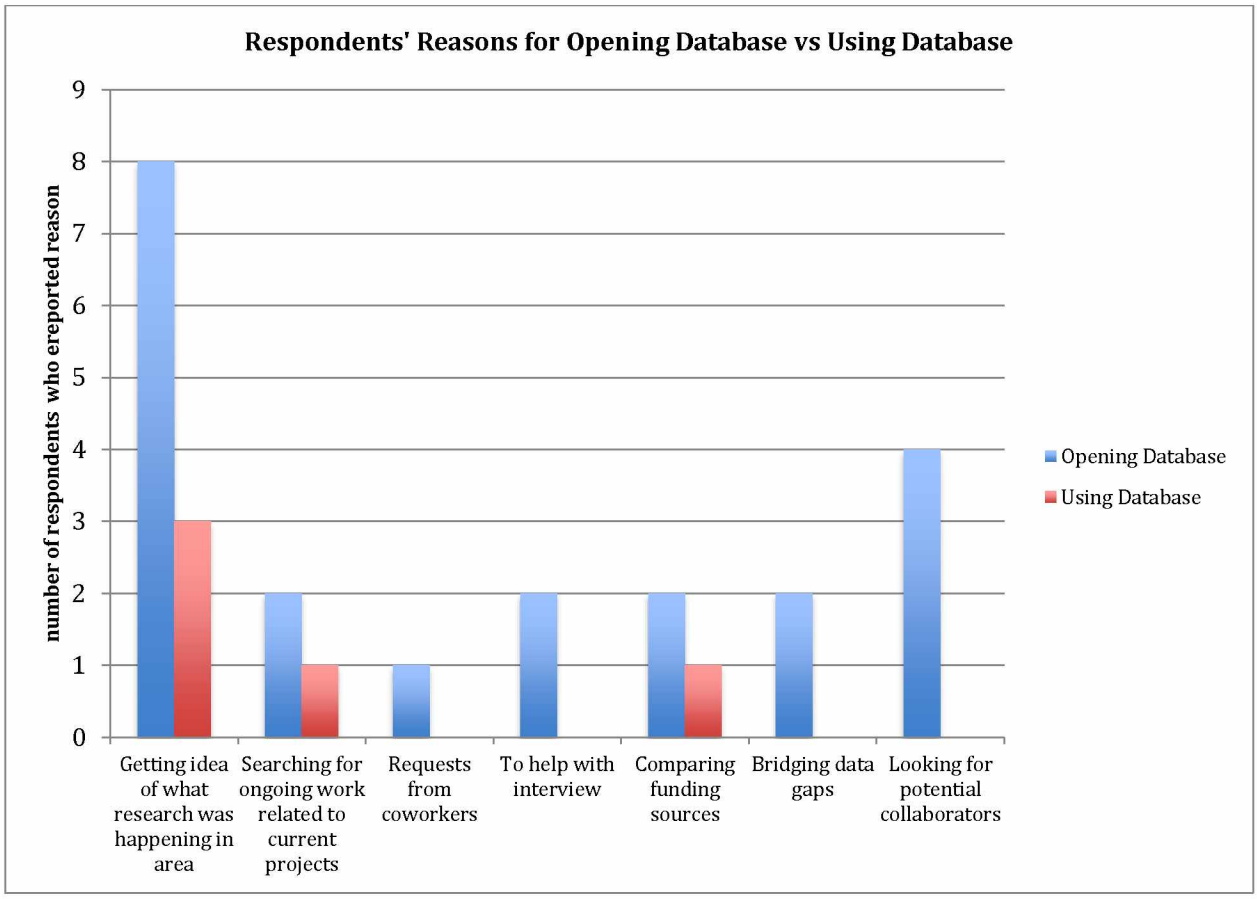

Figure 7. Why did respondents open the database? The most common reason for opening the database was to get an idea of what research was happening in the region. Interviewees often gave several reasons; each time a reason was mentioned, it was counted.

Of the sixteen respondents that opened the database, five of them applied the information in their own work as follows. As follows, three of these used the database to enhance their general understanding of the projects happening in the area. One respondent used the information to search for work in their area like their own, and one respondent used the database to compare funding sources of different projects to help complete a research proposal.

Most respondents were satisfied with the design of the database. 81% answered that the database was organized in a way that was easy to understand. While zero respondents ever

explicitly said that the Excel database was hard to understand, nearly 20% (n=3) stated a preference for the map portion, saying it was easier to understand over the tabulated database. As a result, 46% of respondents (n=7) agreed that the database was easy to use, but 26% of respondents (n=4) stated a preference for the map portion in regard to actually using the information provided, stating that the visual aspect was more intuitive for them. 40% of respondents (n=6) were unsure whether the database was easy to use; this uncertainty usually stemmed from unfamiliarity with the database itself or confusion over its target audience.

Of the twelve respondents that remarked on the database's accuracy, 75% (n=9) said that they trusted the contents of the database to be accurate, while 25% (n=3) found it to be missing fundamental pieces (traditional knowledge, a focus beyond coastal systems, and a focus on specific solutions for community issues, respectively).

Twelve respondents affirmed that the tool was relevant for research in the area. Nearly all of them (n=11) cited the database's format as the key reason, usually in its ability to store projects conveniently in one place or its usefulness in raising awareness of ongoing research in the region. One-third of these respondents (n=4) also cited the database's potential to encourage collaboration as a key factor in its relevance. However, eight respondents stated that the database's static nature could easily make it irrelevant in the future if the database is not updated continuously.

The database's static nature was a common theme in respondents' answers. This was one of the most common concerns regarding the database's capability to be an effective tool for its audiences, along with the need for some additional data, the lack of continuous outreach, and problems regarding the tool's design. Respondents also stressed the need for the tool to be updated, as they emphasized the database's potential for becoming outdated (and therefore irrelevant) without this maintenance. Finally, 33% of respondents (n=5) shared a concern over the database's lack of consistent outreach, therefore limiting its audience and influence.

Additionally, the database faced many challenges in terms of accessibility. Because access to the database requires an Internet connection, respondents working in rural communities shared concerns that this could inhibit their ability to utilize this tool. Other respondents, especially those active in research communities, were more concerned that the database's outreach was not placing it in venues where it was more likely to be seen, thus blocking it from potentially interested audiences (such as incoming researchers from outside Alaska). Respondents also reported concerns regarding *when* the database was accessed; several found the database after their work was already underway, which meant utilizing the database would require dismantling some of that work to incorporate the new information. This also relied on respondents finding the database within the website, which was not always intuitive for respondents, even with written instructions. Finally, accessing the database required enough time for respondents to explore it; many cited time constraints as a key obstacle in their efforts.

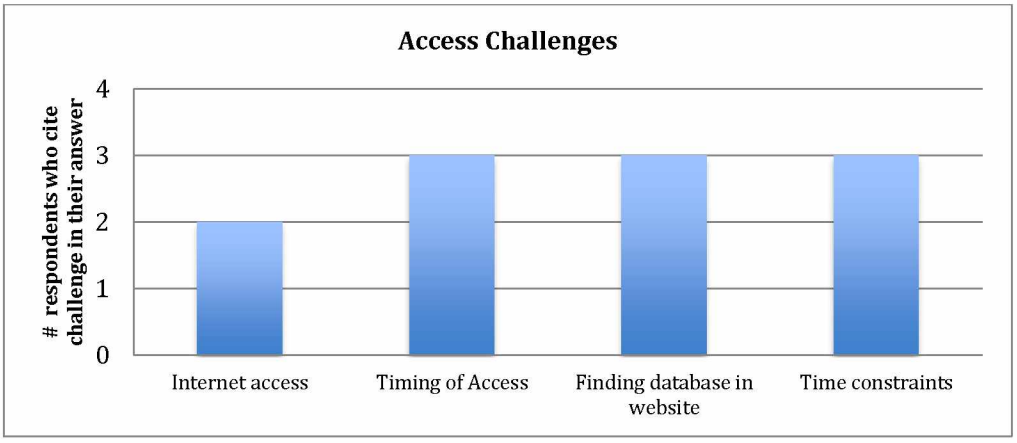

Figure 8. Database access challenges. Eleven of the 17 respondents believed there to be challenges in terms of accessing the database itself. These answers were split nearly evenly among four key categories: Internet access (n=2), ineffective exposure (n=3), finding the database in the website (n=3) and time constraints (n=3).

5. Discussion

a. Comparing Results to Evaluation Criteria and Information Needs

When viewed in comparison to the evaluation criteria from the previous section, these results show some clear patterns in terms of the database's utility. These patterns are the foundation for answering the evaluation questions.

- Is the information in the database perceived as credible and complete?
- Does it respond to a need in the region?
- Is it perceived as simple to access?
- Is it perceived as simple to use?
- Did anyone use the database to enhance his or her own understanding of research in the area?
- Did anyone use the database in a way that influenced their own work?
- Did anyone use the database to pursue new collaborations?
- Are there elements of the database that need improvement?

The database is perceived as credible and mostly complete.

To be a viable decision support tool, the database must be credible, salient, and legitimate (Dilling & Lemos, 2011). More specifically, a tool such as this database must be 1) based on accurate information and perceived as such, 2) relevant to an important need or topic in the respective field,

and 3) fair to all stakeholders involved to dissuade power imbalances. While asking respondents to discuss their experiences with the database, part of the interview process also helped to gauge how respondents felt about the contents of the database itself, and whether they trusted the information to be true.

While only twelve respondents felt comfortable remarking on the database's accuracy, the majority of those reported that they trusted the database's information to be true. Several remarked that they recognized projects within the database and praised the tool's comprehensive nature in regards to the ongoing research at the time of its creation. However, these respondents also made an important distinction: while they trusted the information on the *projects* to be accurate, respondents did not believe the same to be true for the *contact information* listed alongside them. Without trustworthy contact information, the utility of the database is limited, especially in terms of collaboration.

Respondents cited the fickle nature of researcher responsibilities to be the main cause of this. Investigators often change positions or retire, thus rendering their previous contact information useless. This problem became a prevalent pattern in the database itself, with nearly 25% of its investigators listed with outdated contact information.

The database responds to a need in the region.

Even the best-made tool must have a task that requires its assistance; otherwise, like a hammer without nails, it becomes a nuisance at best and a bludgeon at worst. As mentioned above, one of the three criteria for a decision-support tool to be successful is for it to be relevant for its stakeholders; that is, it should be in response to their needs. The majority of respondents (70%) agreed that the database was a relevant tool for Western Alaska. Most cited its convenience as the primary factor; having the project information all in one list could save users the time and effort

usually needed to scour their own resources for the same data. Four respondents also stated that the database's focus on collaboration could help, especially since many funding sources view interdisciplinary collaboration as a good investment. A few respondents believed that broadening the database's focus to include traditional knowledge and solution-based efforts would improve the tool considerably.

Challenges to ease of access.

Accessing the database generally required a few key elements: 1) consistent access to Internet resources, 2) familiarity with the ACCAP and WALCC project website formats, and 3) clear directions on how to find the database from their project pages. While all respondents had access to a stable Internet connection, those who worked with local communities emphasized how the need for Internet could be a prerequisite for this tool that limited its influence on potential users without regular access to online resources.

For respondents with regular access to the Internet, accessing the database still posed a significant challenge. Respondents had to navigate the ACCAP and WALCC project websites, which were platforms that many respondents were completely unfamiliar with. Then, once respondents finally accessed the project page, they still had to find the link to the database within the list of project products. This led many respondents to click on the map portion as they mistook the visual representation for the database itself. This suggests a need for better explanation or documentation to go along with the database. Without explicit directions, newcomers were highly unlikely to find the database on their own.

The database is perceived as being easy to understand.

Respondents nearly unanimously agreed that once they could access the database, navigating the database was exponentially easier. The tabulated database was intuitive enough for them to explore it without any problems. A fraction of respondents emphasized that the map version of the database was easier for them to interpret, and so they gravitated to the visual portion first. The strict categories and prevalent jargon in the database caused concern for a small portion of respondents (especially those working locally), but not enough for them to dismiss the database completely.

The database faces challenges in its use.

Understanding the database and using the database proved to be two different goals within the context of this evaluation. *Understanding* the database required minimal effort and could be done in a relatively short amount of time. *Using* the database required respondents to internalize the information, translate it for their own purposes, and interweave it with their ongoing thought processes in their work. This required a much greater investment of their time and effort, and as such, it occurred much less often. Over a third of them weren't sure if it was easy to use; some reported that they hadn't had enough time to thoroughly explore the database enough to make that assertion, while others simply couldn't picture how they would use it in their own work and didn't want to make that judgment. Only 29% of respondents actually used the database and were able to give concrete assessments of their utility experience; the other respondents had to draw conclusions from their limited experience with the database's functions.

The database was used enhance understanding of research in the area.

The database offered many benefits to its potential users, one of which was giving a general overview of projects occurring in Western Alaska. Half of the respondents who opened the database

listed this as their primary motivation for exploring the database. This was the most reported reason for opening the database, and of the five respondents who used the database in their own work, three of them cited this as their primary motivation for doing so. Respondents liked this tool for expanding general knowledge of research in the area, and overall, they expressed their satisfaction in the results.

Using the database in personal work.

Many respondents believed the database to be a good tool for increasing awareness of the projects happening in Western Alaska. However, they also expressed the distinction between *potential* uses of the database (the reasons for initially exploring the database) and the *actual* uses of this tool. Actual use of this tool requires an onlooker to incorporate the information into their work in a transformative way. This can occur in explicit ways (for example, collaborating with another researcher or incorporating other data to add another perspective in the existing project), or in more subtle ways (such as searching out other similar projects for personal reference).

The five respondents that reported actual use of the database tended to use it in the subtler ways. Four of them used the database as a reference tool, either for general knowledge or for exploring projects in their specific field. This required internalizing the information in a way that could manifest later in their work, even if that didn't occur soon after opening the database. One respondent used the database more explicitly; this respondent used the database to assess the different funding sources to inform his own proposal. This resulted in an actual product (in the form of the submitted proposal) that was informed by the database, albeit subtly.

Using database for collaboration.

While many respondents agreed that the database would be a good reference for pursuing collaborations, none of them used it for this purpose.

Potential improvements for database.

Respondents suggested many ways to improve the database for the future. Some of these included smaller fixes, such as adding papers and other project information, including metadata, adding a category for shore processes specifically, and listing more historical projects in addition to ongoing research. These depended on the affiliation of the respondent. For example, respondents working locally were more likely to ask for ways to make the information more accessible to people without an extensive scientific background, while respondents associated with larger agencies were more likely to ask for more project results and technical data. Expanding the project's visual components to include the same amount of information as the tabulated database would help the potential users that gravitate towards the visual representation.

Respondents shared two specific concerns regardless of their affiliation: namely, *the database's risk of becoming outdated quickly*, and *the apparent lack of outreach*. To be most effective, the database must be a dynamic tool; more specifically, someone must consistently add new projects and edit outdated information. The database briefly had a page to allow researchers to submit their projects, but this relied on voluntary participants, and so project leaders that didn't know about the database did not have the chance to submit their information as well, even if they were willing to do so. Increasing outreach to make researchers aware of the database's existence theoretically could alleviate this. Most respondents that knew of the database had heard of it near its release date when WALCC staff was actively trying to make people aware of it, and the rise of hits on the database's website during this time supports this. When this push of outreach faded, however, so did the number of people who opened the database.

Is the information in the database perceived as credible and complete?	*Does it respond to a need in the region?*	*Is it simple to access?*	*Is it simple to understand?*	*Is it simple to use?*	*Did anyone use the database to influence his or her own work?*	*Did anyone use the database to pursue collaboration?*	*Are there any elements that need improvement?*
Mixed, project info and variety good; Contact information easily outdated	Yes, the need for better awareness and collaboration	No, hard to find within the websites	Yes, although can be expanded with map portion for visual learners	Possibly, depends on the motivations for use; often time-intensive and needs strong direction or reward	Yes, especially as a reference tool	No	Yes; tool would benefit from expansion of database contents, updating contact information, and increased outreach

Evaluation Results Summary. The results of the evaluation summarized in correlation with the evaluation questions from section 11.

b. Putting Things in Context

The database's objectives are as follows (Brown & Knapp, 2015):

- Foster better coordination about coastal change in Western Alaska
- Help practitioners and scholars learn from each other
- Identify information gaps in management needs

Based on this evaluation, it meets these objectives partly, but none of them completely. It does encourage its audience to reach out to other researchers in the area, but its audience remains fairly small, limiting the number of people who actually have the time and opportunity to do so. Those who explored the database learned more about the research in Western Alaska—thus, arguably helping them to learn from each other, albeit indirectly—but this didn't appear to translate into fostering better coordination in future projects. Most respondents used the database to inform their own work, but not necessarily transform it into something more collaborative. Finally, the database indicates some stark information gaps between stakeholder-recommended needs and ongoing research in Western Alaska; however, due to its relatively static nature, it could not continue to do so as time progressed.

In September 2016, the database was updated with new projects. I reviewed these projects again and compared them to the identified needs from the Coastal Hazards Workshop to see if they had changed after the database's initial release. While the number of ocean-to-shore processes and bathymetry projects remained the same, the number of nearshore projects increased from 5 to 8. This category showed a heartening increase, but this was the only tangible improvement in terms of bridging existing information gaps. The database itself did not appear to spur further changes, but it can still help identify what those information gaps *are*.

It is also important to note that, as mentioned in the database's initial report, it is likely that this gap may not be as large as indicated by the database's contents. There are likely more ongoing projects that are not indicated in the database itself, especially since the added projects were submitted voluntarily by their principal investigators.

Why wasn't it as successful as we might have hoped?

Before elaborating on why the database might not have been as successful as initially planned, it is important to remember the limitations of this evaluation. The low response rate is a particular concern; some people might have used the database in their work, but were unavailable to contribute due to time constraints or even lack of knowledge of the evaluation altogether. The reported concerns regarding the database might be skewed or incomplete for similar reasons. However, the existing contributions do give some intriguing insights that merit discussion.

This evaluation has shown little in the way of "success" in terms of meetings its objectives. Based on the responses received, this doesn't appear to be a fundamental design flaw on part of the database; rather, the challenge arises in integrating the use of the database into the current research process.

For the database to influence research in transformative ways (i.e. inspiring changes to the research by adding new perspectives), it must help participants accomplish four goals: awareness, communication, connection, and action (Roux et al, 2006; Winterfeldt, 2013; Wyborn, 2015). First, the database must help in *awareness* by ensuring that the information is made readily available, possibly in response to prior information gaps. Secondly, it must enable *communication* between participants by encouraging participants to pursue their curiosities on the topic and making the initial contact with other researchers. Thirdly, that communication must lead to an exchange between the interested parties that results in them emerging with different ideas, changed perspectives, or the beginnings of a working relationship. Lastly, these resulting ideas or relationships should ideally manifest as *action* by influencing how these people approach their work. This can be in the form of collaborative projects, more interdisciplinary perspectives reflected in ongoing research, or other transformative means.

While these goals build on one another, they can't always carry the others' momentum. Progressing to the next step in the sequence requires overcoming unique obstacles. Progressing from awareness to communication is time-intensive and complicated by the logistics of technology and travel, especially in Alaska. Finding the time to reach out to the other person, coordinate agendas, and then decide on the proper communication method (be it email, phone, online, or in-person) can be difficult for personnel already burdened with hectic schedules. This amount of effort is only a worth investment if the other person might be receptive, and if both parties can envision enticing results.

Crossing from communication to establishing an actual connection can be equally daunting, but it is equally as crucial. This requires the people involved to overcome some logistical obstacles such as differing communication styles, the limits of the technology used to interact with one another. The biggest challenge, however, often comes in the form of bias stemming from the people's' respective disciplines (Crona & Parker, 2008). For example, researchers and managers may have different motivations, jargons, and ideas of what the *other* person values. In mild cases, this can be a minor inconvenience; in more severe cases, this can hinder any productive exchanges altogether.

Moving from an established connection to initiating action can also be logistically challenging. Any future efforts may face limited funding, an unreceptive audience, or simply no perceived reward for the effort required. Without this incentive, the momentum behind collaborative efforts is difficult to sustain.

The WALCC Coastal Change Database operates best as an awareness tool at this time. Respondents liked its convenience (by having project information all in one place) and that the contents were easy to read and follow for most parties (although perhaps a little jargon-heavy). It helps reach the awareness goal with relative ease, but getting to the next three (communication,

connection, and action) has been more difficult. The information provided by the database simply is not enough to propel participants into the next steps. Putting people and data together does not always lead to them forging a course with it (although it can, if the people are incentivized). To do this, they might need something that not only brings people to the database but also rewards them for incorporating it into future decisions. Finding places where this connection is encouraged to foster and grow may help encourage this process, especially if these interactions emphasize what some of the benefits of using this database might be.

What could be changed in the future for the database to achieve its original objectives?

For WALCC staff, the tool was perceived as a useful gauge of the region's research in relation to the organization's goals for the future. The problems start to appear when the database is placed into its context with users beyond WALCC staff. The database relied on a participatory model where the users dictated how and when the tool would be integrated into their own work, based on their own needs and restrictions. This gave users the freedom to apply the information in the way they felt most effective, but it also put the burden of that effort solely onto them. Translating and integrating this type of information requires a significant amount of time and dedication, which are two elements usually not in abundant supply for most researchers.

For the database's approach to work, it must have the proper environment. The tool needs to be connected to a pertinent topic, released to a receptive audience, and needs to be introduced at a crucial point of the research process. This helps ensure that the tool has enough attention and momentum to sustain consistent, effective use. Designing a tool that's relevant and appealing to its target audience is an important step, but putting in in front of that audience at the right time can be

more difficult. This timing is perhaps the most crucial in terms of a tool's success (Lynam et al, 2007).

The WALCC Coastal Change Database, at least in its beginning, satisfied these requirements. It addressed a specific issue—coastal change—that has a large impact on research, management, and Alaskan livelihoods. Its audience—mostly, but not limited to, researchers in Western Alaska—expressed an interest in increasing awareness of ongoing research and developing interdisciplinary relationships. Lastly, when participants learned of the database via workshops and webinars, hits on the database's webpage peaked exponentially. However, this initial curiosity proved to be unsustainable, and now, the hits and awareness of the database's existence remain consistently low.

The results of this evaluation indicate one major thing: as it is, the database is fading slowly into obscurity. An obscure tool is generally a useless tool, no matter how relevant or well-designed it may be. Increasing the database's outreach would help keep it in the public eye, thus encouraging people to continue opening it and exploring its contents. The method of such outreach will depend on how much time and effort any responsible staff can invest in such a task. Simply including the database's name and description in any newsletters, list-serv emails, and other mass media from WALCC and ACCAP could help accomplish this with minimal effort. This would at least bring some curious minds in the database's direction without requiring significant time or funding in the process.

To stimulate some more significant results, however, the database could also benefit from some fine-tuned direction in regards to its outreach once it is updated consistently. This would require outreach that aimed to place this database in front of researchers at a particular point in their research process, rather than dispersing it for the general masses. Placing this database in front of researchers *before* they begin their projects would help them to use it more fully. By targeting researchers at this part of their process, it would allow them to incorporate the

information in the database a little easier; their projects will still be in developmental stages, and so internalizing new information will not require dismantling any of the work already done for other information to fit. Upcoming researchers could use this database to assess funding sources for their proposals, identify any knowledge gaps in research, or use the contact information to network and collaborate with other researchers in their field. This could be accomplished by using the existing WALCC and ACCAP networks, or by introducing the database at key events (workshops, seminars, networking events) where there are social incentives for the users to explore in a little more detail than they might in their own time.

6. Conclusion

With the results from this evaluation, I can now revisit the three main questions this project aimed to answer (found originally in Section 8).

How was the database used since its creation?

Based on the responses given in interviews, this database was mostly used as a reference tool for users to gage the types of projects happening the region. Curiosity tended to be a bigger motivator that the prospect of collaboration. The actual rate of use is also fairly low (29% for evaluation respondents), likely due to the significant investment of time required to integrate the new information into the user's existing research framework.

What challenges does this database face as a science communication tool in Western Alaska?

This evaluation also revealed obstacles that this database faces as a science communication for this region. Some of these are tied intimately with the tool's maintenance; for example, the outdated contact information and the database's resulting static nature. The tool still must reach as large an audience as possible, which in the remoteness of Western Alaska, is a monumental feat. Hosting the database in an Internet medium made it easy to reach some audiences (such as researchers) but difficult for others (such as local communities).

Finally, the database still had to contend with the fickle balance of effort versus reward. Anyone accessing the database needed the time and resources to 1) translate the information into a usable format for them, and then 2) integrate the information into their work in a way that most benefits them. The amount of effort this person is willing to invest into this database will be directly proportional to the perceived reward they hope to gain from it. Based on the responses in this evaluation, the reward for use of the database (especially the collaboration aspect) is simply not significant enough for researchers to commit to the required investment of resources.

How can this evaluation inform the creation and use of science communication tools in this region in the future?

In addition to revealing certain challenges for this database, this evaluation has also revealed some strengths of the database that may benefit future tools as well. A large portion of respondents gravitated to the components of the database that seemed more flexible and visually stimulating. Dynamic, visual tools will more likely attract and engage their audience. This is especially important for tools in this area, as the remoteness already makes it difficult to get tools into researchers' hands; a forgettable tool is a failed tool. Respondents indicated that a place exists for these support tools to flourish, but they need 1) persistent outreach, 2) a dynamic design, and 3) immediate benefits for users' time.

Future Considerations. The interviews provided in this evaluation provided the basis for this evaluation, but they are not fully comprehensive. If any changes are implemented for the database's maintenance or design, further study could be done to monitor the response and note any improvements or further challenges. There are other similar projects in neighboring LCCs (such as the coastal resilience workshops in the Aleutian Bering Sea LCC) whose products could be compared to the WALCC database, especially in terms of how they encapsulate the needs for coastal communities. Future tools (especially those who want more of a focus on collaboration, rather than internal use) might benefit from the incorporation of potential users in the development process; having a focus group might help refine the tool to better benefit them.

The evaluation of the WALCC Coastal Change Database has shown how a tool can assist science communication in Western Alaska, and yet still suffer from its own intrinsic limitations. Coastal change will continue to be a challenge for Western Alaska and beyond, and while collaborative efforts may help approach these issues creatively and efficiently, these efforts will need additional support to succeed.

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