Coastal Community Vulnerability Index and Visualizations of Change in Cook Inlet, Alaska

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Abstract

The Cook Inlet Response Tool (CIRT) is a web-based data integration and visualization platform designed to assist with planning for oil and gas extraction activities in the region and to improve outcomes in the event of an environmental crisis. The CIRT is a component of the Alaska Ocean Observing System (AOOS) portal, which provides interactive public access to environmental data for Cook Inlet and other regions around Alaska. This project added to the CIRT by creating an integrated human-dimension, socio-economic data layer titled *Wild Resource Harvest and Use by Cook Inlet Communities*. We partnered with Axiom Data Science to add harvest and use data that can be overlaid to create maps and visualizations. Meetings were held with environmental managers representing three Cook Inlet native villages to ground-truth the harvest and use data and to get a better understanding of coastal change, resource abundance, and harvesting activities. The villages engaged in the project included Tyonek in northern Cook Inlet, Seldovia in southern Cook Inlet (Kachemak Bay), and Nanwalek at the mouth of Cook Inlet. Community members expressed interest in using the CIRT and proposed adding data on contaminants, vessel traffic, harmful algal blooms, ocean acidification, and seabirds to inform the analysis of harvest and use activity.

Introduction

The Cook Inlet Response Tool (CIRT) is a web-based data integration and visualization tool designed to assist in planning for oil and gas extraction activities in the region and to improve outcomes in the event of a technological disaster (e.g., a catastrophic event such as an oil spill) caused by human error in controlling technology or a malfunction of a technology system. The CIRT is available on the Alaska Ocean Observing System (AOOS) data portal and is a test case for an interactive response tool for technological disasters. The tool was developed and funded by the Cook Inlet Regional Citizens Advisory Council (CIRCAC). Interactive and web-based, the CIRT combines static Geographic Information Systems (GIS) spatial data layers with real-time observations based on instrumentation in Cook Inlet, images of coastal change (through the ShoreZone tool, aoos.org), and forecasts for winds, waves, and ocean circulation. The CIRT brings together data to provide oil and gas planners and disaster responders with crucial up-to-date information. Cook Inlet provides an excellent test case for the newly-developed tool as there are robust data available and ongoing monitoring activities in the region.

This project added to the CIRT by creating an integrated human-dimension data layer titled *Wild Resource Harvest and Use by Cook Inlet Communities* under the socio-economic category of the CIRT data catalog. The new data make the CIRT more useful to area tribal organizations and their environmental departments by including their harvest and use data. Figure 1 shows the project area and communities represented in the new data layer.

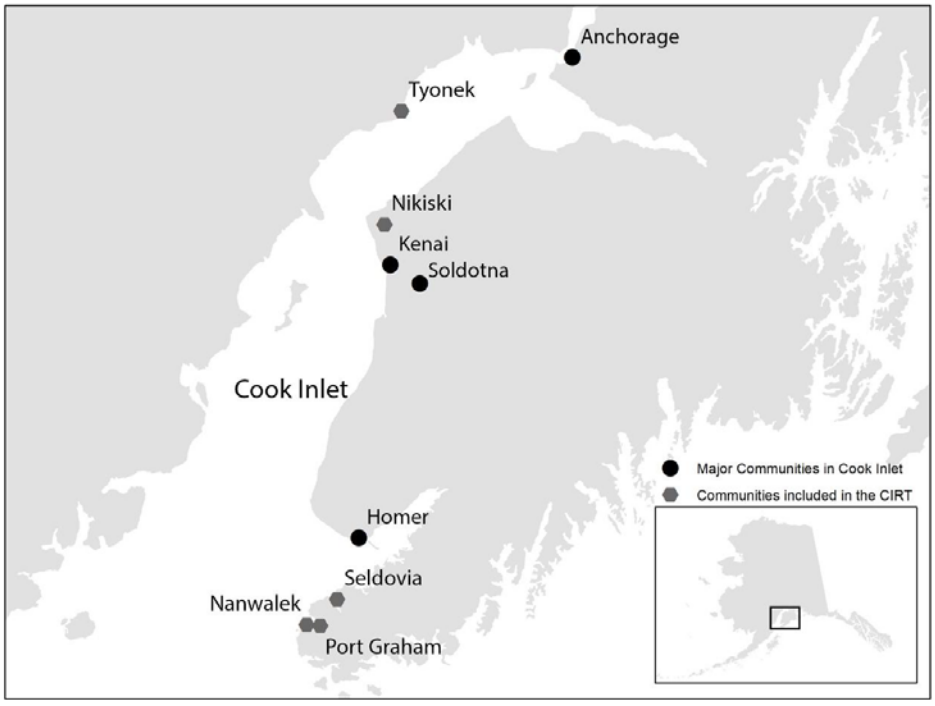

Figure 1. Cook Inlet region and communities included in the project.

The new layer reflects one calendar year of harvest activity data for each of the communities: 2013 for Tyonek and 2014 for Nanwalek, Nikiski, Port Graham, and Seldovia (Jones et al. 2015; Jones and Kostick 2016). Harvest is displayed by community; resource category such as salmon, shellfish, or non-salmon fish; month of harvesting activity; method of access, such as boat or ATV; method of harvest, such as rod and reel fishing or dip net; and amount harvested, shown as intensity of use. Figure 2 shows the online data interface. The new layer shows areas of vulnerability for human populations that use Cook Inlet for harvesting wild resources. In the event of a technological disaster in Cook Inlet, a region with active oil and gas drilling and heavy ship traffic, this tool would help responders mitigate environmental damage in areas shown to be most important for the harvest of wild resources.

Figure 2. CIRT data interface: Wild Resource Harvest and Use by Cook Inlet Communities.

Background

The Cook Inlet region of Alaska has been an important area for oil and gas exploration and development since 1896 (Stanek et al. 2006) and was impacted by the 1989 *Exxon Valdez* oil spill in Prince William Sound (Fall and Zimpelman 2016). The energy industry shares Cook Inlet with commercial fishing, important for local livelihoods, and residents who harvest abundant salmon, shellfish, and other marine resources for household consumption. Recent efforts to expand gas production to meet the growing energy needs of Southcentral and Interior Alaska have increased ship traffic and exploration activity in Cook Inlet, as would a proposed liquid natural gas pipeline, which would terminate in Nikiski. These development activities, which provide energy and jobs benefitting the local and state economy, exist alongside commercial, sport, and personal use fishing activities (Holen 2017; Holen and Fall 2011; Holen 2009; Jones et al. 2015; Jones and Kostick 2016; Stanek et al. 2006).

The harvest and use of wild resources have been mapped for the Cook Inlet by the Alaska Department of Fish and Game Division of Subsistence (ADF&G); however, no synthesis of these data has been compiled (Holen 2017; Jones et al. 2015; Jones and Kostick 2016). In Alaska, with limited funding and a vast but sparsely populated coastline, there has been relatively little coastal mapping in most areas to measure shoreline erosion or to project possible impacts of sea-level rise. However, in recent years, there have been increased efforts to collect data on coastal change in Cook Inlet, and high-resolution elevation and coastal and riverine mapping are ongoing or completed for the region, which hosts a majority of Alaska's population. Larger municipalities, with greater resources than rural areas, have made efforts to document shoreline change for community planning (e.g., Homer http://www.cityofhomer-ak.gov/planning/coastal-erosion), and social scientists have compiled coastal community fishery involvement indices to understand the wellbeing of coastal communities in Alaska (Himes-Cornell and Kasperski 2016). Residents who use the region's the marine resources are concerned about impacts from industry as well as climate change and natural processes such as erosion along coasts and rivers, sea-level rise, the impacts of ocean acidification on shellfish, and changes in salmon abundance due to marine conditions. This project provided a synthesis of harvest and use data, which can be used to consider oil and gas development activities within the broader scope of activities and climate-related changes occurring within Cook Inlet.

Synthesis of existing data sets, using GIS or other means, supports assessment of the potential effects of offshore development and informs oil spill risk analysis and mitigation of impacts on the biological and human environments. Coupling related data with contemporary harvest patterns and local observations of environmental change improves the information available to environmental and resource managers. For example, existing layers in the AOOS data portal for the CIRT can be used to investigate impacts to shellfish beds in lower Cook Inlet due to relative sea-level rise or decline. Shellfish have declined in the area around Seldovia and Nanwalek in recent years, a concern to fishery managers and residents who continue to depend on these resources for household consumption and traditional subsistence practices. In Tyonek, rapid erosion is occurring south of the community, drastically altering the coastline near a former timber loading area slated to be transformed into a fish processing plant. Understanding potential coastal changes would help communities and planners assess the suitability of locations for such economic development projects as well as subsistence harvesting. In addition, by engaging residents closest to current and potential exploration and development, local concerns could be documented to inform developers and managers of sensitive areas and seasonal activities.

The harvest and use visualization layer is a component of the CIRT and is designed to be broadly available online to assist responders in the event of a technological disaster. The tool, which includes geographic response strategies, uses mature data sets and could be a model for other areas of Alaska such as Prince William Sound and the Bering Sea. Prince William Sound, which hosts the Valdez Marine Terminal for the Trans-Alaska Pipeline, experiences high oil-vessel

traffic, and the Bering Sea will see an increase in shipping as open water increases and arctic sea ice retreats.

Objectives

This project leveraged the existing CIRT to visualize coastal and marine conditions and changes overlaid with hunting, fishing, and gathering data. The goal was to provide oil and gas planners, technological disaster responders, the CIRCAC, and other stakeholders with data to understand where harvest and use of wild resources are taking place in the event of a technological disaster. We also set out to overlay data on weather, climatic, and marine conditions with information on human use of the marine environment in Cook Inlet for use by tribal environmental programs and local planners. The outcome of this project provides visualizations through the AOOS data portal as part of the CIRT. The tool allows users to layer multiple data sets available through the portal (http://portal.aoos.org) and makes useful information readily accessible to stakeholders.

The objectives followed a workflow from consolidating data to creating a data portal.

1. Compile spatial harvest data for Cook Inlet as part of the data available for the Cook Inlet Response Tool (CIRT) available on the Alaska Ocean Observing System (AOOS) data portal.
2. Enter the data into a GIS platform to produce maps or visualizations for review.
3. Review data at meetings with three of the five communities represented by the new harvest and use layer to gain input on long-term environmental trends and recent changes, community concerns related to oil and gas activity in Cook Inlet, and additional layers to include in the CIRT.
4. Produce a model of a coastal vulnerability index for the AOOS CIRT module.

Methods

Data Collection and Entry

Gorokhovich et al. (2014) completed a similar study in Northwest Alaska, overlaying geomorphology, sea-level rise, and coastal erosion mapping with hunting, fishing, and gathering data. We adapted the Gorokhovich study to conditions specific to Cook Inlet, where sea level is declining relative to vertical land movement and tectonic activity can cause dramatic shifts in the position of the shoreline. Harvest-mapping in the Gorokhovich project was completed through participatory workshops where residents picked areas they deemed important for harvesting activities. Here, we used conducted by

This project used ADF&G data derived from comprehensive household surveys for all harvests conducted by households for a single calendar year for each of five communities: 2013 for Tyonek and 2014 for Nanwalek, Nikiski, Port Graham, and Seldovia. ADF&G collected the data through a census in the smaller communities and a random sample in larger communities using a standardized harvest assessment mapping methodology. The data included the resource, month of search or harvest, search area, harvest location, harvest amount, harvest method, and mode of access (e.g., boat, ATV, etc.) (Holen et al. 2014; Jones et al. 2015; Jones and Kostick 2016). These data represent the most complete and recent harvest activity mapping in Cook Inlet.

Axiom Data Sciences entered preliminary data sets following the standard protocols they use to upload other data to the AOOS platform. A comprehensive overview of sampling strategy and methodology to collect the data is included as Appendix A, and a summary is available in the metadata section of the tool at https://portal.aoos.org/cirt.

Community Input and CIRT Review

During the project, our objectives were modified to streamline the community consultations. Seldovia replaced Ninilchik for on-site meetings, and individual interviews proposed with residents were replaced by meeting with tribal representatives. These on-site meetings were held with tribal councils and their environmental departments to look beyond the annual data to understand longer-term harvest patterns. The specific goals of the meetings were (1) to review the CIRT and new layer to gauge the potential utility of the tool, (2) to identify layers that would be useful to show alongside the harvest and use layer, and (3) to learn about recent changes and community concerns that may not be reflected in the harvest data. A secondary goal was to assess the tool in a small geographic area as a pilot to see if a larger-scale project in the Bering Sea region would be useful.

Meetings in each community were led by the project PI, Davin Holen, who led similar subsistence studies while working at ADF&G and developed the GIS data collection and documentation methodology used in gathering these spatial harvest data. In Seldovia and Nanwalek, Dr. Holen was assisted by Emilie Springer, an anthropologist living in Homer. Standardized presentations were provided at each community meeting, and notes were taken from the guided discussions.

Results and Discussion

Data Collection and Data Entry

ADF&G compiled and transferred their 2013/2014 comprehensive harvest data sets; final GIS data were received in early August 2017 (see Appendix A for additional data detail). Axiom Data Sciences added interactive data layers and sublayers to the existing AOOS/CIRT portal. The new data in the catalog were finalized, metadata was finalized, and feedback was included in the CIRT based on (1) accuracy in how harvest and use of wild resources by communities was displayed, (2) perceived utility of the tool by local communities, and (3) data layers identified as most useful to pair with the new layer.

Community Input and CIRT Review

Meetings were held in Seldovia on October 3, 2018, in Nanwalek on November 3, 2018, and in Tyonek on April 8, 2019. These communities represent a spread geographically, with Tyonek in Northern Cook Inlet, Seldovia in Kachemak Bay in Lower Cook Inlet, and Nanwalek in outer Cook Inlet. Meeting notes for Seldovia are included as Appendix B, Nanwalek as Appendix C, and Tyonek as Appendix D. Although a standardized presentation was provided to each community, each meeting was very different. For example, in Seldovia, the tribal council leadership and staff focused on the utility of the tool and other layers that could be included. In Nanwalek, the environmental department focused on changes in recent years that may not be reflected in the data. In Tyonek, the council president and environmental department director focused on concerns from recent oil and gas activity in Cook Inlet. Meetings included opportunities for open feedback and guided questioning (see Appendices).

During the meetings with the tribal councils, all three communities noted that the harvest and use tool demonstrates the diversity and scope of resource harvesting activities and emphasizes local knowledge. Representatives indicated they were satisfied with the format for displaying the data and found it was beneficial to have a component showing local use and the importance of resources to local communities. Residents expressed concern over changes in shellfish harvests. In response to changes, Seldovia is actively working on reestablishing shellfish beds by seeding local beaches through a partnership with the Alutiiq Pride Shellfish Hatchery. The community of Nanwalek also has a tradition of shellfish harvesting, and now community members must travel long distances to maintain this subsistence activity. Shellfish harvesting activities are not adequately represented in the data. If the shellfish surveys are expanded, future development of the CIRT could involve adding newly collected data such as these. The best remaining razor clam harvesting area is at Kustatan, south of Tyonek in west Cook Inlet. Residents of Nanwalek, Tyonek, and Seldovia travel to this area to harvest these resources. In Tyonek, they noted that in May 2019 there would be seismic testing from Ninilchik down to Seldovia. Community members are concerned with potential disruptions to clam harvesting in this area.

In Nanwalek, they stressed that harvest activities have changed, with harvesters traveling further in summer and staying close by during winter. This is due to competition with sportfishing

operations close to the community in the summer, forcing subsistence harvesters further offshore. In winter, subsistence harvesters are staying closer to shore due to rougher weather in the Gulf of Alaska. These harvest patterns may not be adequately displayed in the data.

The meeting in Tyonek elicited a great deal of feedback. The discussion focused on changes that may result from oil and gas activity in Cook Inlet. Although some changes may be based on climate and ocean conditions, the participants indicated that increased oil and gas activity could at least be a contributing factor to the observed changes. The following is a summary of the meeting, beginning with concerns specific to oil and gas development, and followed by concerns that may be peripheral to these activities.

In Tyonek, the tribe and environmental department have been working closely with nearby oil and gas developers. Residents feel they are kept well informed of exploratory and production activity. However, they still have significant concerns, especially as extensive oil and gas infrastructure crosses the land (Stanek et al. 2006; Stanek et al. 2007). While the oil and gas platforms are allowed to dump a certain amount of waste, residents are concerned that, over the years, this has had a detrimental impact on marine mammals and fish, especially salmon. They reported that they could smell oil and methane on the shores for about a month after the discharge. They know that surface sampling occurs, intended to verify that there is no detrimental impact, but they are concerned that sampling is not occurring in the deeper water strata. They are also worried about air quality based on the intensity of the smell. Harvesters in the local subsistence and sport fishery are observing more frequent deformations in salmon, what they call “squiggle backs.” They wonder if salmon have the deformed spine because of oil contamination.

In the summer of 2018, there were at least six known pipeline breaks in the marine environment. Tyonek residents are concerned about old lines running in the Inlet. Community members working in the oil industry in Cook Inlet observe what is happening on land; new lines are being attached to old lines causing concern about possible corrosion. They would like to know the plan to replace the aging infrastructure to prevent further leaks in the pipelines in the marine environment.

Outside of the marine environment, a new proposed gas pipeline would run through Tyonek land to the Donlin Mine. Residents are worried about pipeline impacts to wetlands used by migratory birds. They believe the environmental impact statement for the Donlin gas line was rushed and did not consider their comments. There is also a high density of moose in the area, and the pipeline will run through areas where moose often congregate during the rut.

Harbor seals have begun appearing in Chuit Lake. They are concerned about what may be causing this behavior in local seal populations. Beluga whales are also exhibiting strange behavior by entering Robert’s Creek to feed. Marine mammals entering freshwater areas to feed is something they have never observed before. They also observed rockfish making their way up into Chuit Lake. They found several rockfish in the lake as well as the creek.

Residents in Tyonek are worried about the installation of the pipeline at Ladd near Beluga, which they think may be responsible for strange behavior in nearby fish. The installation of the pipeline stirred up silt in the water, impacting the fishery nearby. This is an area used for both subsistence and commercial fishing. Kelp has been washing up on the beach near Tyonek, which is a new occurrence and unusual for a community so far up the inlet. Tyonek residents are worried that too much activity in the Inlet is stirring things up.

Finally, contamination and harmful algal blooms are a major concern. Residents in Tyonek are worried about higher levels of paralytic shellfish poisoning and domoic acid present in shellfish or other algae blooms contaminating beach locations. They noted that recently four moose close to fish camps near the village were eating something off the beach and quickly died. Bears would come by to inspect but would not touch the dead moose. Community members ended up burying the moose. This story underscored the utility of adding data on contamination and harmful algae blooms to the CIRT. Ship traffic data would also be helpful in understanding activity occurring nearby.

Based on discussions in all three communities, the following layers were identified as being helpful for the tribal environmental departments, planners, and responders and should be added in development of the CIRT:

- Contaminants
- Vessel traffic
- Harmful algal blooms
- Ocean acidification
- Sea bird distribution

Conclusions

This project was a test case to see what utility a human-dimension layer would have for environmental planning at the local level, as well as planning and response at the regional level. There was active interest in this project by the three communities where meetings were held. The meetings demonstrated that the CIRT is a useful tool for communities and elicited suggestions of other layers that would be helpful for environmental planning.

A valuable application of this work would be to develop a similar response tool for Prince William Sound, particularly given the amount of tanker traffic and potential for accidents in that region. The Prince William Sound Regional Citizens Advisory Council has expressed interest in seeing something like this developed. Similarly, participants at the 2018 Bering Sea Data Synthesis Workshop expressed interest in developing a Bering Sea response tool. Dr. Holen is working with Axiom Data Sciences on an AdaptAlaska (adaptalaska.org) project funded by the Western Alaska Landscape Conservation Cooperative, through the National Park Service, to build a similar tool for the Bering Sea Region, which includes 29 communities from Unalaska to Kivalina. This is in response to community concerns over increased ship traffic and potential for vessel drift and fuel spills.

Acknowledgments

Special thanks to community members Michael Opheim (Seldovia), Gwen Kvasnikoff and Priscilla Evans (Nanwalek), and Art Standifer and Justin Trenton (Tyonek) for participating in this project and providing invaluable input. This project was funded by the Coastal Marine Institute and Bureau of Ocean Energy Management (BOEM). Thank you to Sue Saupe for supporting the project and securing match funding by the Cook Inlet Citizens' Advisory Council. We thank Chris Campbell (BEOM) for having a vision for including more social science in the Coastal Marine Institute, Dr. Lima and Dr. Primo (BOEM) for helpful comments on reports, Dave Partee (Alaska Sea Grant) for editing assistance, and Molly McCammon (AOOS) for helping to pull this project together. Thanks also to Rob Bochenek and John Dunaway (Axiom Data Sciences) for designing the harvest and use tool and Emilie Springer for assisting in interviews.

Study Products

Harvest and Use data is available on the Cook Inlet Response Tool through the AOOS data portal (http://portal.aoos.org).

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Appendix A: Data Collection Methodology

The following is a summary of subsistence harvest data collection. For a detailed description, see Jones and Kostick (2016) and Jones et al. (2015). The primary method for collecting subsistence harvest and use information was a systematic household survey. The study years were early 2015 for Nikiski, 2014 for Nanwalek, Port Graham, and Seldovia, and 2013 for Tyonek. Following receipt of comments at community meetings, where the project was described to residents, Alaska Department of Fish and Game Division of Subsistence (ADF&G) researchers finalized the survey instrument. A key goal was to structure the survey instrument to collect demographic, resource harvest and use, and other economic data that are comparable with information collected in other household surveys in the study communities across Alaska and with data in the Community Subsistence Information System http://www.adfg.alaska.gov/sb/CSIS/. The objective of this study was to survey all households in Tyonek, Nanwalek, Port Graham, and Seldovia (including Seldovia City proper and Seldovia Village census-designated place). To complete a census survey, ADF&G researchers worked with a combination of locally hired research assistants, knowledgeable community members, and tribal administrators to develop a community household list (Jones et al. 2015; Jones and Kostick 2016).

The sampling strategy employed in the larger community of Nikiski was to execute a random sample survey, requiring a different approach employed to determine the sampling universe (i.e., number of eligible households). First, a parcel layer (ArcGIS feature class) containing ownership and usage data (e.g., “residential,” “commercial,” “public facility,” etc.) was downloaded from the Kenai Peninsula Borough (KPB) Geographic Information Systems website on November 25, 2014, http://www.kpb.us/gis-dept. The KPB parcel layer was then clipped using ArcGIS to align with the Nikiski 2010 Census Designated Place boundaries. According to the usage category, some residential parcels were listed as having multiple units. These parcels were tagged and ground-truthed to determine the number of occupied units on those parcels. Occupied units were then added to the sampling frame. This process resulted in the identification of a total of 1,925 potential households. Based on this sample size, it was determined that 200 households would be a representative sample size for Nikiski. Following the initial determination for the sampling frame and random sample survey goal, residential parcels listed as “vacant” were spot-checked prior to sample selection, and the sample size was updated. Additionally, during the survey effort, identified unoccupied structures were removed from the sampling frame, resulting in a final estimate of 1,568 households in Nikiski. The initial sample survey goal was achieved (203 households surveyed), resulting in a 13% sample achievement of the final estimate of Nikiski households (Jones and Kostick 2016: 19-20).

During household interviews, the researchers asked respondents to indicate the locations of their hunting, fishing, and gathering activities during the study year. A standard mapping protocol guided ADF&G researchers. Features included points, polygons (shapes), and lines. Points were used for harvest locations that were specific to a small area; polygons were used for search areas, such as when hunting moose, and harvest areas, such as for migratory waterfowl or small game

where respondents might indicate a larger area where there were multiple harvests; and lines were used occasionally to depict traplines. Overall, the protocol for documenting harvests is a guide and researchers were trained to use the feature that best captured the activity that was related by the respondent (Jones et al. 2015; Jones and Kostick 2016).

Harvest locations and hunting and gathering areas were documented using an application designed on the ArcGIS Runtime SDK for iOS platform. As mentioned previously, the application was developed by HDR, an environmental research firm located in Anchorage. The device used to collect the data was an iPad. The point, polygon, or line was drawn on a U.S. Geological Survey topographic relief map displayed on the iPad. The iPad allowed the user to zoom in and out to the appropriate scale and the ability to document search and harvest activities wherever they occurred in the state of Alaska. Once a feature was accepted, an attribute box was filled out by the researcher that noted the species harvested, amount, method of access to the resource, and month(s) of harvest. The data were uploaded via Wi-Fi to a server. Data uploads to the server were undertaken once daily in the field when cellular networks or Wi-Fi connections were available. This provided a back-up of the spatial harvest data. During the check-in process, the number of successful point, line, and polygon uploads was displayed on the device. Upload failures were also displayed on the device and recorded by the researchers. Data that failed to upload were later downloaded directly from the device and added to an ArcGIS geodatabase. Researchers periodically conducted quality control checks on uploaded data with a website developed by HDR as a means of validating successful uploads. Once data collection was complete, the data were downloaded into an ArcGIS geodatabase. Paper maps were also available to be used as a reference for respondents as well as by a local researcher when an ADF&G researcher was not available for the interview to provide an iPad. These maps were 11x17 inches at a scale of 1:250,000 and 1:500:000 and only documented areas within the Cook Inlet region (Jones et al. 2015; Jones and Kostick 2016).

Appendix B: Meeting Notes – Seldovia Village Tribe

October 3, 2018 (notes by Emilie Springer)

1:05 PM Meeting at SVT in Seldovia, AK

Present: Christa Collier (SVT Director), Michael Opheim (SVT environmental coordinator), Jan Yaeger (SVT social science, library history, environmental), Davin Holen, and Emilie Springer

No general community members. No one outside of SVT (http://svt.org)

The following notes are based on Holen's general presentation demonstrating the Cook Inlet Response Tool. He was introducing the data portal and presenting different ways to filter and observe data available. As relatively new to the project (unlike Davin), the data appears quite sterilized—doesn't address individual behavior or subsistence preferences or how these have changed over time. The questions that I was interested in hearing about pre-presentation were:

What kind of changes has the community witnessed over time?

- What kind of information do you have to demonstrate this?
- Would community responses be fairly similar across the community spectrum, or would there be substantial variation in types of subsistence/ commercial products available?

What has influenced/ impacted change?

- EVOS example.
- General oil and gas development as potential hazard?
- Naturally occurring events: 1964 earthquake
- Changes in fisheries technology and harvest techniques (vessel size, structure, availability, cost. General gear development—the introduction of synthetic web, for example)

Any comments on historic hatcheries in the region?
Changes specifically in regards to herring? Shrimp? Crab? Clams (razor or otherwise)?
Ask about "SVT node/ Spatial Viewer"—I could not find this readily available on-line.

Comments from participants:

- CC: "Traditional knowledge is not held as a high priority in the same way across the state."
- MO: Homer/ SVT have the most consistent data samples available for the longest period. Referred to 2004-2005 clam study/ project. Alutiiq Pride hatchery project to re-seed clams in Seldovia and Kasitsna Bay. (http://alutiiqpridehatchery.com--see website for collaborators)
- Davin's question to the group: "*What other visual layers would you be interested in searching in these visual data sets?"*
- The only individual who responded to this was MO. He discussed maps showing contaminants, vessel traffic. He noted: Look at research affiliated with Kris Holderied with NOAA lab: Sea bird distribution survey (https://www.boem.gov/2017-011/), HAB data (http://accs.uaa.alaska.edu/files/kachemak-

bay/PhytoplanktonHarmfulAlgalBloomsProceedings.pdf), Gulf Watch Alaska (https://www.gulfwatchalaska.org/monitoring/) long-term monitoring affiliated with EVOSTC Grant.

Other acronyms/ research venues MO mentioned:

- IGAP (Indian environmental general assistance program)
- BIA Subsistence research
- Assessment of CI Tribe Subsistence (http://svt.org/wp-content/uploads/2016/03/assessment-of-cook-inlet-tribes-subsistence-consumption-final.pdf)

- Davin encourages those present to look at AdaptAlaska website that is available to look at now and should be more functional soon: http://adaptalaska.org
- Short discussion with Jan Y re: Project JukeBox and recorded/ transcribed Seldovia commentary from residents and members of SVT. https://jukebox.uaf.edu/site7/seldovia
  In subsequent email discussion, Jan says that much of this information is housed in museum collections venue of tribe but also available online, see website.

Appendix C: Meeting Notes – Native Village of Nanwalek

November 1, 2018 (notes by Emilie Springer)

10:30-1:30 PM Meeting at Nanwalek Council Office

Present: Gwen Kvasnikoff and Priscilla Evans, Nanwalek IRA Environmental Department

- We arrived at the tribal office around 11:30 after a brief flight with KBay air from Homer. It was a clear day for a flight and an interesting run-way experience (sharp turn just before the mountainside, gravel runway, small landing shack at the base of the hill below town). We walked up to the office, and several people were preparing food for elder/village lunch set to begin while we were still on-site. One woman was cleaning herring roe on branches that she mentioned were from Sitka. There were also some strips of smoked salmon and "Indian fry bread" in preparation in the kitchen.
- Meeting was generally set with Gwen Kvasnikoff, tribal administrator but Priscilla Evans was also present for some of the meeting. Davin began it by basically explaining the Cook Inlet Response tool and AOOS data portal and showing the website. "If there was a technical/ environmental disaster—the data portal tells us where the contaminant may go and how it may impact subsistence areas."
- We talked about primary subsistence harvest, and the three primary species that GK mentioned were bidarki, octopus, and various clam species (I would assume razor and butter clams—ES). We did discuss former primary targets as razor clams, cockles, and crabs, but those species have either suffered from overharvest or seal/ sea lion conflicts.
- GK mentioned one transition as having to go "much farther out in the summer and in the winter we don't go out at all" (I recall her talking about halibut at this point and some conflict of interest with the halibut charter boats from Homer. She mentioned something about "having to wait until after the charter boats go back to the dock").
- Discussion of subsistence and including something in the "elder food boxes" once each week. Species: seal, winter King.
- Following this Davin offered to show an example of the website during the lunch session, but after sitting there with some of the attendants, it didn't seem very practical or that there would be much interest. We took a quick walk around the village and took note of some of the intensity of Russian Orthodox. (Questions: What do all of the icons posted regularly around town mean? What is the difference between a closed/ gated grave and one that is open?)
- As of noon 11/5, I am looking into possible options to return to the community for some follow-up outreach specifically related to some oral history manuscripts we were briefly introduced in the "museum" room of the tribal office.
- Other introductions: 1st Chief John Kvasnikoff

- Websites to consider for further information:

Specifically related to marine/ fisheries resources and socio-cultural community identity:

- NOAA AFSC. From the community profile project. https://www.afsc.noaa.gov/REFM/Socioeconomics/Projects/communityprofiles/Nanwalek_Profile_2000_2010.pdf

Related more to cultural/anthro dimensions of community identity:

- Homer's Pratt museum catalog: http://www.prattmuseum.org/wp-content/uploads/2014/10/Catalog-09-22-14-Lower-Kenai-Peninsula-Sugpiaq-Material.pdf
- Nanwalek History organized by Dr. Medeia Csoba DeHass at UAA.https://nanwalekhistory.com.
- UAF's Nanwalek Project
  Jukebox: http://jukebox.uaf.edu/NanPG/nanwalek/html/people.html

Appendix D: Meeting Notes – Native Village of Tyonek

April 8, 2019 (notes by Davin Holen)

12:00–1:00 PM Meeting at NVT Council Building

Present: Justin Trenton (Director of the NVT Environmental Department), Art Standifer (NVT resident), Davin Holen

- I traveled alone to Tyonek on the morning of April 8, 2019, on an 8:30 AM flight. For most of the morning, I spoke with community members who came into the council building in the morning to visit. I had been in contact the week prior with Justin Trenton, the new Director of the Environmental Department. Justin posted a meeting notice for noon and contacted tribal council members to attend. At noon, the time set for the meeting, the only member present was Art Standifer, Native Village of Tyonek (NVT) Tribal Council President who had spent most of the morning with me. I've known Art for almost 20 years spending time at his fish camp, at cultural camps, and for research I conducted working collaboratively with the NVT while at ADF&G. The NVT has recently gone through a shake-up in both leadership and staffing. Art is working hard to rebuild the staff, and Justin is working to rebuild and expand the environmental department working closely with the Tyonek Tribal Conservation District. At noon we went ahead with the meeting with just Art and Justin in attendance. Below is a summary of our meeting which lasted about an hour. Art and Justin focused their comments on observed and potential impacts from oil and gas development in Cook Inlet.
- There will be seismic testing this next month from Ninilchik down to Seldovia. Community members are worried about impacts on beluga whales and disruption to clamming activities in the lower inlet. People will be down near Kustatan and Polly Creek harvesting where there is a considerable amount of oil-related activity.
- The oil and gas platforms are allowed to dump a certain amount of waste. Residents are concerned that over the years this has had a detrimental impact on marine mammals and fish, especially salmon. They said that they could smell the oil and methane on the shores for about a month after the discharge. They know that there is surface sampling done to ensure there is no detrimental impact but worried it is not enough. Besides what they can observe in the survey, they are worried about what is occurring in the deeper water strata where sampling is not taking place. They are also worried about air quality as well based on how intense the smell is from the oil and methane.
- They are observing more frequent deformations in salmon, what they call squiggle backs. They wonder if salmon have the deformed spine because of oil contamination.
- Last summer, they knew of six pipeline breaks in the marine environment. They are concerned about old lines running in the inlet. As there are community members who participate in working in the oil industry in Cook Inlet they know, and they can also observe what is happening on land, that new lines are being attached to old lines that may be

corroded. They would like to know what the plan is to replace the aging infrastructure to prevent further leaks in the infrastructure.

- A new potential pipeline running through their land would be the gas line to the Donlin Mine. Residents are worried about the wetlands nearby where the pipeline would run that are important for migratory birds. They said the EIS was rushed and didn't take into consideration comments. There is also a high density of moose in the area, and the pipeline will run through areas where moose often congregate during the run.
- Harbor seals have begun appearing in Chuit Lake. They are concerned about what may be causing this behavior in local seal populations. Beluga whales are also exhibiting strange behavior by entering Robert's Creek to feed. Marine mammals entering freshwater areas to feed is something they have never observed before.
- They also observed rockfish making their way up into Chuit Lake. They found several rockfish in the lake as well as the creek. They found a large goldfish as well.
- They are worried about the installation of the pipeline at Ladd near Beluga which they are concerned may be responsible for strange behavior in nearby fish. The installation of the pipeline stirred up a lot of silt in the water and impacted the fishery nearby. This is an area used for both subsistence and commercial fishing.
- They are worried about higher levels of PSPs in salmon that bears may be consuming.
- Recently there was an event which they could not explain but would like to know the cause. Four moose were eating something off the beach and quickly died. This occurred right outside the village. The bears would come by to inspect but would not touch the dead moose. Community members ended up burying the moose that died which were close to fish camps.
- Kelp has been washing up on the beach near Tyonek which is new for a community so far up the inlet. They are worried that too much activity in the inlet is stirring things up.
- Basic changes due to climate shifts include the appearance of salmon sharks which began moving in the area in the early 2000s. Orca have also been spotted as well as porpoises, and pilot whales. All are species never observed before near the community which is located relatively far up Cook Inlet.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.