Indicators of Fishing Engagement and Reliance of Alaskan Fishing Communities

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Processing plant in Kenai, AK.
Photo by Kristin Hoelting

Introduction

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA) of 2006 requires fishery management actions to provide the optimum yield from a fishery in a fair and equitable manner to all fishermen while providing for the sustained participation of fishing communities and, to the extent practical, minimizing adverse economic impacts on such communities [MSA §301]. National Standard 8 of the MSA specifically states that communities need to be considered when changes in fishing regulations are made, requiring that we "take into account the importance of fishery resources to communities."

If policymakers and regulatory agencies such as the National Marine Fisheries Service (NMFS) are to effectively regulate and protect marine resources while also supporting local communities as mandated by the MSA, there remain several key questions that must be answered about how involved communities are in fisheries; how these communities may be differentially affected by changes in fisheries management; how they are physically, socially, and culturally impacted by fisheries management decisions; and finally, how they adapt to those impacts in a shifting context of environmental, social, and political change.

In response to the first two questions above, the AFSC's Economic and Social Sciences Research program has developed a set of fisheries engagement and reliance indices using secondary data for 89 communities in Alaska that participate in commercial and recreational fisheries in the North Pacific. The purpose of the study is to explore the degree to which communities are engaged in fisheries in Alaska and how reliant they are on these fisheries, and which communities may be impacted by changes in fisheries management. We consider three main types of fisheries involvement—commercial processing, commercial harvesting, and recreational fishing— and create numerical indices of engagement and reliance for each category of fisheries involvement. Engagement represents the scale of the industry in the community while reliance represents the importance to the community of the industry in terms of numbers per resident.

These statewide indices are a first step toward assessing fisheries involvement by communities across Alaska. Additional indices are necessary to assess the importance of a particular fishery to communities, the importance of certain communities to a fishery, or the relative fisheries engagement and reliance of communities within a specific region of the state. Here we define engagement as a community's participation in fisheries as a whole and reliance as a per capita measurement of fisheries participation. By separating commercial processing from commercial harvesting, the indices presented here show the importance for those communities that may not show up in the NMFS report "Fisheries of the United States" because they have a small amount of commercial landings, but have a large number of fishermen and vessel owners in the community. Additionally, by separating engagement from reliance, these indices highlight communities with relatively small-scale fisheries, but with a large proportion of residents that participate in the fishing industry that may otherwise be overlooked by policy makers given their relatively small scale of fisheries. These indicators give policy makers and communities themselves a quantitative measure of community involvement in a variety of different aspects of fisheries which will help provide information about which communities will likely be the most affected by changes in fisheries management.

These indices are intended to improve the analytical rigor of fisheries Social Impact Assessments through analysis of adherence to National Standard 8 of the MSA and Executive Order 12898 on Environmental Justice in components of Environmental Impact Statements. An advantage to this approach, especially given the short time frame in which these analyses are conducted, is that the data used to construct these indices are readily accessible via the AFSC's Community Profiles of the North Pacific project, do not require time intensive in-person interviews, and can be compiled quickly to create measures of community engagement and reliance and to update community profiles. A summary of data available for this project can be viewed on the AFSC's Community Profiles of the North Pacific: Alaska website.

Methods

Data were collected from state and federal sources for 89 communities across the state of Alaska. Communities were selected for inclusion in our study population if commercial fisheries landings were made in the community or if there was a charter business located in the community. We use mean values from 2005 to 2009 for all variables, and separate them into three different categories of fisheries involvement: commercial processing, commercial harvesting, and recreational fishing. For the commercial processing category, we include the amount of commercial landings, commercial revenue, and the number of processors in each community. For the commercial harvesting category, we include the number of permits, vessels, and crew members in each community. Finally, the recreational fishing category includes the number of charter businesses, sportfish guide businesses, sportfish guide licenses, and sportfishing licenses in each community. For each community, we estimate their engagement in and reliance upon commercial processing, commercial harvesting, and recreational fishing. Community engagement is represented by their actual values of a variable and the reliance is represented by their per capita (divided by population) equivalent.

To examine the relative engagement and reliance of each community to the three categories of fisheries involvement, we conducted two separate principal components analyses (a statistical procedure) for each category to determine a community's relative engagement and relative reliance for each category of fisheries involvement. Principal component analysis was used to create quantitative indices that bring together information from several variables that can help represent specific concepts of fisheries involvement. We used the six principal components analyses included in this study to create six indices of fisheries involvement for each community: commercial processing engagement, commercial processing reliance, commercial harvesting engagement, commercial harvesting reliance, recreational engagement, and recreational reliance.

Results

Our six principal component analyses were designed to each result in a single factor solution, such that all the variables included in each principal components analysis can be summarized by a single index and represent a single concept of fisheries involvement. These indices describe the engagement or reliance of each community to each category of fisheries involvement in a robust and statistically meaningful way.

Below we define the various indices we computed for the 89 included communities in various dimensions, including commercial processing and harvesting engagement and reliance, and recreational engagement and reliance. Table 1 presents the rotated factor loadings and total variance explained for all of the variables included in each of the six principal components analyses. To provide a summary of the community engagement and reliance indices of fisheries involvement for each of the six indices described above, communities were each defined as being minimally engaged in commercial or recreational fisheries if they fell in the bottom 10% of index scores, moderately engaged with an index score in the middle 80%, and the highly engaged with index scores in the top 10% (Figs. 1-6).

The results of the highly engaged communities are presented in Table 2 using a binary scale of 1 or 0 for each index. A community receives a value of 1 in the table for a given index if they are in the top 10% of included Alaskan communities with the final column representing a sum of all other columns. Of the 89 communities included in this analysis, there were 5 communities that have a total index score of 3, 12 communities with a total index score of 2, 9 communities with a total index score of 1, and the other 63 communities have a total index score of zero. Four of the five communities with a total index score of 3, Juneau, Ketchikan, Kodiak, and Sitka, are in the top 10% of communities for commercial processing engagement, commercial harvesting engagement, and recreational engagement. The other community with a total index score of 3, Elfin Cove, was in the top 10% of communities for commercial processing reliance, commercial harvesting reliance, and recreational reliance, largely because Elfin Cove had a small population of 36 residents during the survey period.

Commercial Processing Engagement and Reliance Indices

Commercial processing engagement represents the scale of the commercial fishing and processing industry in the community. The commercial processing engagement index contains commercial revenues, commercial pounds landed, and the number of processors in the community and explains 71% of the variance in the variables. Commercial processing reliance represents the importance to the community of the commercial fishing and processing industry in terms of values per person. The commercial processing reliance index contains commercial revenues per capita, commercial pounds landed per capita, and the number of processors per capita in the community and explains 94% of the variance in the variables.

Commercial Harvesting Engagement and Reliance Indices

Commercial harvesting engagement represents the number of fishermen and commercial fishing vessel owners in the community. The commercial harvesting engagement index contains the number of commercial fishing permits, the number of vessels owned by residents of the community, and the number of crew licenses in the community and explains 95% of the variance in the variables. Commercial harvesting reliance represents the importance to the community of the fishermen and vessel owners in the community. The commercial harvesting reliance index contains the number of commercial fishing permits per capita, number of vessels owned per capita, and the number of crew licenses in the community and explains 92% of the variance in the variables.

Recreational Engagement and Reliance Indices

Recreational engagement represents the scale of the recreational, charter, and guide industry in the community. The recreational engagement index contains the number of charter businesses, sportfish licenses, sportfish guide businesses, and sportfish guide licenses in the community and explains 79% of the variance in the variables. Recreational reliance represents the importance to the community of the recreational, charter, and guide industry. The recreational reliance index contains the number of charter businesses per capita, the number of sportfish licenses per capita, the number of sportfish guide businesses per capita, and the number of sportfish guide licenses per capita in the community and explains 77% of the variance in the variables.

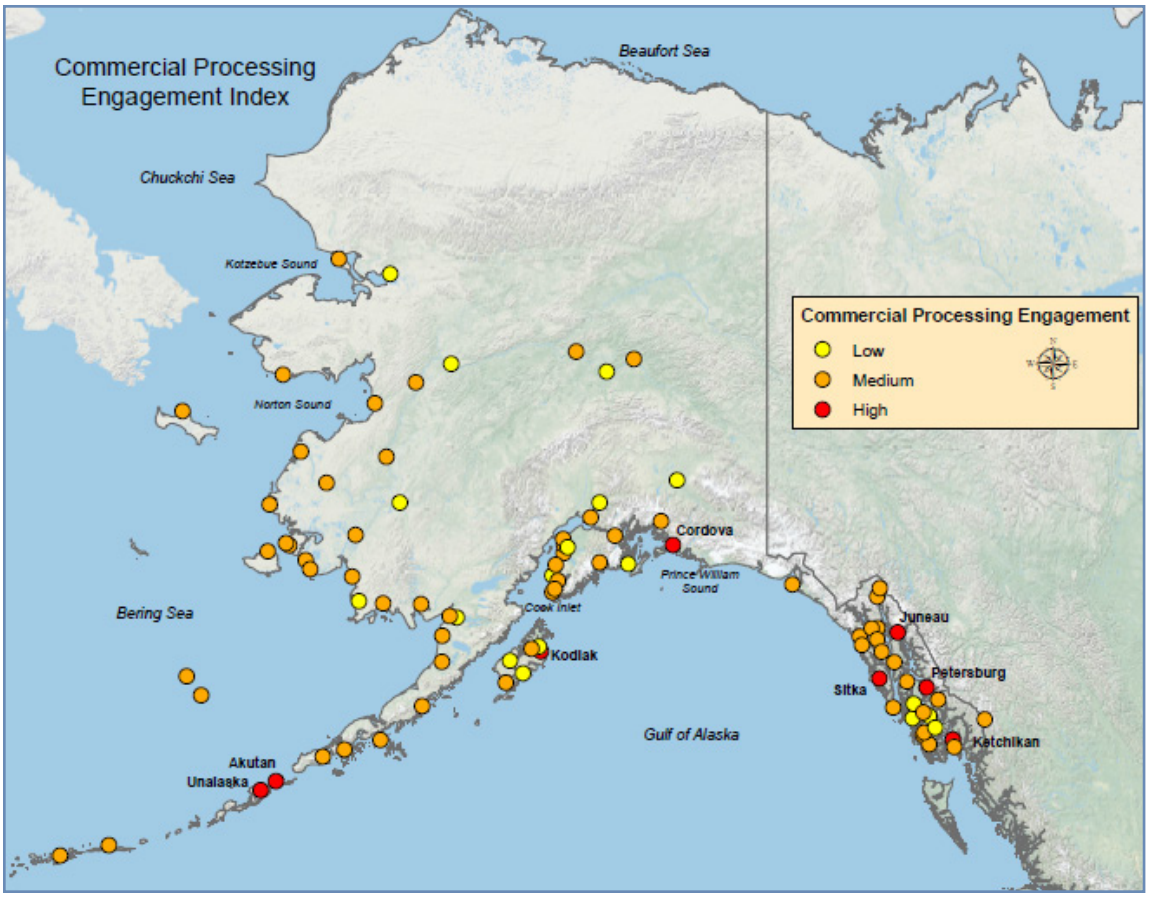

Figure 1: Distribution of commercial processing engagement for 89 Alaskan fishing communities. All communities that rank in the top 10% are considered high and are labeled and in red.

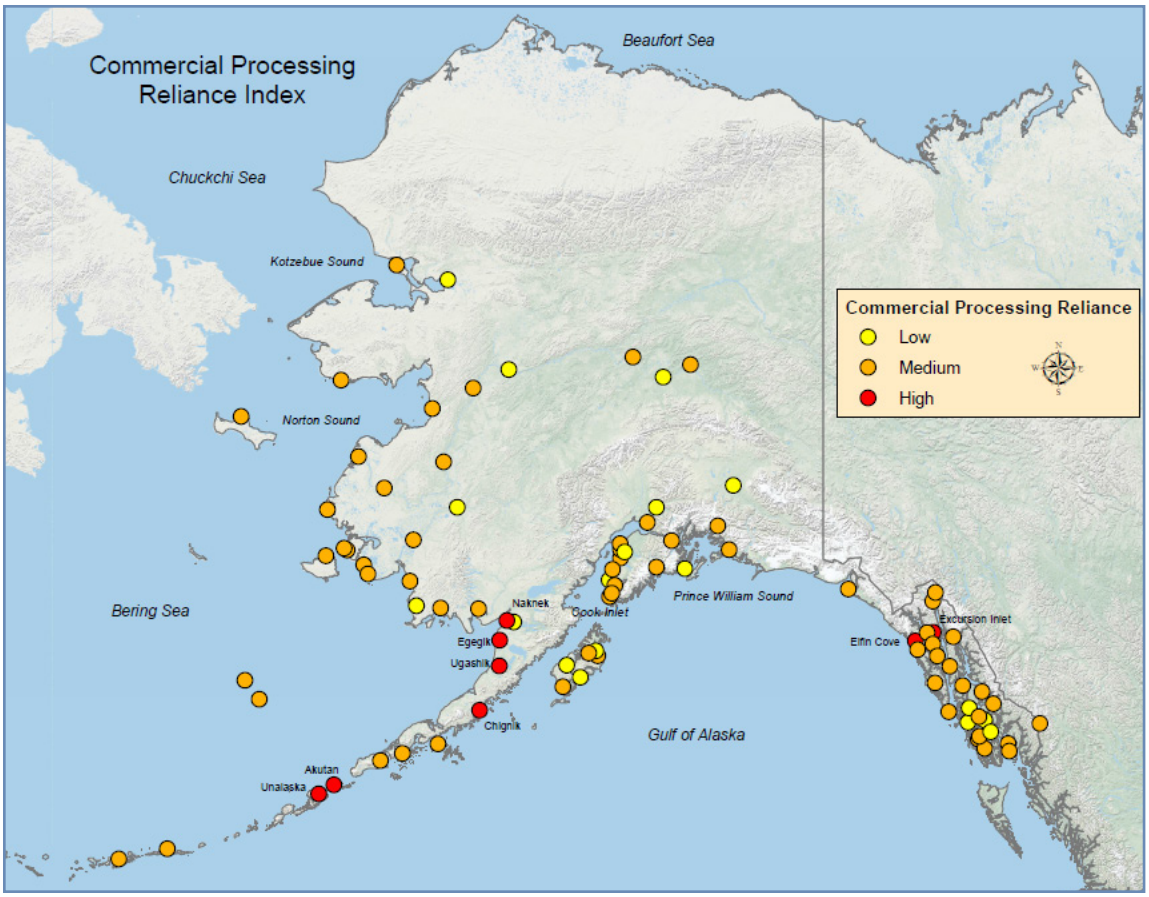

Figure 2: Distribution of commercial processing reliance for 89 Alaskan fishing communities. All communities that rank in the top 10% are considered "high" and are labeled and in red.

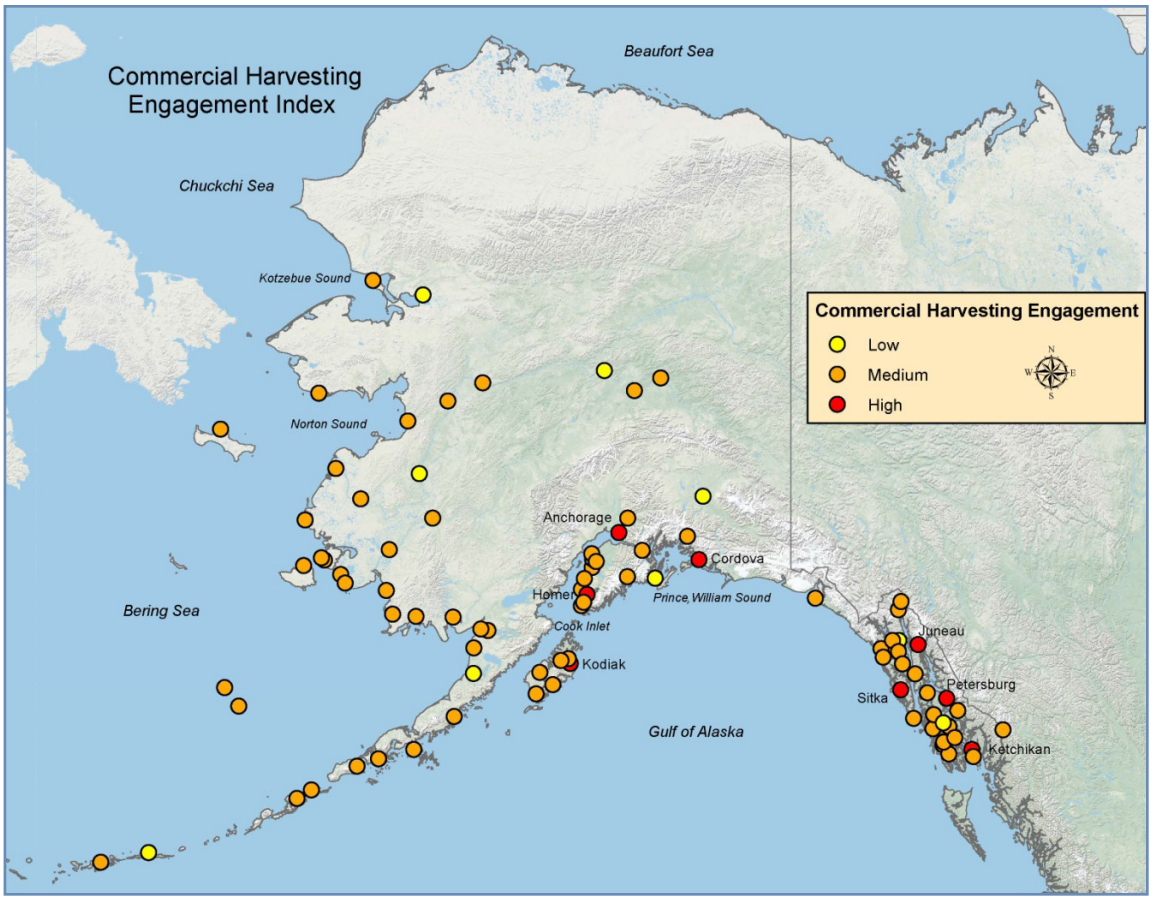

Figure 3: Distribution of commercial harvesting engagement for 89 Alaskan fishing communities. All communities that rank in the top 10% are considered "high" and are labeled and in red.

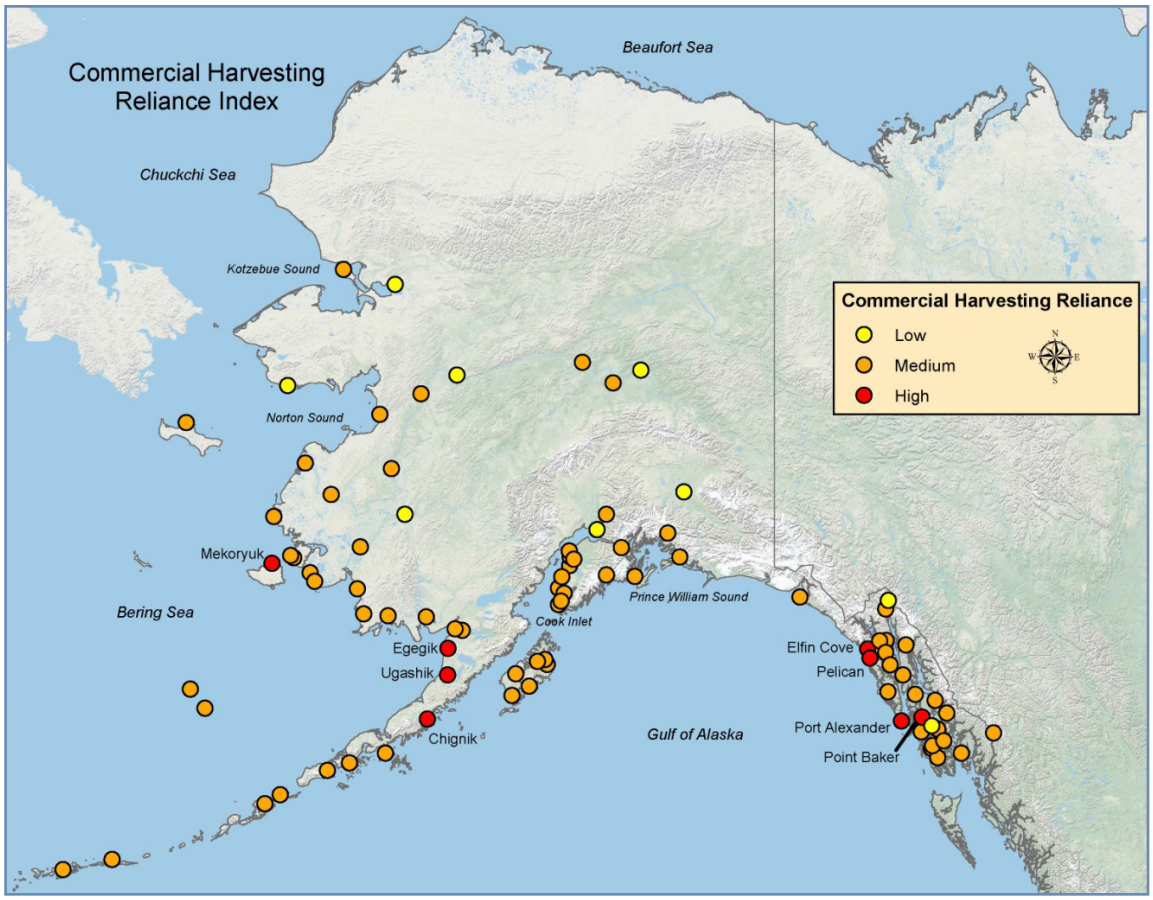

Figure 4: Distribution of commercial harvesting reliance for 89 Alaskan fishing communities. All communities that rank in the top 10% are considered "high" and are labeled and in red.

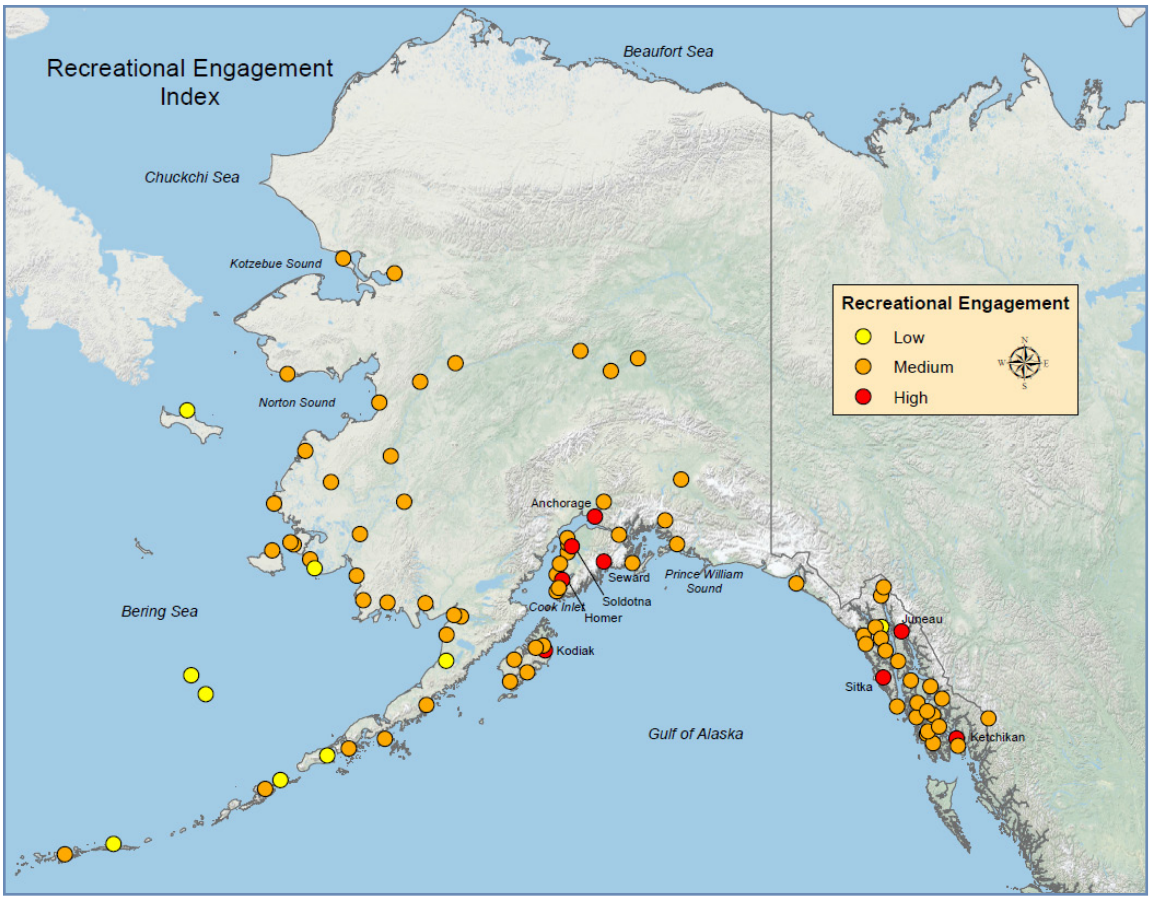

Figure 5: Distribution of Recreational Engagement for 89 Alaskan fishing communities. All communities that rank in the top 10% are considered "high" and are labeled and in red.

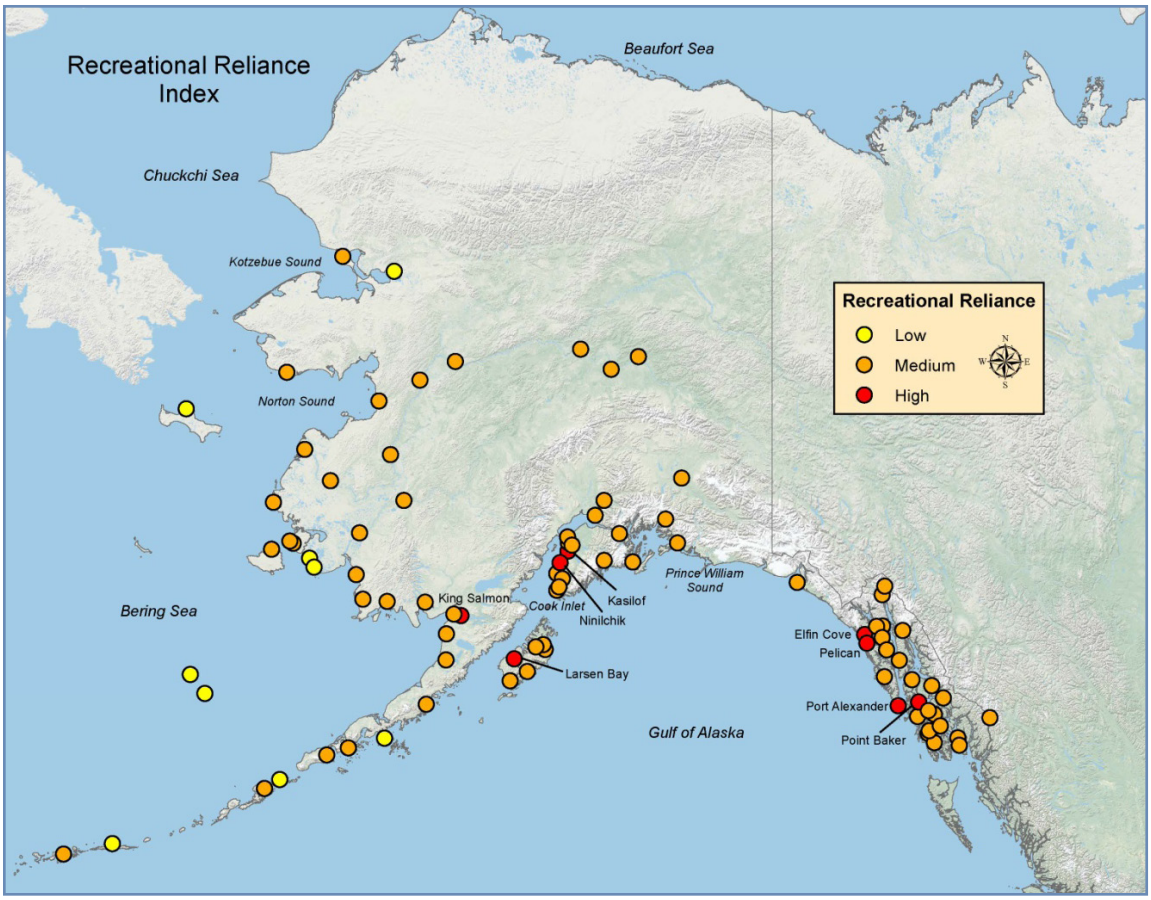

Figure 6: Distribution of recreational reliance for 89 Alaskan fishing communities. All communities that rank in the top 10% are considered "high" and are labeled and in red.

Beach landing site in Aleknagik, AK.
Photo by Kristin Hoelting

Discussion

The results of this analysis show a number of interesting trends in commercial and recreational fisheries participation around the state. As seen in Figures 1-4, regarding commercial fisheries, all of the highly reliant and engaged communities are located in the southern half of the state between the Aleutian Islands, Alaska Peninsula, Gulf of Alaska and Southeast Alaska. Similarly, Figure 5 and 6 show that recreational fishing is most prominent in Southeast Alaska, on Kodiak Island, on the Kenai Peninsula, and in Bristol Bay. However, communities that rank highly in engagement do not generally also rank highly in reliance for the same category of fisheries involvement. This is often a result of communities with a high degree of engagement have a larger population than some smaller communities that have more involvement per resident. The two exceptions are the communities of Akutan and Unalaska which both rate highly in the commercial processing engagement as well as the commercial processing reliance.

As noted previously, Table 2 summarizes the top communities for each of the six indices, where a community receives a score of 1 for each index for which it falls into the top 10% of communities. Of the six potential indices, only five communities had a total index score of 3. One of these communities scored a 1 in all three reliance categories, while the other four communities scored a 1 in all three engagement categories. Of the 12 communities that scored a total of 2, 6 communities have a 1 in both commercial engagement categories, 4 communities have a 1 in both commercial reliance categories, and 2 have a 1 in both commercial processing engagement and reliance. No communities have a 1 in both recreational engagement and recreational reliance. These results show the variety of fishing community types that exist in Alaska and to some extent highlight the diversity in commercial and recreational fisheries involvement seen across the state.

In this study we have chosen to group communities as the highest 10%, the middle 80%, and the lowest 10% for each of these indices, which equates to 8 high communities, 73 middle communities, and 8 low communities. This does not mean that the 9th most engaged or reliant community is not engaged or reliant on fisheries, but rather that there are other communities that are relatively more engaged or reliant. However, in this study we are focusing only on a small number of communities to highlight those areas in which they have a very high involvement in commercial and recreational fisheries relative to the rest of the state.

We created these indices to comport with NOAA's Next Generation Strategic Plan and they will be a significant contribution to the assessment of community well-being in the context of catch share management regimes that govern the majority of Alaska's federal fisheries. Our intent is that these indices will be useful for both fisheries managers and communities themselves to assess and predict community level impacts from fisheries management changes. To further improve these indices, we completed fieldwork in 2013 in 12 communities across the state to groundthruth the results and validate the indices' ability to measure community engagement and reliance on fishing. We are currently using the results of this fieldwork to test the indices and make modifications to the methodology where appropriate.

Table 1: Fisheries involvement indices with factor loadings and total variance explained.

	Rotated Factor Loading	Total Variance Explained
Commercial Processing Engagement		
Commercial revenue	0.983	71%
Commercial pounds landed	0.927	
Number of processors	0.544	
Commercial Processing Reliance		
Commercial revenue per capita	0.988	94%
Commercial pounds landed per capita	0.970	
Number of processors per capita	0.947	
Commercial Harvesting Engagement		
Number of commercial fishing permits	0.990	95%
Number of vessels owned	0.975	
Crew licenses	0.957	
Commercial Harvesting Reliance		
Number of commercial fishing permits per capita	0.972	92%
Number of vessels owned per capita	0.982	
Crew licenses per capita	0.917	
Recreational Engagement		
Number of charter businesses	0.718	79%
Number of sportfish licenses	0.865	
Number of sportfish guide businesses	0.981	
Number of sportfish guide licenses	0.975	
Recreational Reliance		
Number of charter businesses per capita	0.940	77%
Number of sportfish licenses per capita	0.562	
Number of sportfish guide businesses per capita	0.980	
Number of sportfish guide licenses per capita	0.969	

Table 2: Community engagement and reliance indices of fisheries involvement for all Alaskan communities that rank in the top 10% of communities and are therefore considered "high" for at least one index.

Community	Comm. Processing Engagement	Comm. Fishermen Engagement	Comm. Processing Reliance	Comm. Fishermen Reliance	Rec. Engagement	Rec. Reliance	Total
Elfin Cove	0	0	1	1	0	1	3
Juneau	1	1	0	0	1	0	3
Ketchikan	1	1	0	0	1	0	3
Kodiak	1	1	0	0	1	0	3
Sitka	1	1	0	0	1	0	3
Akutan	1	0	1	0	0	0	2
Anchorage	0	1	0	0	1	0	2
Chignik	0	0	1	1	0	0	2
Cordova	1	1	0	0	0	0	2
Egegik	0	0	1	1	0	0	2
Homer	0	1	0	0	1	0	2
Pelican	0	0	0	1	0	1	2
Petersburg	1	1	0	0	0	0	2
Point Baker	0	0	0	1	0	1	2
Port Alexander	0	0	0	1	0	1	2
Ugashik	0	0	1	1	0	0	2
Unalaska	1	0	1	0	0	0	2
Excursion Inlet	0	0	1	0	0	0	1
Kasilof	0	0	0	0	0	1	1
King Salmon	0	0	0	0	0	1	1
Larsen Bay	0	0	0	0	0	1	1
Mekoryuk	0	0	0	1	0	0	1
Naknek	0	0	1	0	0	0	1
Ninilchik	0	0	0	0	0	1	1
Seward	0	0	0	0	1	0	1
Soldotna	0	0	0	0	1	0	1

Conclusion

Through this project we have developed a novel way for fisheries managers to look at the potential community impacts associated with fisheries management changes. The approach presented here represents a quantitative method for incorporating multiple data sources across commercial processing, commercial harvesting, and recreational fishing involvement into measurable concepts of fishing engagement and reliance at the community level. We are currently expanding this methodology to create other types of indices, including a set of Alaskan social vulnerability and resilience indices that include information about the labor force, housing characteristics, poverty, population composition, personal disruption, housing disruption, subsistence fishing, and species-specific dependence. Socio-economics researchers at the Northeast Fisheries Science Center and Southeast Regional Office have developed a website where one can explore a set of similar social indices for the East Coast of the United States. The data for Alaskan communities will be available for exploration on this website in spring 2014.

The main advantage of this methodology is the ability to assimilate large amounts of information by combining a large number of correlated variables into a single index. A second advantage is the ability to rely on secondary data sources to analyze community impacts rather than having to undertake primary data collection (in-person interviews). Primary data collection inevitably takes considerably more time and resources, and ultimately may not fit within the short timeframes in which social impact assessments must often be written in the fisheries management process.

This research represents a glimpse into a larger research project where we are looking at many different indicators of community vulnerability, resilience, and well-being. Some of the additional concepts for which we are developing indices include climate change vulnerability (e.g., changes in sea ice extent, sea level rise, erosion risk), and vulnerability to specific fisheries management actions (e.g., the potential Gulf of Alaska bycatch management program). We are also creating a time series of engagement and reliance indices to facilitate retrospective comparisons of engagement and reliance before and after fisheries management regulations are implemented.

Additional Resources

Himes-Cornell, A., Hoelting, K., Maguire, C., Munger-Little, L., Lee, J., Fisk, J., Felthoven, R., Geller, C., Little, P., 2013. Community profiles for North Pacific Fisheries - Alaska. U. S. Dep. Commer., NOAA Tech. Memo. National Marine Fisheries Service-AFSC-259, Volumes 1-12.

National Marine Fisheries Service (NMFS), 2013. Fisheries of the United States 2012. Silver Spring, MD.

Main harbor and processing plant in Sand Point, AK.
Photo by Conor Maguire