Update of the 2006 Community Vulnerability Analysis

1. Introduction

The 2007-2008 Groundfish Harvest Specifications EIS included an evaluation of west coast fishing community engagement in fishing, dependence on groundfish fisheries, and socioeconomic resilience (PFMC 2006, Appendix A). Together, these criteria were used to assess each community's overall vulnerability to adverse socioeconomic impacts. The 2006 analysis was based on a review of available literature describing community vulnerability assessment methods, which provided guidance in developing the metrics specific to the assessment of community impacts related to groundfish fishery management. (Section 8, below, excerpts the description of this methodology from the 2006 EIS.) This document describes an update to the 2006 analysis, which will be used to supplement the evaluation of socioeconomic impacts in the 2011-2012 Groundfish Harvest Specifications EIS.

This update is not a comprehensive redesign of the 2006 methodology. However, in looking at some aspects of the 2006 methodology various modifications have been implemented in the type of data used for certain indicators and the methods for classifying communities relative to the metric values. In the 2011-2012 harvest specifications EIS projected personal income impacts at the community level under different harvest specifications/management measures alternatives can then be compared to the assessment of community status derived from the updated analysis.

2. Geographic Resolution of the Analysis

This analysis uses somewhat different geographic units for the analysis. As with the 2006 analysis, dependence and engagement metrics are based on commercial fishery landings and recreational participation data, and resiliency metrics are based on U.S. Census Bureau and Bureau of Labor Statistics (BLS) data. The description of the 2006 analysis does not specify precisely what census data were used, but it is presumed that it was 2000 decennial census data, because only that source has the needed geographic resolution for the types of data used. These data likely come from the census long form, including Summary File 3 (SF3) tables. The estimates in these tables are based on survey data rather than a whole population enumeration. The Census Bureau has replaced the long form with the American Community Survey (ACS), which provides inter-decennial estimates on an ongoing basis (US Census Bureau 2008). The ACS uses a rolling sample frame that produces 1-year, 3-year, and 5-year estimates. The multi-year estimates incorporate single year estimates to produce data at a finer geographic resolution. The 1-year estimates release data for geographic areas with populations of 65,000 and greater; the 3-year estimates for areas with populations of 20,000 and greater, while the 5-year estimates are at the census block group level (the resolution of decennial long form data). Thus, to replicate the geographic

resolution of the 2006 analysis 5-year ACS estimates would be necessary.[1] However, the first ACS 5-year estimate, 2005-2009, will only become available in latter half of 2010. For that reason the most recent 3-year estimate, 2006-2008, was used.[2] The geographic resolution of this data set only allows evaluation at a county level. (Several west coast counties have populations less than 65,000 preventing use of the most recent 1-year estimate.)

Another important difference between ACS data and decennial census long form data is the inclusion of margin of error estimates (MOEs). (Although the Census Bureau estimated error in the long form data, these estimates were not made publicly available.) An assessment of statistical significance can be derived from theses MOEs. A pair-wise test of one of the derived statistics, unemployment, suggests that when county level statistics are arrayed in ranked order, there is no statistical difference between counties adjacent to one on another in the rank order, although statistically significant differences may emerge when comparing counties far apart in the rank order.[3] Table 1 illustrates this for the calculated unemployment rate from ACS data. Counties are ranked by unemployment rate and each column and row is a county so that each cell represents a pairwise comparison derived from the standard errors for the statistic. If the test value is greater than the critical value of 1.645 then the difference between the two unemployment values are considered statistically significant at the 90 percent confidence interval and the cell is shaded. It can be seen that the unemployment rate for Del Norte County, which is ranked highest and thus the first column, is not statistically different from the unemployment rates for the next 10 lower ranked counties but is statistically different from 22 of the 23 counties ranked below the top 11. On the other hand, Curry and Pacific Counties (in Oregon and Washington respectively) show no significant difference in unemployment rate from any other county (of the 34 coastal counties included in the analysis), probably because of their small population size. Generally, it can be said that higher ranked counties as a group are significantly different from lower ranked counties as a group. For this reason, as discussed below, counties are put into three groups for each metric in order to assess socioeconomic vulnerability.

[1] Although not documented, it is likely the 2006 analysis used data at the level of Census Designated Places (CDPs), Zip Code Tabulation Areas (ZCTAs), or block groups since results are reported at a "city" level.

[2] ACS data may be downloaded at http://factfinder.census.gov/home/saff/main.html?_lang=en.

[3] The margin of error tends to decrease with population size of the geographic unit. Thus, two counties with large populations may be more likely to show a statistical difference in relatively similar estimates as compared to counties with small populations.

Table 1. Pairwise comparison of counties for statistically significant difference in calculated unemployment rate.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2	0.659																																	
3	0.781	0.416																																
4	0.818	0.517	0.067																															
5	0.862	0.724	0.123	0.049																														
6	0.805	0.464	0.273	0.240	0.224																													
7	1.203	2.019	0.885	0.826	0.924	0.117																												
8	0.933	0.646	0.435	0.401	0.390	0.114	0.037																											
9	1.227	1.707	0.898	0.844	0.911	0.171	0.139	0.023																										
10	1.244	1.527	0.901	0.850	0.897	0.218	0.232	0.077	0.102																									
11	1.484	3.369	1.562	1.518	1.784	0.399	0.873	0.255	0.554	0.348																								
12	1.544	4.244	1.760	1.721	2.088	0.450	1.130	0.307	0.715	0.467	0.181																							
13	1.647	6.143	2.095	2.067	2.621	0.546	1.641	0.406	1.027	0.696	0.625	0.534																						
14	1.668	6.768	2.170	2.145	2.747	0.566	1.768	0.427	1.098	0.747	0.742	0.695	0.264																					
15	1.651	3.114	1.813	1.775	1.998	0.597	1.249	0.465	0.942	0.717	0.573	0.483	0.245	0.189																				
16	1.761	6.521	2.375	2.356	2.977	0.666	2.062	0.531	1.351	0.963	1.135	1.181	1.091	1.112	0.126																			
17	1.765	5.952	2.351	2.330	2.904	0.673	2.004	0.539	1.343	0.968	1.108	1.123	0.947	0.907	0.151	0.064																		
18	1.802	6.859	2.484	2.469	3.129	0.707	2.232	0.574	1.471	1.058	1.327	1.431	1.519	1.654	0.253	0.344	0.220																	
19	1.542	1.753	1.327	1.290	1.330	0.619	0.867	0.503	0.743	0.632	0.479	0.420	0.295	0.268	0.162	0.116	0.102	0.056																
20	1.862	7.856	2.667	2.658	3.412	0.767	2.540	0.636	1.662	1.202	1.659	1.906	2.690	3.821	0.439	1.003	0.699	0.612	0.029															
21	1.856	5.566	2.510	2.492	3.040	0.773	2.201	0.644	1.555	1.164	1.393	1.431	1.312	1.286	0.438	0.612	0.516	0.397	0.052	0.094														
22	1.717	2.573	1.771	1.734	1.863	0.713	1.262	0.591	1.042	0.859	0.742	0.676	0.511	0.474	0.284	0.250	0.227	0.163	0.047	0.041	0.005													
23	1.965	7.782	2.900	2.897	3.682	0.876	2.865	0.750	1.938	1.436	2.061	2.366	3.037	3.496	0.767	1.719	1.366	1.424	0.192	1.151	0.507	0.196												
24	1.958	6.202	2.774	2.763	3.394	0.877	2.587	0.752	1.840	1.395	1.813	1.936	1.975	2.000	0.736	1.211	1.057	0.996	0.201	0.729	0.451	0.207	0.050											
25	1.978	7.410	2.906	2.902	3.659	0.891	2.849	0.766	1.955	1.459	2.058	2.321	2.768	3.017	0.803	1.652	1.361	1.383	0.216	1.111	0.564	0.229	0.122	0.040										
26	2.015	8.085	3.027	3.028	3.853	0.927	3.059	0.803	2.081	1.551	2.286	2.654	3.513	4.082	0.923	2.141	1.715	1.857	0.267	1.684	0.780	0.305	0.424	0.235	0.254									
27	2.075	7.766	3.141	3.144	3.957	0.992	3.190	0.872	2.222	1.680	2.454	2.796	3.399	3.693	1.102	2.295	1.938	2.051	0.365	1.882	1.061	0.444	0.840	0.567	0.663	0.482								
28	2.138	8.916	3.348	3.359	4.289	1.054	3.557	0.936	2.440	1.839	2.860	3.399	4.811	5.745	1.313	3.251	2.618	2.998	0.454	3.110	1.471	0.575	1.512	0.950	1.212	1.080	0.418							
29	2.150	9.858	3.420	3.436	4.441	1.064	3.724	0.946	2.511	1.880	3.046	3.760	6.600	10.613	1.368	4.128	3.067	3.887	0.467	4.964	1.636	0.597	1.978	1.082	1.499	1.438	0.547	0.082						
30	1.985	3.280	2.296	2.266	2.459	0.982	1.865	0.868	1.577	1.339	1.351	1.310	1.170	1.139	0.819	0.895	0.860	0.805	0.403	0.686	0.611	0.448	0.432	0.395	0.391	0.319	0.166	0.039	0.023					
31	2.278	9.827	3.710	3.733	4.780	1.198	4.117	1.086	2.846	2.165	3.508	4.241	6.285	7.648	1.756	4.521	3.648	4.308	0.665	4.770	2.260	0.882	2.776	1.771	2.319	2.340	1.463	1.274	1.559	0.279				
32	2.388	11.254	4.030	4.065	5.258	1.309	4.666	1.202	3.199	2.434	4.151	5.200	9.157	13.575	2.128	6.416	4.894	6.286	0.829	8.203	3.028	1.124	4.403	2.551	3.570	3.892	2.519	2.683	3.982	0.525	1.183			
33	2.587	###	4.411	4.451	5.607	1.522	5.055	1.424	3.643	2.845	4.581	5.382	6.973	7.631	2.657	5.694	4.958	5.528	1.140	5.798	3.600	1.555	4.346	3.205	3.911	4.010	3.172	3.211	3.607	0.990	2.259	1.674		
34	2.621	8.491	4.302	4.330	5.269	1.566	4.681	1.471	3.547	2.839	4.160	4.607	5.173	5.341	2.610	4.411	4.068	4.257	1.202	4.217	3.195	1.610	3.423	2.848	3.203	3.180	2.680	2.590	2.721	1.070	1.903	1.442	0.268	
35	2.208	2.783	2.304	2.277	2.355	1.329	1.947	1.236	1.788	1.638	1.608	1.573	1.479	1.458	1.270	1.314	1.294	1.260	0.904	1.189	1.141	0.992	1.036	1.008	1.010	0.968	0.873	0.800	0.794	0.672	0.609	0.466	0.168	0.087

Key: 1. Del Norte County, California; 2. Monterey County, California; 3. Mason County, Washington; 4. Grays Harbor County, Washington; 5. Douglas County, Oregon; 6. Curry County, Oregon; 7. Humboldt County, California; 8. Pacific County, Washington; 9. Mendocino County, California; 10. Coos County, Oregon; 11. Whatcom County, Washington; 12. Santa Cruz County, California; 13. Alameda County, California; 14. Los Angeles County, California; 15. Clallam County, Washington; 16. Pierce County, Washington; 17. Lane County, Oregon; 18. Contra Costa County, California; 19. Jefferson County, Washington; 20. San Diego County, California; 21. Thurston County, Washington; 22. Clatsop County, Oregon; 23. Ventura County, California; 24. San Luis Obispo County, California; 25. Sonoma County, California; 26. San Francisco County, California; 27. Santa Barbara County, California; 28. Snohomish County, Washington; 29. Orange County, California; 30. Lincoln County, Oregon; 31. San Mateo County, California; 32. King County, Washington; 33. Marin County, California; 34. Skagit County, Washington; 35. Tillamook County, Oregon.

Commercial landings data do not have the same limitations in that it is not sample data; in principal all commercial landings are direct measurements (although there is undoubtedly some level of unquantified measurement error). For that reason metrics based on these data can be reported at the port level. But to allow comparison with the resiliency metrics, fishery data are presented at the county level. Recreational fishery data are also estimates, but since no quantification of sample error (statistical uncertainty) is available it is not possible to determine whether differences among the values are significant.

3. Description of Metrics Used in the Analysis

Engagement and Dependence Metrics

As discussed in Section 8, the 2006 analysis used state and Federal permit holder address information, number of vessels making landings in a port, the amount of nongroundfish and groundfish landings, and the number of processors/buyers as metrics to evaluate fishery engagement and groundfish fishery dependence. In this updated analysis the permits addresses were not used for two reasons. First, this information is more difficult to obtain. Second, it is not clear permit holder address best represents where economic activity related to the vessel is occurring, because the permit holder could reside at a different location from where economic activity related to fishery landings is occurring. The following measures of commercial fishery engagement are used, based on PacFIN data:

- Total number of vessels making at least one landing by port in 2008
- Total commercial ex-vessel revenue by port in 2008
- Total buyers that received at least one landing by port in 2008

For recreational fisheries the following measures of engagement are used:

- Number of charter vessels in each port
- Total of private/rental plus charter angler trips by port[4]

Recreational fishery data were provided by the state representatives on the Groundfish Management Team.

The following measures of dependence on the groundfish fishery are used:

- The number of "groundfish vessels" that made landings in 2008 as a proportion of all vessels that made at least one landing in the port in 2008. Groundfish vessels were determined by the composition of the vessel's landings. If the largest proportion of a vessel's total landings into a given port was groundfish it was counted as a groundfish vessel.[5]
- Total revenue from groundfish as a proportion of total revenue from all species for the port in 2008

[4] In cases where reporting regions consisted of more than one county, angler trips were distributed to counties based on county populations.

[5] A vessel can be counted in more than one port if they have a different mix of landings in two or more ports. For example, a vessel could be a groundfish vessel in one port 1 and a salmon vessel another port. Although this suggests some double counting, since the metric is counting vessels within each port this should not be an issue, because a vessel can only have one primary fishery in a given port.

- The number of buyers for which at least 10 percent of the fish they received in a port in 2008 was groundfish.
- Total revenue from groundfish as a proportion of total revenue from groundfish for all ports in analysis in 2008

For recreational fisheries the following measures of groundfish dependence are used:

- Private/rental plus charter groundfish trips in the port as a proportion of total trips for port[6]
- Private/rental plus charter groundfish trips in the port as a proportion of total groundfish trips for all ports in the analysis[7]

4. Resiliency metrics

The metrics used in the analysis are described below, which are for the most part the same as those used in the 2006 analysis.[8] As noted above, these metrics are derived from ACS 3-year estimates tables and the BLS.

Industry diversity index

The Shannon-Weiner index is conventionally used in ecology to measure ecosystem diversity. However, it has also been used in socioeconomic analyses to measure industry diversification. According to Wikipedia, the Shannon-Weaver Index is one of several diversity indices used to measure diversity in categorical data. It is the information entropy of the distribution, treating species as symbols and their relative population sizes as the probability. The computation is $H = \left|\sum P_i(\ln P_i)\right|$ where P_i is the proportion of each species in a sample. In this application the "species" is an industry category in census employment data and the sample is the county. The 2006-2008 ACS Table C24030 is used to obtain the estimates. This table provides estimates of the civilian employed population 16 years and over in each industry category. The table includes 20 industry employment categories as shown in Table 2.

[6] In cases where reporting regions consisted of more than one county, angler trips were distributed to counties based on county populations.

[7] In cases where reporting regions consisted of more than one county, angler trips were distributed to counties based on county populations.

[8] The description of the 2006 analysis does specify which census tables were used, so the tables to use had to be deduced from the available descriptions.

Table 2. Industry categories in ACS Table C24030.

1	Agriculture, forestry, fishing and hunting
2	Mining, quarrying, and oil and gas extraction
3	Construction
4	Manufacturing
5	Wholesale trade
6	Retail trade
7	Transportation and warehousing
8	Utilities
9	Information
10	Finance and insurance
11	Real estate and rental and leasing
12	Professional, scientific, and technical services
13	Management of companies and enterprises
14	Administrative and support and waste management services
15	Educational services
16	Health care and social assistance
17	Arts, entertainment, and recreation
18	Accommodation and food services
19	Other services, except public administration
20	Public administration

Population Density

Population density figures are not reported in 2006 analysis although it appears that this metric was used in the communities scores (since communities could have a maximum score of 5 with one point assigned for each metric). ACS Table B0001 provides total population estimates. Land area values for each county were obtained from Wikipedia and used to compute population density values at the port group level.

Unemployment Rate

Estimates from the Bureau of Labor Statistics are used for the unemployment rate. County level data for 2008 was downloaded from the BLS website (http://www.bls.gov/data/#unemployment). The unemployment rate may also be derived from 2006-2008 ACS Table C23001. This table reports sex by age by employment status for the population 16 years and over. The unemployment rate is determined by dividing the sum of the unemployed population in each sex-age category, by the sum of the civilian population in the labor force from each sex-age category. (This approach excludes those in the armed forces and those not in the labor force.) Unemployment data from these two sources were compared in the evaluation and showed some differences as to whether a county would be rated high medium or low for this statistic. Although these census derived estimates of unemployment were not used on the resiliency scores, the MOE estimates were used to explore the issue of whether differences between counties are statistically significant, as discussed above.

Percentage of the Population Living Below the Poverty Line

Table B17001 from the 2006-2008 ACS is used to compute the percentage of the population below the poverty line. The table presents estimates of the population with income in the past 12 months below the poverty level by sex and age. The universe is the population for whom poverty status is determined. To

arrive at the poverty rate the estimated number below the poverty level are summed for the age and sex categories and divided by the total population.

Isolated Cities

The 2006 analysis uses and earlier study to identify isolated cities.[9] Because of uncertainty about the definition that was used and the fact that this update reports metrics at a larger geographic scale, this metric was not used.

5. Method for Assigning Scores to Communities for Each Metric

This update derives scores for engagement, dependence, and resiliency differently than the 2006 analysis. In the original analysis the number of times a community fell in the top one-third of ranked communities for a metric was summed. Those with the highest frequency of falling in the top third were then identified as vulnerable. In this update communities are identified in high, low, and medium categories based on an overall score for engagement, dependence, and resiliency. (Since some communities show no groundfish landings for the dependence score a fourth category, not dependent, is added.) Counties are ranked for each metric and given a score of 1, 2, or 3 depending on their rank. These scores are then summed for each of the three metric categories (engagement, dependence, and resiliency) and the results are again binned into three categories and assigned to the high-medium-low descriptive categories.

In the 2006 analysis commercial and recreational fishery metrics were considered separately in the scoring scheme while in this update those scores are combined to arrive at single score for fishery engagement and groundfish fishery dependence. The 2006 analysis classified vulnerable areas as those that are highly engaged in fisheries or dependent on groundfish fisheries and also least resilient. Some areas were rated "most vulnerable" if they had the highest levels of engagement or dependence and the lowest level of resiliency. Since this update uses a different scoring scheme, the assessment of vulnerability is also slightly different: As with the 2006 analysis, counties were rated vulnerable if they are highly engaged or highly dependent, and have low resiliency. But since the scores are descriptive bins (high, medium, low) rather than frequency counts (number of times in the top third), "most vulnerable" counties are identified as those that are highly engaged, highly dependent, and have low resiliency rather than based on the value of a numeric score.

6. Results of Evaluation

Table 5 through Table 7 show the metric values, rank, and resulting classification of counties by engagement, dependence, and resiliency. Table 3 summarizes the results and, using the criteria described above, identifies counties rated vulnerable and most vulnerable. The table also reports the vulnerability ratings from the 2006 analysis for comparison. There is a good correspondence between the results, although the 2006 analysis rated a greater number of counties as vulnerable or most vulnerable. Clallam County, Washington, Clatsop County Oregon; and Monterey and Los Angeles Counties in California were rated vulnerable in the 2006 analysis but not rated vulnerable in this update. Of these, Clatsop,

[9] The 2006 analysis states the criteria for defining geographically isolated cities as those cities located in coastal counties with a population of 1,900 or less, which were not located on a major highway and fell outside of the 35-mile buffer of cities over 20,000. However, no counties have a population of 1,900 or less. They may have meant cities with a population of 1,900 or less.

Monterey, and Los Angeles rated high/low in at least one metric category and Clallam rate medium in all three categories in this update.

The evaluation of socioeconomic impacts will use the port group area as the unit of analysis; the results of the income impacts model are reported at this scale, for example. Port group areas are regional entities that have been created to evaluate socioeconomic impacts of groundfish fisheries. Table 4 lists the port group areas and shows the number of counties within the area rated vulnerable or most vulnerable out of the total number of counties in the area. As part of the impact assessment the relative change in ex-vessel revenue and personal income from status quo for a port group area under an alternative set of harvest limits and management measures can be assessed in relation to the occurrence of vulnerable rated counties in the port group area as part of the impact assessment.

Table 3. Summary of fishery engagement, groundfish dependence, and economic resiliency scores, and vulnerability rating.

County	Engagement Rating	Dependence Rating	Resiliency Rating	Vulnerability Rating	2006 Rating
King County, Washington	Low	Not dependent	High		
Pierce County, Washington	Low	Not Dependent	High		
Skagit County, Washington	Low	Not Dependent	Medium		
Snohomish County, Washington	Low	Not Dependent	Medium		
Thurston County, Washington	Low	Not Dependent	High		
Whatcom County, Washington	Low	Medium	Medium		
Clallam County, Washington	Medium	Medium	Medium		Vulnerable
Jefferson County, Washington	Low	Not Dependent	Medium		
Grays Harbor County, Washington	High	Medium	Low	Vulnerable	Most Vulnerable
Pacific County, Washington	High	Low	Low	Vulnerable	Most Vulnerable
Clatsop County, Oregon	High	Medium	Medium		Vulnerable
Tillamook County, Oregon	High	Medium	Low	Vulnerable	
Lincoln County, Oregon	High	High	Low	**Most Vulnerable**	Most Vulnerable
Coos County, Oregon	Medium	High	Low	Vulnerable	Most Vulnerable
Douglas County, Oregon	Low	Low	Low		
Lane County, Oregon	High	Low	Medium		
Curry County, Oregon	Medium	High	Low	Vulnerable	Vulnerable
Del Norte County, California	High	High	Low	**Most Vulnerable**	Vulnerable
Humboldt County, California	Medium	High	Low	Vulnerable	Most Vulnerable
Mendocino County, California	High	High	Low	**Most Vulnerable**	Most Vulnerable
Marin County, California	Medium	Low	High		
Sonoma County, California	Medium	Medium	High		
Alameda County, California	High	Low	High		
Contra Costa County, California	Low	Low	High		
San Francisco County, California	Medium	Medium	High		
San Mateo County, California	Medium	Medium	High		
Monterey County, California	High	High	Medium		Vulnerable
Santa Cruz County, California	Medium	Medium	Medium		
San Luis Obispo County, California	High	High	Medium		
Santa Barbara County, California	High	Medium	High		
Ventura County, California	High	Medium	High		
Los Angeles County, California	High	Medium	Medium		Vulnerable
Orange County, California	High	Medium	High		
San Diego County, California	High	Medium	High		

Table 4. Comparison of port group areas containing vulnerable counties.

Port Group Area	Number of Counties of Total in Group Rated Vulnerable or Most Vulnerable
Puget Sound, Washington	None out of 8*
North Washington Coast, Washington	None out of 2
South and Central Washington Coast	2 out of 3
Astoria, Oregon	None out of 2
Tillamook, Oregon	1 out of 1
Newport, Oregon	1 out of 1 (Most Vulnerable)
Coos Bay, Oregon	1 out of 3
Brookings, Oregon	1 out of 1
Crescent City, California	1 out of 1 (Most Vulnerable)
Eureka, California	1 out of 1
Fort Bragg, California	1 out of 1 (Most Vulnerable)
Bodega Bay, California	None out of 2
San Francisco, California	None out of 2
Monterey, California	None out of 2
Morro Bay, California	None out of 1
Santa Barbara, California	None out of 2
Los Angeles, California	None out of 2
Sand Diego, California	None out 1

*Two counties in the port group area, Mason and San Juan, were not rated. Mason was not rated because of the lack of fishery landings activity and San Juan because the population is too small to obtain 3-year ACS data.

Table 5. Fishery engagement metrics and county ratings.

	Total Revenue		Number of Commercial Vessels		Total Buyers		Total Recreational Trips		Number of Charter Vessels		Engagement Rating
County	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	
Whatcom	$4,408,090	20	49	2	14	11	0	0	0	0	Low
Skagit	$1,384,550	13	15	2	3	6	0	0	0	0	Low
Snohomish	$1,295	1	3	2	2	3	0	0	0	0	Low
King	$35,605	5	4	2	4	7	0	0	0	0	Low
Pierce	$38,591	6	5	2	3	5	0	0	0	0	Low
Thurston	$2,711	2	1	1	1	1	0	0	0	0	Low
Jefferson	$490,735	11	23	2	2	4	0	0	0	0	Low
Clallam	$1,945,411	14	76	2	10	9	15,400	9	15	20	Medium
Grays Harbor	$38,253,505	35	261	2	44	26	37,547	21	35	25	High
Pacific	$17,161,923	29	228	2	23	15	41,496	22	28	23	High
Klickitat	$15,080	3	5	2	1	2	0	0	0	0	Low
Clatsop	$31,722,869	33	255	2	30	19	5,545	6	13	17	High
Tillamook	$2,763,287	15	133	2	31	21	24,089	16	13	18	High
Lincoln	$32,624,821	34	300	2	71	33	51,595	24	30	24	High
Lane	$110,125	7	7	2	8	8	16,907	10	0	0	Low
Douglas	$1,069,549	12	28	2	18	12	5,024	4	9	13	Medium
Coos	$20,384,735	30	201	2	42	25	3,056	2	4	5	Medium
Curry	$7,266,993	25	152	2	29	18	27,409	18	13	19	High
Del Norte	$9,292,238	27	129	2	23	14	4,418	3	1	1	Medium
Humboldt	$11,219,829	28	139	2	48	27	19,715	12	4	6	High
Mendocino	$7,136,539	23	113	2	36	24	1,603	1	5	9	Medium
Sonoma	$3,638,528	19	91	2	32	22	8,718	7	7	10	Medium
Marin	$274,051	9	40	2	31	20	5,324	5	2	3	Low
Alameda	$113,998	8	36	2	26	16	31,522	19	15	21	High
Contra Costa	$31,149	4	14	2	14	10	21,984	15	0	0	Low
San Francisco	$6,658,290	21	194	2	66	30	17,322	11	1	2	Medium
San Mateo	$3,157,404	17	87	2	61	28	15,181	8	8	12	Medium
Santa Cruz	$390,391	10	38	2	19	13	20,734	13	4	7	Medium
Monterey	$7,579,474	26	113	2	28	17	33,254	20	4	8	High
San Luis Obispo	$2,775,024	16	133	2	35	23	21,734	14	9	14	Medium
Santa Barbara	$7,228,139	24	170	2	67	31	26,102	17	7	11	High
Ventura	$21,162,551	31	188	2	94	35	51,393	23	10	15	High
Los Angeles	$21,475,021	32	222	2	71	32	332,352	27	10	16	High
Orange	$3,421,499	18	131	2	72	34	101,587	25	2	4	High
San Diego	$6,814,849	22	162	2	63	29	102,611	26	19	22	High

Table 6. Groundfish dependence metrics and county ratings.

	Groundfish Vessels		Groundfish Revenue		Groundfish Buyers		Groundfish Revenue, All Ports		Rec. Groundfish Trips		Rec. Groundfish Trips, All ports		Dependence Rating
County	Percent	Rank	Percent	Rank	Number	Rank	Percent	Rank	Percent	Rank	Percent	Rank	
Whatcom	42.86%	22	55.38%	27	6	10	3.918%	20	0.00%	0	0.00%	0	Medium
Skagit	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
Snohomish	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
King	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
Pierce	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
Thurston	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
Jefferson	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
Clallam	30.26%	20	45.99%	24	3	7	1.436%	14	29.58%	3	0.78%	8	Medium
Grays Harbor	7.66%	5	12.55%	11	2	5	7.701%	24	39.33%	4	2.52%	16	Medium
Pacific	5.26%	2	7.73%	9	1	3	2.130%	16	3.47%	1	0.25%	2	Low
Klickitat	0.00%	0	0.00%	0	0	0	0.000%	0	0.00%	0	0.00%	0	Not Dependent
Clatsop	15.29%	12	38.09%	22	4	8	19.389%	28	7.86%	2	0.07%	1	Medium
Tillamook	18.05%	14	6.15%	8	8	13	0.273%	7	46.21%	10	1.90%	14	Medium
Lincoln	19.00%	16	33.11%	21	12	20	17.332%	27	58.97%	17	5.20%	23	High
Lane	0.00%	0	2.63%	4	1	1	0.005%	2	48.74%	12	1.41%	12	Low
Douglas	10.71%	8	5.56%	7	1	2	0.095%	6	48.74%	11	0.42%	6	Low
Coos	23.38%	17	32.90%	20	12	19	10.761%	26	48.74%	13	0.25%	3	High
Curry	55.92%	25	54.27%	26	13	21	6.329%	23	82.35%	22	3.86%	21	High
Del Norte	25.58%	19	27.43%	19	7	12	4.090%	21	79.28%	20	0.60%	7	High
Humboldt	31.65%	21	45.32%	23	14	24	8.159%	25	79.28%	21	2.67%	17	High
Mendocino	46.90%	23	47.96%	25	15	25	5.493%	22	93.16%	27	0.26%	4	High
Sonoma	7.69%	6	8.35%	10	10	14	0.487%	10	93.16%	26	1.39%	11	Medium
Marin	0.00%	0	0.92%	1	2	4	0.004%	1	44.43%	6	0.40%	5	Low
Alameda	2.78%	1	5.53%	6	5	9	0.010%	3	44.43%	7	2.39%	15	Low
Contra Costa	14.29%	10	22.05%	18	3	6	0.011%	4	44.43%	8	1.67%	13	Low
San Francisco	14.43%	11	21.82%	17	16	27	2.332%	18	44.43%	9	1.32%	10	Medium

County	Groundfish Vessels		Groundfish Revenue		Groundfish Buyers		Groundfish Revenue, All Ports		Rec. Groundfish Trips		Rec. Groundfish Trips, All ports		Dependence Rating
	Percent	Rank	Percent	Rank	Number	Rank	Percent	Rank	Percent	Rank	Percent	Rank	
San Mateo	16.09%	13	14.74%	14	18	28	0.747%	12	44.43%	5	1.15%	9	Medium
Santa Cruz	23.68%	18	12.64%	12	12	17	0.079%	5	83.86%	25	2.97%	18	Medium
Monterey	47.79%	24	18.66%	15	16	26	2.270%	17	83.86%	23	4.77%	22	High
San Luis Obispo	67.67%	26	70.75%	28	13	22	3.150%	19	83.86%	24	3.12%	19	High
Santa Barbara	7.65%	4	3.05%	5	7	11	0.353%	8	71.93%	19	3.21%	20	Medium
Ventura	7.98%	7	1.46%	3	14	23	0.497%	11	71.93%	18	6.32%	24	Medium
Los Angeles	5.86%	3	1.23%	2	11	16	0.423%	9	55.71%	15	31.65%	27	Medium
Orange	18.32%	15	19.30%	16	12	18	1.060%	13	55.71%	16	9.67%	25	Medium
San Diego	14.20%	9	13.42%	13	10	15	1.467%	15	55.71%	14	9.77%	26	Medium

Table 7. Resiliency metrics and county ratings.

County	Pop. Density	Rank	Industry Diversity	Rank	Poverty Rate	Rank	Unemployment Rate	Rank	Resiliency Rating
King County, Washington	802.45	7	2.691	12	9.5%	6	4.6%	1	High
Pierce County, Washington	712.84	8	2.678	16	11.3%	12	5.5%	13	High
Skagit County, Washington	60.42	21	2.684	14	12.3%	17	5.5%	13	Medium
Snohomish County, Washington	306.74	13	2.644	25	7.8%	3	5.4%	9	Medium
Thurston County, Washington	308.44	12	2.607	30	10.1%	9	4.9%	4	High
Whatcom County, Washington	76.83	18	2.685	13	15.2%	25	4.9%	4	Medium
Clallam County, Washington	26.33	27	2.702	8	14.2%	22	6.8%	23	Medium
Jefferson County, Washington	13.39	33	2.577	33	13.5%	19	5.4%	9	Medium
Grays Harbor County, Washington	31.96	25	2.604	31	15.2%	26	7.4%	28	Low
Pacific County, Washington	17.44	32	2.646	24	17.0%	31	7.3%	26	Low
Clatsop County, Oregon	34.30	24	2.579	32	12.2%	16	5.2%	6	Medium
Tillamook County, Oregon	22.02	30	2.644	26	17.6%	32	5.4%	9	Low
Lincoln County, Oregon	38.32	22	2.615	29	16.8%	30	6.5%	21	Low
Coos County, Oregon	35.17	23	2.664	20	15.1%	24	8.2%	31	Medium
Douglas County, Oregon	20.25	31	2.647	23	14.0%	21	9.8%	34	Low
Lane County, Oregon	72.62	19	2.648	22	15.7%	28	6.7%	22	Medium
Curry County, Oregon	10.93	34	2.631	27	15.3%	27	8.0%	30	Low
Del Norte County, California	23.47	28	2.449	34	20.3%	34	8.7%	33	Low
Humboldt County, California	31.81	26	2.672	18	18.4%	33	7.2%	25	Low
Mendocino County, California	22.22	29	2.664	21	16.8%	29	6.8%	23	Low
Marin County, California	298.29	14	2.666	19	7.1%	2	4.7%	2	High
Sonoma County, California	262.06	15	2.701	9	10.0%	8	5.7%	15	High
Alameda County, California	1774.87	4	2.672	17	10.8%	10	6.2%	18	High
Contra Costa County, California	1267.70	5	2.705	6	8.8%	5	6.2%	18	High
San Francisco County, California	3440.41	1	2.616	28	11.0%	11	5.2%	6	High
San Mateo County, California	949.70	6	2.703	7	6.7%	1	4.8%	3	High
Monterey County, California	107.56	16	2.699	11	11.5%	13	8.4%	32	Medium
Santa Cruz County, California	360.32	10	2.700	10	12.0%	15	7.3%	26	Medium
San Luis Obispo County, California	72.52	20	2.718	3	12.9%	18	5.7%	15	Medium
Santa Barbara County, California	106.26	17	2.729	2	13.5%	20	5.4%	9	High
Ventura County, California	359.52	11	2.758	1	8.7%	4	6.2%	18	High
Los Angeles County, California	2069.05	3	2.710	5	15.1%	23	7.5%	29	Medium
Orange County, California	3149.78	2	2.683	15	9.5%	7	5.3%	8	High
San Diego County, California	655.31	9	2.715	4	11.7%	14	6.0%	17	High

Note: Rank order for each metric is 1 = highest resiliency.

Table 8. Port group areas, counties and PacFIN ports.

State	Port Group Area	County	PCID	PacFIN Port Name
Washington	**Puget Sound**	Whatcom	BLN	Blaine
		Whatcom	BLL	Bellingham Bay
		San Juan	FRI	Friday Harbor
		Skagit	ANA	Anacortes
		Skagit	LAC	La Conner
		Snohomish	ONP	Other North Puget Sound Ports
		Snohomish	EVR	Everett
		King	SEA	Seattle
		Pierce	TAC	Tacoma
		Thurston	OLY	Olympia
		Mason	SHL	Shelton
	North Washington Coast	Jefferson	TNS	Port Townsend
		Clallam	SEQ	Sequim
		Clallam	PAG	Port Angeles
		Clallam	NEA	Neah Bay
		Clallam	LAP	La Push
	South & Central WA Coast	Grays Harbor	CPL	Copalis Beach
		Grays Harbor	GRH	Grays Harbor
		Grays Harbor	WPT	Westport
		Pacific	WLB	Willapa Bay
		Pacific	LWC	Ilwaco/chinook
		Klickitat	OCR	Other Columbia River Ports
			OWC	
Oregon	**Columbia River**	Multnomah	CRV	Psuedo Port Code for Columbia R.
	Astoria-Tillamook	Clatsop	AST	Astoria
		Clatsop	GSS	Gearhart - Seaside
		Clatsop	CNB	Cannon Beach
		Tillamook	NHL	Nehalem Bay
		Tillamook	TLL	Tillamook / Garibaldi
		Tillamook	NTR	Netarts Bay
		Tillamook	PCC	Pacific City
	Newport	Lincoln	SRV	Salmon River
		Lincoln	SLZ	Siletz Bay
		Lincoln	DPO	Depoe Bay
		Lincoln	NEW	Newport
		Lincoln	WLD	Waldport
		Lincoln	YAC	Yachats
	Coos Bay	Lane	FLR	Florence
		Douglas	WIN	Winchester Bay
		Coos	COS	Coos Bay
		Coos	BDN	Bandon
	Brookings	Curry	ORF	Port Orford
		Curry	GLD	Gold Beach
		Curry	BRK	Brookings
California	**Crescent City**	Del Norte	CRS	Crescent City
		Del Norte	ODN	Other Del Norte County Ports
	Eureka	Humboldt	ERK	Eureka (Includes Fields Landing)
		Humboldt	FLN	Fields Landing

State	Port Group Area	County	PCID	PacFIN Port Name
		Humboldt	TRN	Trinidad
		Humboldt	OHB	Other Humboldt County Ports
	Fort Bragg	Mendocino	BRG	Fort Bragg
		Mendocino	ALB	Albion
		Mendocino	ARE	Arena
		Mendocino	OMD	Other Mendocino County Ports
	Bodega Bay	Sonoma	BDG	Bodega Bay
	San Francisco	Marin	BOL	Bolinas
		Marin	TML	Tomales Bay
		Marin	RYS	Point Reyes
		Marin	OSM	Other Son. and Mar. Co. Outer Coast Ports
		Marin	SLT	Sausalito
		Alameda	OAK	Oakland
		Alameda	ALM	Alameda
		Alameda	BKL	Berkely
		Contra Costa	RCH	Richmond
		San Francisco	SF	San Francisco
		San Mateo	PRN	Princeton
		San Francisco	SFA	San Francisco Ara
		San Francisco	OSF	Other S.F. Bay and S.M. Co. Ports
	Monterey	Santa Cruz	CRZ	Santa Cruz
		Monterey	MOS	Moss Landing
		Monterey	MNT	Monterey
		Monterey	OCM	Other S.C. and Mon. Co. Ports
	Morro Bay	San Luis Obispo	MRO	Morro Bay
		San Luis Obispo	AVL	Avila
		San Luis Obispo	OSL	Other S.L..O. Co. Ports
	Santa Barbara	Santa Barbara	SB	Santa Barbara
		Santa Barbara	SBA	Santa Barbara Area
		Ventura	HNM	Port Hueneme
		Ventura	OXN	Oxnard
		Ventura	VEN	Ventura
		Ventura	OBV	Other S.B. and Ven. Co. Ports
	Los Angeles	Los Angeles	TRM	Terminal Island
		Los Angeles	SPA	San Pedro Area
		Los Angeles	SP	San Pedro
		Los Angeles	WLM	Willmington
		Los Angeles	LGB	Longbeach
		Orange	NWB	Newport Beach
		Orange	DNA	Dana Point
		Orange	OLA	Other LA and Orange Co. Ports
			OCA	
	San Diego	San Diego	SD	San Diego
		San Diego	OCN	Oceanside
		San Diego	SDA	San Diego Area
		San Diego	OSD	Other S.D. Co. Ports

7. References

PFMC. 2006. Final environmental impact statement for the proposed groundfish acceptable biological catch and optimum yield specifications and management measures: 2007-2008 Pacific coast groundfish fishery and Amendment 16-4: Rebuilding plans for seven depleted Pacific coast groundfish species. Portland, OR: Pacific Fishery Management Council. Oct. 2006.

US Census Bureau. 2008. A compass for understanding and using American Community Survey data; What Federal agencies need to know.: Department of Commerce, Economis and Statistics Administration. Dec. 2008.

8. Description of Methodology Used in the 2006 Vulnerability Analysis (Source: PFMC 2006, Appendix A)

Methodology for determining engagement and dependence in the commercial and recreational fisheries

Characterization of community engagement in fishing requires consideration of geographic use on the Pacific fish resource in general while a description of community dependence requires consideration of geographic use of the Pacific groundfish resource specifically. The following indicators are used as proxies for overall community engagement in the Pacific coast commercial fishery:

- Number of federal and state fishing permits as a percentage of each state's total number of permits (based on owner mailing address).
- Number of commercial fishing vessels (based on owner mailing address).
- Revenue from fish landings as a share of coastwide revenue from fishing landings
- Number of processors/buyers.

Port/city and county level data was available for each of the above indicators. Data for 2005 is used because it is the most recent year data is available for and because a using a single year is the most simplified way to conduct the analysis (which was a deemed necessary due to time constraints).

The following indicators are used as proxies for overall community engagement and dependence in the Pacific coast recreational fishery:

- Number of charter vessels as a percentage of each states total number of charter vessels.
- Number of private/rental angler trips as a percentage of each state's total number of private/rental angler trips.
- Number of private/rental groundfish angler trips as a percentage of each state's total number of private/rental groundfish angler trips.
- Number of party/charter trips as a percentage of each state's total number of party/charter trips.
- Number of party/charter groundfish trips as a percentage of each state's total number of party/charter groundfish trips.

Port/city level data was available for Oregon and Washington. Region level data was available for California. Data for 2005 is used for the reasons given above.

The following indicators are used as proxies for community dependence on the Pacific coast groundfish fishery specifically:

- Number of federal and state groundfish permits as a percentage of each state's total number of groundfish permits (based on owner mailing address).[10]

[10] Permits were characterized as "groundfish" permits if they were one of the following types: federal LE groundfish permit with a trawl or fixed gear endorsement, CA deeper nearshore species fishery permit, CA nearshore fishery bycatch permit, CA nearshore north central trap endorsement permit, CA nearshore north central fishery permit, CA nearshore north fishery permit, CA nearshore south central fishery permit, CA nearshore south central trap endorsement permit, CA nearshore south fishery permit, CA nearshore south trap endorsement permit,

- Groundfish revenue as a percentage of total community fisheries revenue.
- Groundfish revenue as a percentage of total groundfish revenue coastwide.

Port/city and county level data was available for each of the above indicators. Region level data was available for California. Data for 2005 is used for the reasons given above.

These sets of indicators were chosen based largely on: 1) the kind indicators seen in the literature and 2) data availability. Most of the data was obtained from PacFIN and state fishery management agencies. Other data, not included in this analysis, was available on a port group level (income from commercial and recreational groundfish fishing as a share of total personal income, number of persons employed by entities involved in commercial and recreational groundfish and other fishing or groundfish and other processing operations as a percentage of the total number of employed persons). This data has been included and discussed in other parts of the environmental impact statement (EIS).

To describe the relative community engagement in and dependence on the Pacific fishery resource, first, indicators represented by values were assigned to each community (port/city/county/region) within each category (Overall Community Engagement in the Pacific Coast Commercial Fishery, Overall Community Engagement and Dependence in the Pacific Coast Recreational Fishery, Community Dependence on the Pacific Coast Groundfish Fishery). Second, the communities were ranked from highest indicator value to lowest indicator value for each indicator. Third, the top one-third of communities was identified for each indicator. Fourth, the number of times a community was listed in the top one-third for each indicator was tallied. The communities that were tallied one or more times in the category of overall community engagement and/or dependence in the Pacific coast commercial fishery and/or overall community engagement and dependence in the Pacific coast recreational fishery were labeled as relatively "highly engaged" or "highly dependent" for each category.

Methodology for determining resilience

The purpose of gauging resiliency by community is to determine which communities are least able to adapt to a decrease in harvest as a result of a change in regulations. In some of the papers reviewed, the authors assume that the relationship between diversity and resiliency in social and economic systems is similar to that in the ecological literature. That is, a system with higher diversity is less affected by change than a system with lower diversity and the more diverse system therefore has higher resiliency. Socioeconomic systems (communities in this case) with higher resiliency are defined here as those that adapt quickly as indicated by rebounding measures of socioeconomic well-being. We assume that communities with high resiliency have access to diverse employment opportunities, higher employment rates, lower numbers of people living below the poverty line, are not located in isolated cities, and have the necessary municipal/county infrastructure to enable a rebound from a decrease in catch limits. That is, it is assumed that if the local fishing sector within a community with high resiliency experiences a major downturn, unemployment rates will rise only briefly until displaced people find other employment.

OR rockfish nearshore endorsement permit, OR rockfish permit, WA coastal hagfish permit, WA Puget Sound whiting trawl permit.

It is assumed that communities with low resiliency have more lingering negative impacts, such as unemployment or out-migration rates that remain high for many years.

The theoretical basis for gauging resiliency rests on the concept of social well-being, which is sometimes defined as a composite of four factors: economic resiliency, social and cultural diversity (population size, mix of skills), civic infrastructure (leadership, preparedness for change), and amenity infrastructure (attractiveness of the area) (McCool and others 1997). For this analysis, indicators were chosen with these factors in mind. The following indicators were used as proxies for describing resiliency:

- Industry diversity index.[11]
- Unemployment rate.
- Percentage of the population living below the poverty line.
- Isolated cities.[12]
- Population density.[13]

City and county level data was available for each of the above indicators except isolated city which was only analyzed on the city level. The most recent data available was used (2002 and 2003).

The above indicators were chosen based on: 1) similar indicators used in the literature and 2) data availability. Almost all of the indicator data was gathered from U.S. Census data. While several other indicators, such as educational attainment and income, could have been added to the analysis, the indicators used were deemed most relevant. Theoretically, many of the indicators used are likely correlated with educational attainment and income.

To describe relative community resilience, first, indicators represented by values were assigned to each community (port/city/county). Second, the communities were ranked from least resilient to most resilient based on the value for each indicator. Third, the top one-third of communities was listed for each indicator. Fourth, the number of times a community was listed in the top one-third for each indicator was tallied. The communities that were tallied one or more times were labeled as relatively "low resilience," for purposes of this analysis.

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[11] The industry diversity index was used to attempt to characterize the diversity of employment in the community. It was assumed that a community with more types of industries, the more resilient the community may be to negative impacts to the fishing industry. The index was used to identify communities with very little employment in industries other than fishing. The index was calculated using all nineteen major industry categories used in the Census. Numbers of persons employed in each industry category was gathered for each port and for each coastal county. The Shannon-Weiner index was used to measure industry diversification. This index was originally used to measure species diversity in an ecosystem. However, it has also been used in socioeconomic analyses to measure industry diversification. The greater number of employees and the more even the distribution of employees across industries both increase the index (see Tables A.4-18 and A.4-19 for diversity index results).

[12] Identification of isolated cities was made by Langdon-Pollack (2004). The analysis defined geographically isolated cities as those cities located in coastal counties with a population of 1,900 or less, were not located on a major highway and fell outside of the 35-mile buffer of cities over 20,000. The isolated cities in Washington include: Neah Bay, La Push, Tahola, Moclips, Copalis Beach, Ocean City, Markham, Junction City, Cohassett Beach, Grayland, Tokeland, Ocean Park, and Naselle. The isolated cities in Oregon include: Oceanside, Cape Mears, Netarts, and Powers. California did not have any geographically isolated cities.

[13] A proxy for municipal infrastructure.

Methodology for identifying "vulnerable areas"

"Vulnerable areas" are defined in this analysis as those communities that are both "highly engaged" or "highly dependent" and have relatively "low resilience". If a community appears in the "highly engaged" or "highly dependent" list and the "low resilience" list, then the community is listed as a "vulnerable area" for the purposes of this analysis. However, it is important to note that various deficiencies in the data make the analysis results somewhat unreliable for the purposes of definitively identifying communities that are most highly engaged, most dependent, and least resilient. For example, the analysis does not incorporate measures of employment and income to supply industries (shipyards, cold storage, processing). Therefore, the results of this analysis must be considered with other information provided in the chapter and appendices.