



United States
Department of
Agriculture

Forest Service

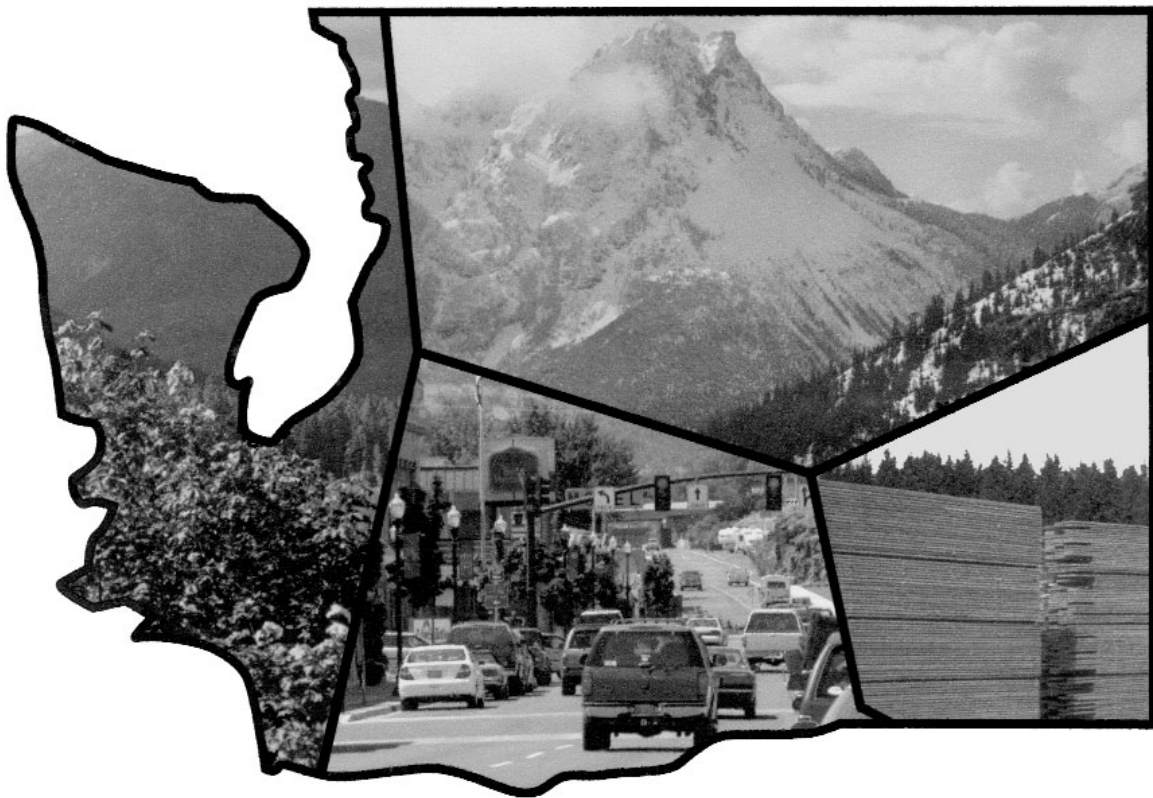
Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-607
April 2004



Assessing Socioeconomic Resiliency in Washington Counties

Jean M. Daniels



Author

Jean M. Daniels is a research forester, Forestry Sciences Laboratory, 620 S. Main, Suite 400, Portland, OR 97205.

Abstract

Daniels, Jean M. 2004. Assessing socioeconomic resiliency in Washington counties. Gen. Tech. Rep. PNW-GTR-607. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p.

The link between forest management and the well-being of communities in forested areas has traditionally been defined by forest sector employment opportunities. Attempts to redefine this relationship have produced methods that use a more comprehensive approach by combining both economic and social indicators to evaluate community well-being. The goal of this study is to evaluate socioeconomic resilience and forest dependence in Washington counties in order to identify counties where changes in forest management could negatively affect the well-being of nearby residents, allowing land managers and decisionmakers to anticipate the effects of land management policies. Results indicate that Ferry, Pend Oreille, Pacific, Skamania, Stevens, and Wahkiakum Counties all have socioeconomic systems that could be particularly vulnerable to forest management changes. The same analyses were performed for the Washington Department of Natural Resources (DNR) by using only counties on the west side of the Cascade Range. Results show that two counties, Wahkiakum and Pacific, may experience disproportionate negative impacts from changes in DNR state forest management. These findings are preliminary in nature; findings should be reassessed using community-level data to determine the optimum geographic scale necessary for detailed evaluation of policy effects.

Keywords: Sustainable forest management, socioeconomic resilience, forest dependency, criteria and indicators, Washington Department of Natural Resources.

Contents

1	Introduction
2	Key Definitions and Concepts
2	Community Viability and Adaptability
4	Forest Dependency
5	Areas of Concern
6	The Washington Department of Natural Resources
9	Methods
10	Assessing Socioeconomic Resiliency
12	Forest Dependence
12	Identifying Counties of Concern
12	Identifying Washington Department of Natural Resources Counties of Concern
13	Results
13	Lifestyle Diversity
16	Economic Diversity
18	Population Density
20	Socioeconomic Resiliency
23	Forest Dependence
23	Counties of Concern
23	Washington Department of Natural Resources Reliance
29	Washington Department of Natural Resources Counties of Concern
31	Discussion
32	Acknowledgments
32	Metric Equivalents
32	References
34	Appendix 1
35	Appendix 2

Introduction

Sustainability, the notion of sustaining economic prosperity that is socially just and environmentally sound, has become a new paradigm in forest resource management. Although sustainability has become popular as a concept, measuring, or even defining sustainability in a forest management context has been fraught with difficulty, because sustainable forest management encompasses not only the production of timber and nontimber forest products, but also economic and social impacts on communities in forested areas. The need to establish a standardized international framework for assessing sustainable forest management led to the drafting of the Montreal Process of Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests in 1995, hereafter referred to as the Montreal Process (Montreal Process Working Group 1998). The United States has demonstrated commitment to sustainable forest management by participating in the international working group that developed criteria and indicators and by subsequently becoming a signatory participant in the Montreal Process.

The Montreal Process establishes a list of 7 criteria and 67 indicators for the sustainable management of temperate and boreal forests. Criterion 6, titled “Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies” contains 19 indicators to reflect the role that forest management plays in promoting and sustaining social, economic, and community well-being in forested areas. This study focuses particularly on Indicator 46, titled “Viability and Adaptability to Changing Economic Conditions of Forest Dependent Communities.”

Indicator 46 combines two concepts, first, community viability and adaptability and second, forest dependency. These two concepts are combined to describe the link between forest management and community well-being. In particular, it reflects concerns that implementing sustainable forest management policies may disrupt economic systems and therefore negatively affect the well-being of forested communities. Forest land management agencies, such as the Washington Department of Natural Resources (DNR), logically have an interest in identifying areas that may encounter obstacles on the path to sustainable forest management.

After a discussion of key definitions and concepts surrounding community viability and adaptability and forest dependency, this study focuses on five objectives. First, the study assesses viability and adaptability for each of the 39 counties in Washington by using a socioeconomic resiliency index. Counties are used as a measure because of the ready availability of data at the county level. Figure 1 provides a base map displaying 39 counties in Washington. Second, forest dependency is assessed for all Washington counties. Then, for each Washington county, socioeconomic resilience ratings are combined with forest dependency ratings to produce a list of “counties of concern” where socioeconomic resilience is low and forest dependency is high. Next, this method is repeated to determine reliance of western Washington counties (hereafter referred to as west-side counties) on DNR forest resources and identify “DNR counties of concern.” These are west-side counties that have both a low socioeconomic resiliency rating and a relatively high percentage of DNR forest land ownership. Findings are then compared against traditional approaches used by the state of Washington to identify areas experiencing economic distress and areas considered dependent on public timber.

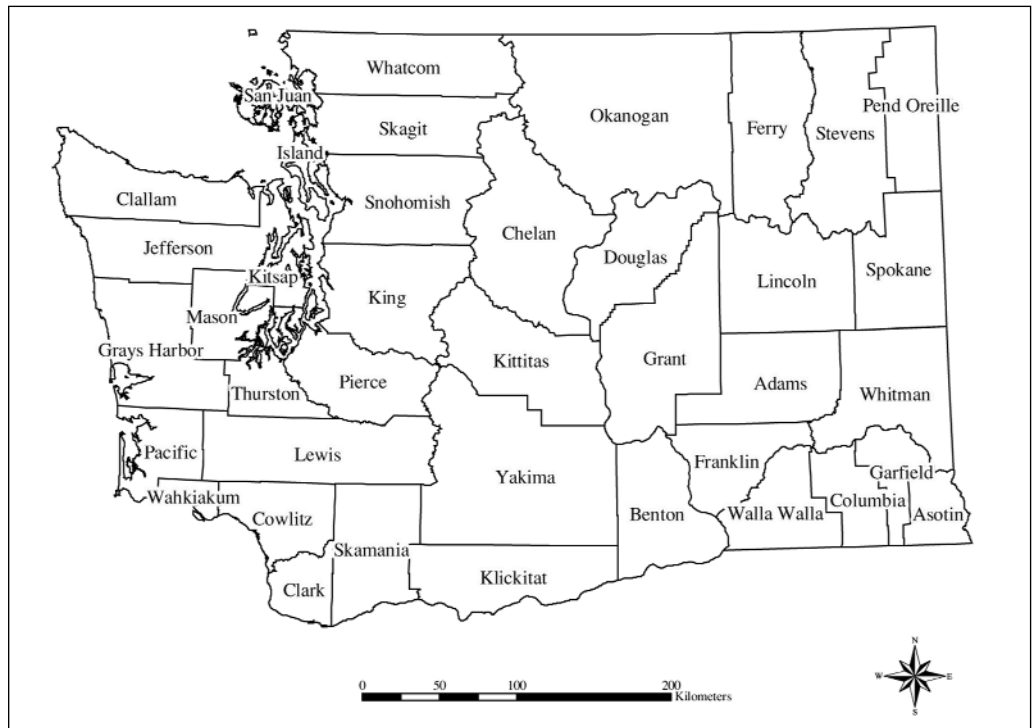


Figure 1—Counties in Washington.

Key Definitions and Concepts

There are several definitions that are key in understanding how to evaluate the propensity of communities to adapt to changing economic conditions. These include community viability and adaptability, forest dependency, and areas of concern. Background information describing the operations of the DNR is also important to gain perspective on how its forest management policies can affect forested areas.

Community Viability and Adaptability

Although community viability and adaptability are not defined in the Montreal Process, their inclusion reflects an expansion of traditional thinking about the connection between communities and the forest resources that surround them. Early notions of community stability refer to jobs and income generated through the harvest and processing of timber from public or private forest lands by residents of communities dependent on income from such activities (Society of American Foresters 1989). However, such notions often treat forest industry employment (both direct and indirect) as the sole determinant of community well-being in forested areas. This approach to community stability ignores the social component of a community (McCool et al. 1997). Communities are made up of individual residents who base their decision to relocate into, remain in, or leave the community on a variety of factors that may or may not include forest sector employment opportunities. Also, community stability oversimplifies the relationship between residents and surrounding forest resources because it does not account for nontimber goods and services that residents obtain from the forest. In other words, communities located in forested areas represent complex dynamic economic and social systems that are ignored by the simple “timber and jobs” perspective of community stability.

The state of Washington continues to apply economic measures to assess community well-being. Washington's Employment Security Department (ESD) determines "distressed areas" by using each county's 3-year average unemployment rate. If the average unemployment rate is 120 percent or more of the statewide unemployment rate, the county is considered distressed and placed on the distressed area list (Washington ESD 2003). The following 19 counties were designated as distressed areas in 2003:

Adams	Klickitat
Chelan	Lewis
Clallam	Mason
Columbia	Okanogan
Cowlitz	Pacific
Douglas	Pend Oreille
Ferry	Skamania
Franklin	Stevens
Grant	Yakima
Grays Harbor	

Although the state of Washington has devised a simple, universally understandable method to gauge economic well-being, it relies exclusively on one variable, unemployment. When community well-being is exclusively considered a function of the wage income of residents, complex interactions between social and economic systems are not addressed. Combining measures of economic well-being with social variables presents a more comprehensive representation of community life. In addition, unemployment itself is not always a consideration when residents decide to leave or remain in a community. Lifestyle choices and traditions are other important determinants of where individuals choose to live.

Expanding beyond traditional employment indicators means incorporating other important aspects of community life, including social variables, into the analysis. The notion of community viability and adaptability broadens employment-based approaches to encompass all factors that contribute to community well-being.

One factor influencing community well-being is the ability of communities to adapt to change. Shocks to social or economic systems occur regularly within communities; indeed, change is an inevitable part of the human condition. So then, why are some communities better equipped to adapt to change than others? Why does an economic downturn spell disaster in some communities whereas others are able to shake off negative impacts with relative ease?

The term "socioeconomic resiliency" is one of many that social scientists have used to describe community health. It reflects the ability of people to manage individual and community transitions with reasonable comfort and confidence in the face of the forces of change. In other words, socioeconomic resilience is the ability of a community to adapt to change. Haynes et al. (1996) initiated discussions linking natural resource policy and community resilience. Researchers have identified several characteristics that likely are all valid determinants of community resilience. These include community character, cohesiveness, services and infrastructure, cultural diversity, economic diversity, resource dependence, attractiveness to business, quality of life, and civic leadership (McCool et al. 1997).

Because techniques to directly measure socioeconomic resiliency do not exist, measuring the socioeconomic resiliency of a community requires the use of social and economic indices. These indices serve as proxies, which are frequently used in economics to estimate the value of a good that has no market in which to establish a price. A model of socioeconomic resiliency requires a method to use social and economic indices to discern the link between a community's social and economic systems and its ability to adapt to change. Horne and Haynes (1999) formulated such a model in an attempt to use indices to assess conditions contributing to socioeconomic resilience of counties in the interior Columbia River basin.

For the purposes of this study, it is assumed that socioeconomic resiliency is directly related to diversity in social and economic systems. In other words, a community with higher social and economic diversity is less affected by change than a community with lower diversity, making the first community more resilient. A community having a highly resilient socioeconomic system is able to adapt to and recover from negative impacts quickly. Residents of areas demonstrating high resiliency have a wide variety of skills and access to a variety of employment opportunities. Should specific firms or industries experience downturns, unemployment rates may rise, but only until displaced workers find other employment. On the other hand, socioeconomic systems having low resiliency may experience longer term negative impacts, such as persistent unemployment or even outmigration. Thus, resilience is directly related to diversity, a relationship that is widely documented in the ecological sciences (Moffat 1996).

Forest Dependency

Indicator 46 of the Montreal Process combines community viability and adaptability with a second concept, forest dependency. Like community viability and adaptability, forest dependency is not defined in the Montreal Process; it stems from an expansion of the concept of timber dependency. Traditionally, timber dependence was a criterion used to identify communities with significant economic dependence on timber harvesting and processing. In fact, provisions in the National Forest Management Act (1976) directed the U.S. Forest Service to publish a list of communities deemed dependent on national forest timber since 1977, although the Forest Service has not produced a list since 1987.¹

Economic benefits from forest land are not limited to timber commodity production. Forest dependence reflects the growing acknowledgment that there is more to the relationship between forests and communities than commodity wood production and forest sector employment. Measures of timber dependency fail to recognize that noncommodity economic opportunities arising from forests, such as tourism and recreation, nontimber forest products, and other nontraditional forest uses also provide income and jobs to residents. In many areas, nontimber uses generate more

¹The Federal Register (42[106]); 28258. Thursday, June 2, 1977) defines communities dependent on national forest timber as "...areas with common social and economic interests bounded by established daily marketing and work force commuting patterns, and encompassing one or more primary wood products manufacturing facilities located within or adjacent to a specific area of National Forest upon which it is dependent for its timber supply and where 10 percent or more of the community work force is employed in the primary manufacture of wood products, including logging and log transportation, and National Forest timber accounts for at least 30 percent of the timber used in the primary wood products manufacturing facilities in the last 5 calendar years."

income for residents than does timber production. In addition, forests contribute to higher quality of life, making communities more attractive to potential new residents and businesses and for retirement settlement areas. Last, most communities possess a mix of industries, of which wood products manufacturing is only one component. To assert that the well-being of a community can be judged entirely by its production of timber ignores the direct and indirect economic impacts made by other local industries. Thus, while jobs and income stemming from timber production do provide important economic opportunities to some forested communities, valuing the forest exclusively in terms of timber production undervalues the forest to residents and oversimplifies its value to society.

For the purposes of this study, forest dependency is defined as a function of forest land, rather than timberland area. Forested landscapes classified as forest land are at least 10 percent stocked with forest trees of any size; timberland is forest land capable of producing industrial timber and not withdrawn from timber use by statute or regulation. All timberland is forest land, but not all forest land is timberland. Communities located in heavily forested areas receive a higher forest dependency rating than communities located outside of forested areas or in less densely stocked forests. Logically, more forest area implies more opportunity for residents to reap benefits from forest resources.

Areas of Concern

One way to single out areas with economic systems that are especially sensitive to changes in forest management strategies is to combine socioeconomic resilience with forest dependence. For example, an area designated as having “high” socioeconomic resilience and “low” forest dependence would not be expected to experience difficulty with changing forest land management policies. On the other hand, areas with “low” socioeconomic resilience and “high” forest dependence could experience negative economic impacts from changes in forest management, because of both inability to adapt to change and dependence on forest resources.

By combining areas that may experience difficulty adapting to change with areas identified as forest dependent, a list of “communities of concern” can be compiled (Donoghue and Haynes 2002). However, for the purposes of this study, analyses were performed at the county, not community, level, owing to limitations associated with release of Census 2000 demographic data. Therefore, rather than “communities of concern,” this study identifies “counties of concern” where low socioeconomic resilience coincides with high forest dependence (Haynes 2003, Horne and Haynes 1999). The intent is to identify for stakeholders in land management agencies those counties that might require mitigation, development assistance, or further understanding of the impacts of decisions before they are implemented as policies, in an attempt to prevent unforeseen negative impacts on county residents. Aggregating the data to the county level may sacrifice spatial detail evident at the community level. Readers are cautioned not to extrapolate results to make inferences at the community level.

**The Washington
Department of
Natural Resources**

Federal, state, and local land management agencies own and control vast areas of public forest land across Washington (table 1). Forest management policies favoring reduced harvest from public forests have been a fact of life in the Pacific Northwest since the early 1990s. As a result, revenues generated from timber harvests have declined substantially. Traditionally, a portion of these revenues was distributed back to counties and other public entities in some form, either in lieu of property and other taxes or as the result of fiduciary responsibilities to various public trust beneficiaries. Declining revenues from timber harvesting have raised concerns that evolving timber management policies negatively affect counties containing a significant amount of public forest land. Appendix 1 displays forest land acreage by ownership.

Presumably, managers of public agencies are interested in identifying counties that may experience disproportionate negative impacts from changing public timber management policies. The DNR is one such agency. Specifically, the DNR has expressed an interest in identifying counties that may experience difficulty adapting to changing harvest levels on state forest lands.

The DNR was established in 1957 to serve as land manager for a variety of lands owned by the state of Washington, including forest lands. The DNR manages approximately 2.1 million acres of state forest land for two main purposes. First, the DNR has a fiduciary responsibility to create revenue as manager of public lands. Revenues generated from DNR operations provide income to public schools and universities, a variety of state institutions, and many counties, in addition to contributions to the state general fund. Second, with the signing of a Habitat Conservation Plan with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service in 1997, the DNR is responsible for maintaining habitat to protect native fish and wildlife species and other sensitive resources on lands under its jurisdiction. In addition, state law (RCW 79.68.050) directs the DNR to provide recreation opportunities (including camping facilities and hiking and biking trails), hunting and fishing, and other multiple-use benefits for all Washington residents.

Washington state forest land management is conducted within the framework of policy direction approved by the Board of Natural Resources, one of which is the DNR's 1992 Forest Resource Plan (FRP). The FRP was developed as a management plan for 2.1 million acres of state forest land over the 10-year period from 1992 to 2002 (Washington DNR 1992). This 10-year period was extended until June 2005 to allow for the completion of sustainable harvest calculations for western and eastern Washington. The DNR is directed by state law (RCW 79.68.040) to apply sustained yield management strategies on state forest lands. As part of this directive, the DNR is required to periodically adjust acreages designated for inclusion in the sustained yield management program and recalculate a 10-year sustainable timber harvest level. The sustainable harvest level is the volume of timber offered for sale from state-owned forest land during a planning decade.

As directed by law, the DNR is recalculating a new sustainable harvest level for state forest land in 2003. By establishing a new sustainable timber harvest level, the DNR not only is fulfilling its legislative mandate, but also is provided the opportunity to make changes to the 1992 Forest Resource Plan. By revising the FRP, the DNR can update its management strategies to better meet the goals of its Habitat

Table 1—Forest land ownership in Washington counties

County	Federal	State	County and municipal	Total public ownership	Private
			<i>Percent</i>		
Adams	0	0	0	0	0
Asotin	61.1	.7	0	61.8	38.2
Benton	0	0	0	0	0
Chelan	83.7	3.8	.9	88.3	11.7
Clallam	48.5	15.0	0	63.4	36.6
Clark	3.4	26.9	.7	31.0	69.0
Columbia	73.2	4.4	0	77.6	22.4
Cowlitz	3.6	11.6	0	15.2	84.8
Douglas	50.0	50.0	0	100	0
Ferry	39.3	3.2	.5	42.9	57.1
Franklin	0	0	0	0	0
Garfield	90.8	0	0	90.8	9.2
Grant	0	0	0	0	0
Grays Harbor	12.1	8.0	4.5	24.6	75.4
Island	5.5	13.2	.2	18.9	81.1
Jefferson	61.9	17.2	0	79.1	20.9
King	32.5	7.2	11.7	51.4	48.6
Kitsap	1.8	13.8	9.9	25.5	74.5
Kittitas	52.1	11.1	0	63.2	36.8
Klickitat	5.3	14.4	1.4	21.1	78.9
Lewis	35.4	9.1	.6	45.1	54.9
Lincoln	3.5	3.3	0	6.8	93.2
Mason	27.5	14.3	0	41.8	58.2
Okanogan	66.0	10.4	0	76.4	23.6
Pacific	.6	13.6	.6	14.8	85.2
Pend Oreille	58.2	5.1	.1	63.3	36.7
Pierce	42.1	4.2	1.2	47.4	52.6
San Juan	.8	13.6	.2	14.6	85.4
Skagit	47.9	15.9	1.0	64.8	35.2
Skamania	80.3	7.8	.4	88.4	11.6
Snohomish	53.4	14.5	.9	68.8	31.2
Spokane	3.4	12.0	1.1	16.5	83.5
Stevens	24.2	14.5	0	38.8	61.2
Thurston	2.9	21.7	0	24.6	75.4
Wahkiakum	0	26.6	0	26.6	73.4
Walla Walla	.3	0	0	0	99.7
Whatcom	66.7	10.5	.6	77.8	22.2
Whitman	0	0	1.4	1.4	98.6
Yakima	41.4	8.7	0	50.0	50.0
Total	43.2	10.5	1.1	54.9	45.1

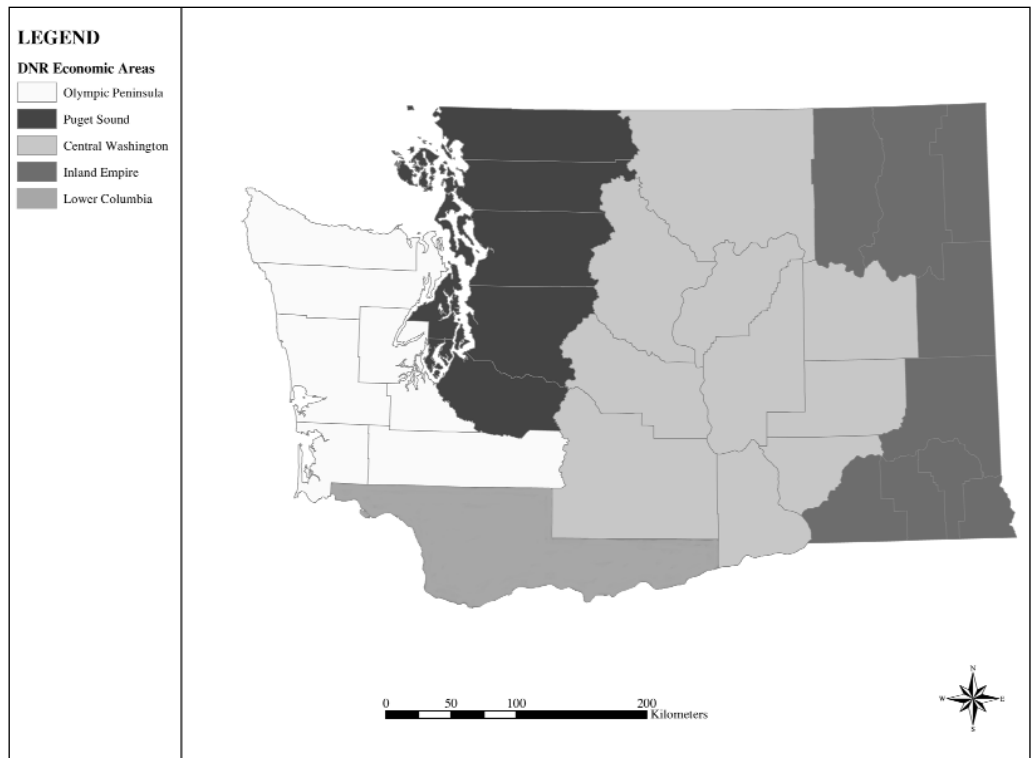


Figure 2—Department of Natural Resources economic areas.

Conservation Plan. In addition, the FRP can more fully address the impacts of DNR timber harvesting operations on water quality, salmon habitat, and other aquatic and riparian resources. Changing the FRP requires the preparation of an environmental impact statement (EIS) presenting a range of alternatives that must all meet DNR management objectives.

One question not addressed by the EIS is whether changing DNR harvesting operations will have a negative impact on communities located near state forest lands. The DNR conducts financial analyses by using projections of timber revenues to estimate cash flows to its beneficiaries. However, such analyses cannot fully capture the direct and indirect effects felt by social and economic systems in these areas—the links are too complex. Examination of socioeconomic resiliency in these forest-dependent areas provides the DNR with an idea of where disproportionate effects may occur from evolving forest land management strategies. For the purposes of this study, Washington counties that may be especially vulnerable to changes in DNR land management policies are called “DNR counties of concern.”

One way the DNR currently acknowledges the relationship between communities and forest resources is through measures of regional mill dependency published in *Washington Mill Survey 2000* (Larsen et al., n.d.). Washington counties are combined into five economic areas: Puget Sound, Olympic Peninsula, Lower Columbia, Central Washington, and Inland Empire (fig. 2). Wood processing facilities located within each economic area report the percentage of total raw materials obtained from each

Table 2—Number of mills identified by percentage of dependency on state lands for raw material requirements

Economic area	Dependency percentage			
	0	1-33	34-66	67-100
	<i>Number of mills</i>			
Puget Sound	30	16	6	1
Olympic Peninsula	63	37	4	4
Lower Columbia	21	10	1	--
Central Washington	5	8	--	--
Inland Empire	10	11	--	--
Total	129	82	11	5

category of forest land owner. Forest land ownership is subdivided into national forest, state, Bureau of Land Management, other public, forest industry, Native American, and farmer and miscellaneous private ownerships. For each mill, raw material source dependency is measured by using four groupings: no dependency, 1 to 33 percent dependency, 34 to 66 percent dependency, and 67 to 100 percent dependency.

Regions containing a relatively large number of mills highly dependent upon any single forest land owner for timber supply are considered “dependent” on that source. DNR timber dependence arises when several mills within a region are highly dependent on state forests for raw material supply. Table 2 contains mill dependency measures for state-owned timber only. Note that one mill in the Puget Sound Economic Area and four mills in the Olympic Peninsula Economic Area are between 67 and 100 percent dependent on state lands for raw materials. Ideally, counties identified as highly reliant on DNR forest resources by this study are located within the two economic regions where mills display high dependency on state timber, making the two measures compatible.

Methods

Assessing socioeconomic resiliency, forest and timber dependency, and reliance on DNR timber of Washington counties is a four-step process. First, each county is assigned a socioeconomic resiliency rating by combining indices to represent lifestyle diversity, economic resiliency, and population density. Second, forest dependence is determined by rating all Washington counties based on proportion of forest land per county. Next, statewide counties of concern are identified, as these are potentially sensitive to changes in regional forest management policies. Last, focus shifts to west-side counties to rate their reliance on DNR forest resources. The DNR reliance ratings for each west-side county are calculated by combining ratings for the proportion of forest land in DNR ownership with socioeconomic resiliency ratings revised to include only west-side counties. The result is a list of west-side “DNR counties of concern” that may experience difficulty adapting to changes in DNR forest management policies.

Assessing Socioeconomic Resiliency

Socioeconomic resiliency in Washington counties was assessed by using methods described in Horne and Haynes 1999. Horne and Haynes developed an operational definition of socioeconomic resilience at the county level by using an index composed of three factors: social and cultural diversity, economic diversity, and civic infrastructure. This study also uses these three factors, but social and cultural diversity and economic diversity are measured differently. Social and cultural diversity are represented by the diversity of lifestyles in each county. Economic diversity is measured by using an index of regional specialization. Civic infrastructure is estimated by using population density as a proxy measure.

Lifestyle diversity—The first component of socioeconomic resiliency is lifestyle diversity. Counties exhibiting greater diversity of lifestyles are assumed to be more resilient to change than those with less diversity of lifestyles. Because lifestyle diversity is not something that can be directly measured, proxy measures were developed by using demographic data from *Census 2000 Gateway* (USDC Bureau of the Census 2002). Demographic factors for mobility, ethnicity, degree of urbanness, race, income, and education in each Washington county were used as proxies in model construction.

Mobility measures the proportion of people who changed their residence between 1995 and 2000 versus those who did not. Ethnicity measures were obtained from census categories of native and born in state of residence, native and born in another state in the United States, native and born outside the United States, and foreign born. Degree of urban and rural was categorized as urban and inside urbanized areas, urban and inside urban clusters, rural farm, and rural nonfarm. Race included the proportion of census respondents identifying themselves as White, African American, Asian, Hispanic, American Indian, Pacific Islanders, and other. Income measured the proportion of people in each of 16 sequential income categories by county. Lastly, education measured educational attainment for the proportion of people over age 25 who had not finished high school, obtained a high school diploma, had a diploma and some college, received an associate's degree, received a bachelor's degree, and received a graduate degree.

Diversity measures for these six indicators were obtained by using the Shannon-Weiner diversity index. This index is commonly used in the biological sciences to calculate, for example, habitat diversity.

$$D = \frac{-\sum p_i \ln(p_i)}{\ln(s)}, \quad (1)$$

where

D = diversity measure, ranging from 0 to 1,
 s = total number of subcategories for each of the six indicator variables, and
 p = proportion of people in each subcategory for each variable.

Thus, D is calculated by considering the distribution of people across subcategories; a relatively low value indicates uneven distribution of people across that indicator. Note that any variable having high concentrations of people in a few subcategories would obtain a low value for D . For example, because 95 percent of King County is concentrated in urban centers, King County would receive a relatively low diversity

rating for the indicator degree of urbanness. Summing the Shannon-Weiner index value for each variable and dividing by six resulted in an overall lifestyle diversity rating for each county.

Economic diversity—Economic diversity is the second component of socioeconomic resiliency and reflects diversity of employment opportunities. Employment by standard industrial classification (SIC) code for 2001 for each Washington county was downloaded from the Labor Market and Economic Analysis Branch of Washington’s Department of Employment Security Web site. Data missing owing to disclosure issues were interpolated from the 1997 County Business Patterns CD-ROM (USDC Bureau of the Census 1999). The year 1997 was selected to ensure data consistency, as subsequent releases use the newer North American industry classification (NAIC) code system.

These county employment figures were then benchmarked against the state of Washington as a whole by using the coefficient of regional specialization index:

$$R_i = \sum \left| \frac{E_{ij}}{E_i} - \frac{E_j}{E} \right|, \tag{2}$$

where

- E_{ij} = employment in county i in industry j ,
- E_i = total employment in county i ,
- E_j = total employment in industry j in all counties, and
- E = total employment in all industries across all counties.

This index is commonly used in geography to determine if a region (county here) is more or less specialized than a benchmark (Washington state here). Values close to zero indicate the county has about the same proportion of people employed in each industry as the state, whereas values around 1 indicate that employment is more specialized in the county than in the state. The assumption used for this analysis is that counties that are highly specialized have employment concentrated among relatively few industries, making those counties more vulnerable if negative impacts occur. In other words, a relatively high value for the coefficient of regional specialization is interpreted to mean the county is less economically diverse and therefore less able to adapt to change. Although using community, rather than county, data might yield more detailed results, disclosure issues are formidable at the community level as some individual businesses can be easily identified.

A coefficient of regional specialization was computed for each of the 39 Washington counties. These values were then sorted from lowest to highest, divided into four groups based on 25th, 50th, and 75th statistical quartiles, and rated from 1 to 4 with low specialization corresponding with high economic diversity.

Population density—The third measure, population density, was used as a proxy for civic infrastructure. Greater population density is assumed to lead to a more developed county infrastructure and so increases socioeconomic resiliency. The number of people per square mile of county area determines population density for each county. Population for 2000 by county was obtained from QuickFacts on *Census 2000*

Gateway (USDC Bureau of the Census 2002). The number of square miles in each county was downloaded from the Washington state data page Web site (Washington ESD 2001). By using a method similar to that of Horne and Haynes (1999), each of the 39 counties was given a population density rating from 0 to 4.

Population density of county	Rating
> 816	4
237 to 816	3
33 to 236	2
11 to 32	1
< 11	0

Socioeconomic resiliency—Each county received an overall socioeconomic resiliency rating corresponding to an unweighted average of its ranks for lifestyle diversity, economic resiliency, and population density. These values were then sorted from highest to lowest value and divided into thirds. Counties in the top third had the highest socioeconomic resilience and so were given a rating of “high.” Counties in the middle third were given a “medium,” and counties in the last third were given a “low” socioeconomic resiliency rating. Although there are alternative ways to rate the counties, of the methods considered, dividing them into three equal parts resulted in the best agreement between the list of counties having a socioeconomic resilience rating of “low” and those appearing on the 2003 distressed county list published by the state of Washington.

Forest Dependence

Identifying the Washington counties with low socioeconomic resiliency is the first step in determining counties whose economies might be strongly impacted by changing forest management policies. The next part of the analysis identifies forest dependence in Washington counties.

The proportion of forest land in each county serves as a proxy for forest dependency; it represents dependence of local residents on forest resources. Total acres and acres of forest land for each Washington county were obtained from the USDA Forest Service’s Forest Inventory and Analysis (FIA) database. These data were used to compile a list of the proportion of forest land in each county. This list was then sorted from highest to lowest value and divided into three equal parts. The top third were assigned a forest dependency rating of “high,” the second third received a “medium” rating, and the lowest third received a “low” rating.

Identifying Counties of Concern

Counties of concern are those where low socioeconomic resiliency and high forest resource dependence increase the likelihood that changing forest management policies may disproportionately impact the well-being of residents. Counties having both a “low” socioeconomic rating and a “high” forest dependency rating were classified as counties of concern.

Identifying Washington Department of Natural Resources Counties of Concern

The DNR counties of concern were determined by combining socioeconomic resiliency ratings with measures of DNR reliance for only west-side counties. As the scale of analysis changed from the entire state to the west-side region, socioeconomic resiliency ratings were reassessed by using a regional instead of a statewide benchmark. Thus, although relative socioeconomic resiliency values remain the same, the dividing line for thirds, and thus some socioeconomic resiliency ratings (i.e., “high,” “medium,” or “low”) changed.

The relative proportion of total forest land in DNR ownership serves as a proxy for reliance on DNR timber. Figures for DNR forest land ownership by county provided by the DNR and total acres of forest land per county obtained from the FIA database were used to calculate the proportion of DNR ownership of total forest land in each west-side county. These proportions were then sorted in descending order. The third of the counties with the highest proportions were rated with “high” DNR reliance. This process was repeated for the second third (“medium” reliance) and the last third (“low” reliance) of the counties.

The resulting list of DNR reliance is compared against the revised list of socioeconomic resiliency ratings. Counties identified as having “high” DNR reliance and “low” socioeconomic resiliency are designated as “DNR counties of concern,” where disproportionate negative impacts may arise from evolving DNR forest management strategies. We would expect to find these counties within the Puget Sound or Olympic Peninsula Economic Areas, where, according to the *Washington Mill Survey 2000* (Larsen et al., n.d.), five mills are between 67 and 100 percent dependent on state timber.

Results

Lifestyle Diversity

Appendix 2 contains actual Shannon-Wiener lifestyle diversity index values for all 39 Washington counties for 6 demographic factors: mobility, ethnicity, urbanization, race, income, and education. Lifestyle diversity ratings for each of these six factors and a composite lifestyle diversity rating for each county are presented in table 3. Composite lifestyle diversity ratings are redisplayed in descending order for emphasis in table 4 and arrayed graphically in figure 3. The mean rating was 2.47 with standard deviation of 0.86. According to the Shannon-Wiener diversity index, Franklin County, with an overall rating of 4.00, has the greatest diversity of lifestyles in Washington. Closely following are Chelan and Grant Counties (3.83), Yakima County (3.67), and Skagit and Whatcom Counties (3.50).

These results may seem counterintuitive, as King and Pierce Counties do not top the list. Table 3 shows that both King and Pierce Counties receive a rating of 1 for urban-rural, because residents of both counties are heavily concentrated in urban areas. Remember, the composite lifestyle diversity rating reflects the distribution of lifestyles present in each county.

On the other hand, Pend Oreille and Wahkiakum Counties have overall lifestyle diversity ratings of 1.00, indicating that these counties have the least diversity of lifestyles in the state. A tied rating of 1.33 for Asotin, Garfield, Lincoln, Skamania, and Stevens Counties places these counties as second to lowest. Grays Harbor and Ferry Counties, with ratings of 1.50, tied for third lowest diversity rating. Again, counties having a low rating should be interpreted as having high concentrations of people in fewer demographic groups, rather than a population that is evenly distributed across demographic groups.

Table 3—Shannon-Wiener lifestyle diversity ratings, Washington counties

County	Mobility	Ethnicity	Urban/rural	Race	Income	Education	Composite
Adams	4	4	4	4	1	3	3.33
Asotin	1	1	1	1	3	1	1.33
Benton	3	3	2	3	3	4	3.00
Chelan	4	4	4	3	4	4	3.83
Clallam	2	2	3	2	3	3	2.50
Clark	4	3	2	2	3	2	2.67
Columbia	1	1	4	1	1	3	1.83
Cowlitz	2	1	4	2	3	1	2.17
Douglas	3	3	3	3	2	4	3.00
Ferry	1	1	1	4	1	1	1.50
Franklin	4	4	4	4	4	4	4.00
Garfield	1	1	1	1	1	3	1.33
Grant	4	4	4	4	3	4	3.83
Grays Harbor	1	1	2	2	2	1	1.50
Island	3	3	3	3	3	2	2.83
Jefferson	2	2	3	1	4	2	2.33
King	4	4	1	4	4	3	3.33
Kitsap	3	3	2	4	4	2	3.00
Kittitas	2	2	3	2	1	3	2.17
Klickitat	2	2	4	3	1	2	2.33
Lewis	2	2	3	1	2	2	2.00
Lincoln	1	1	1	1	2	2	1.33
Mason	2	2	2	3	2	1	2.00
Okanogan	3	3	2	4	1	4	2.83
Pacific	2	2	3	2	1	2	2.00
Pend Oreille	1	1	1	1	1	1	1.00
Pierce	4	4	1	4	4	2	3.17
San Juan	2	2	1	1	4	1	1.83
Skagit	3	3	4	3	4	4	3.50
Skamania	1	2	1	1	2	1	1.33
Snohomish	3	3	2	3	2	2	2.50
Spokane	2	2	2	2	4	3	2.50
Stevens	1	1	2	2	1	1	1.33
Thurston	3	3	3	4	3	3	3.17
Wahkiakum	1	1	1	1	1	1	1.00
Walla Walla	4	4	2	3	2	4	3.17
Whatcom	4	4	4	2	4	3	3.50
Whitman	4	3	3	2	1	3	2.67
Yakima	3	4	4	4	3	4	3.67

Table 4—Composite lifestyle diversity rating in Washington counties

County	Composite lifestyle diversity rating
Franklin	4.00
Chelan	3.83
Grant	3.83
Yakima	3.67
Skagit	3.50
Whatcom	3.50
Adams	3.33
King	3.33
Pierce	3.17
Thurston	3.17
Walla Walla	3.17
Benton	3.00
Douglas	3.00
Kitsap	3.00
Island	2.83
Okanogan	2.83
Clark	2.67
Whitman	2.67
Clallam	2.50
Snohomish	2.50
Spokane	2.50
Jefferson	2.33
Klickitat	2.33
Cowlitz	2.17
Kittitas	2.17
Lewis	2.00
Mason	2.00
Pacific	2.00
Columbia	1.83
San Juan	1.83
Ferry	1.50
Grays Harbor	1.50
Asotin	1.33
Garfield	1.33
Lincoln	1.33
Skamania	1.33
Stevens	1.33
Pend Oreille	1.00
Wahkiakum	1.00

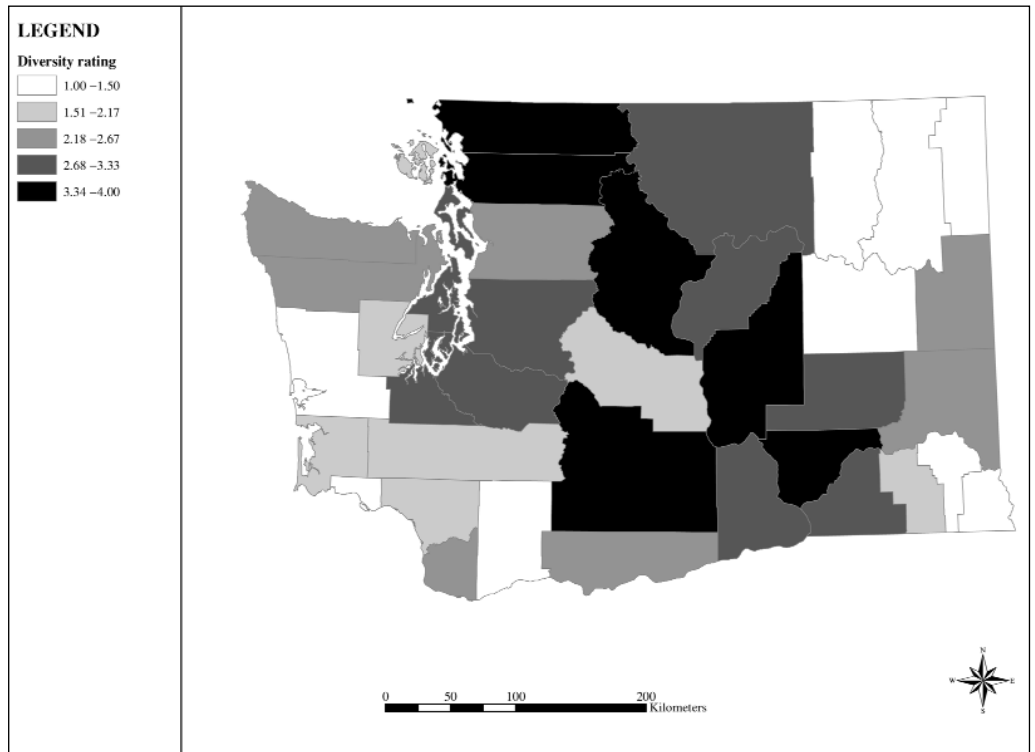


Figure 3—Composite lifestyle diversity ratings in Washington counties.

Economic Diversity

Economic diversity values and ratings using the coefficient of regional specialization index are presented for each Washington county in table 5. The average economic diversity index value was 0.709 with standard deviation of 0.266. To reiterate, counties having low coefficients of regional specialization are interpreted as having high economic resiliency because the distribution of employment across industries is similar to the state as a whole. In other words, jobs are widely distributed across a multitude of industries. A relatively high value for the coefficient of regional specialization means that jobs are highly concentrated into a few industries, implying a less diverse economy.

According to this index, Spokane County, with a coefficient of 0.268, has the highest economic resiliency of all Washington counties. Following closely is Whatcom County on the Canadian border with a rating of 0.269. King and Pierce Counties have the third and fourth highest economic resiliency ratings with 0.279 and 0.293, respectively. Not surprisingly, these counties tend to be highly urbanized and to possess large transportation networks.

At the opposite end of the spectrum, Columbia has the greatest coefficient of regional specialization at 1.287, making it the Washington county with the least diverse economy. Employment in Columbia County is heavily concentrated in highly

Table 5—Economic diversity in Washington counties

County	Coefficient of regional specialization	Economic diversity rating
Spokane	0.268	4
Whatcom	.269	4
King	.279	4
Pierce	.293	4
Clark	.371	4
Snohomish	.411	4
Skagit	.443	4
Cowlitz	.489	4
Kitsap	.536	4
Thurston	.548	4
Lewis	.573	3
Grays Harbor	.576	3
Clallam	.583	3
Yakima	.598	3
Island	.613	3
Jefferson	.625	3
Chelan	.632	3
Asotin	.649	3
Benton	.652	3
Franklin	.670	2
Kittitas	.672	2
Walla Walla	.698	2
Stevens	.724	2
Mason	.744	2
San Juan	.805	2
Whitman	.806	2
Grant	.809	2
Douglas	.816	2
Pacific	.830	2
Okanogan	.910	1
Klickitat	.935	1
Lincoln	.969	1
Adams	1.037	1
Pend Oreille	1.044	1
Skamania	1.050	1
Wahkiakum	1.075	1
Garfield	1.176	1
Ferry	1.181	1
Columbia	1.287	1

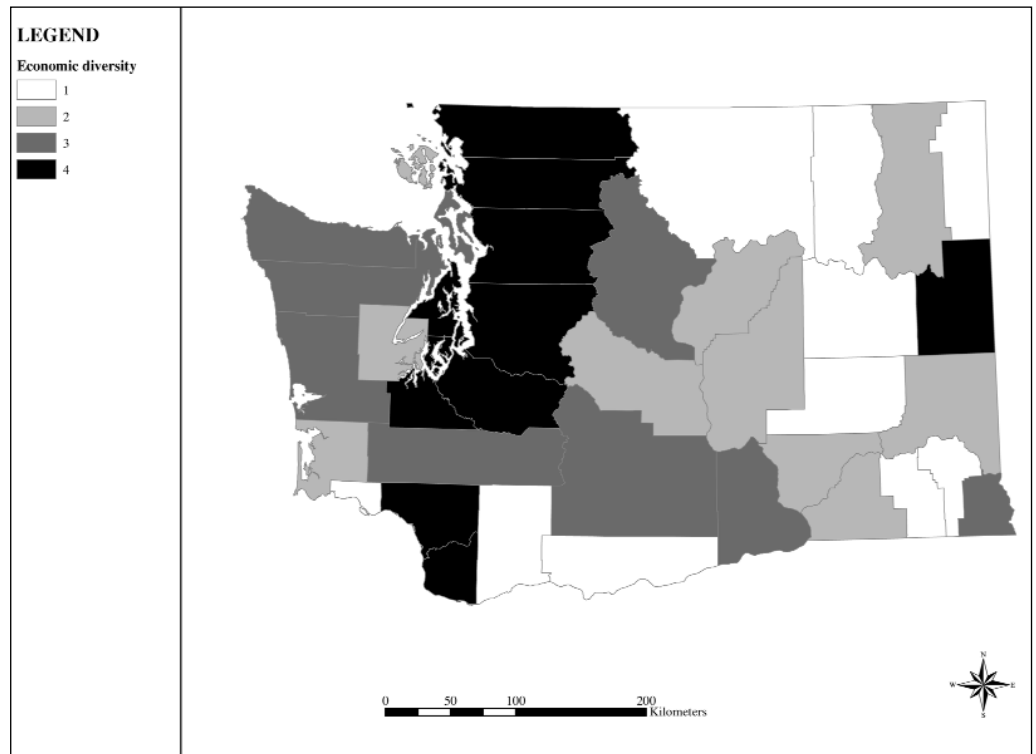


Figure 4—Economic diversity ratings in Washington counties.

seasonal agriculture and food processing industries. Ferry, Garfield, and Wahkiakum Counties have the second, third, and fourth lowest ratings of 1.181, 1.176, and 1.075, respectively. Counties were assigned economic diversity ratings as shown in the following tabulation.

<u>Coefficient of regional specialization</u>	<u>Rating</u>
0.268 to 0.548	4
0.547 to 0.652	3
0.651 to 0.830	2
> 0.830	1

The geographic distribution of these ratings is displayed in figure 4.

Population Density

Population density values and population density ratings for each Washington county are provided in table 6. The mean population density is 95 persons per square mile with standard deviation of 152. As expected, King County is the most densely populated county with 817 persons per square mile. Because of the wide disparity between King County and the next most densely populated county (Kitsap with 586 persons per square mile), King County is the only county selected for a 4 population density rating. At the opposite end of the spectrum, counties containing 10 or fewer persons per square mile were assigned a rating of 0. Recall that population density is used here as a proxy measure for civic infrastructure. Intuitively, the relative isolation of these counties results in a lower propensity to establish elements of civic infrastructure. A map of county population density ratings is provided in figure 5.

Table 6—Population density in Washington counties

County	Total population	People/square mile	Population density rating
King	1,737,034	817	4
Kitsap	231,969	586	3
Clark	345,238	550	3
Pierce	700,820	418	3
Island	71,558	343	3
Snohomish	606,024	290	3
Thurston	207,355	285	3
Spokane	417,939	237	3
Benton	142,475	84	2
Cowlitz	92,948	82	2
San Juan	14,077	80	2
Whatcom	166,814	79	2
Skagit	102,979	59	2
Yakima	222,581	52	2
Mason	49,405	51	2
Walla Walla	55,180	43	2
Franklin	49,347	40	2
Clallam	64,525	37	2
Grays Harbor	67,194	35	2
Asotin	20,551	32	2
Lewis	68,600	28	1
Grant	74,698	28	1
Chelan	66,616	23	1
Pacific	20,984	22	1
Whitman	40,740	19	1
Douglas	32,603	18	1
Stevens	40,066	16	1
Kittitas	33,362	15	1
Wahkiakum	3,824	14	1
Jefferson	25,953	14	1
Klickitat	19,161	10	0
Adams	16,428	9	0
Pend Oreille	11,732	8	0
Okanogan	39,564	8	0
Skamania	9,872	6	0
Columbia	4,064	5	0
Lincoln	10,184	4	0
Garfield	2,397	3	0
Ferry	7,260	3	0

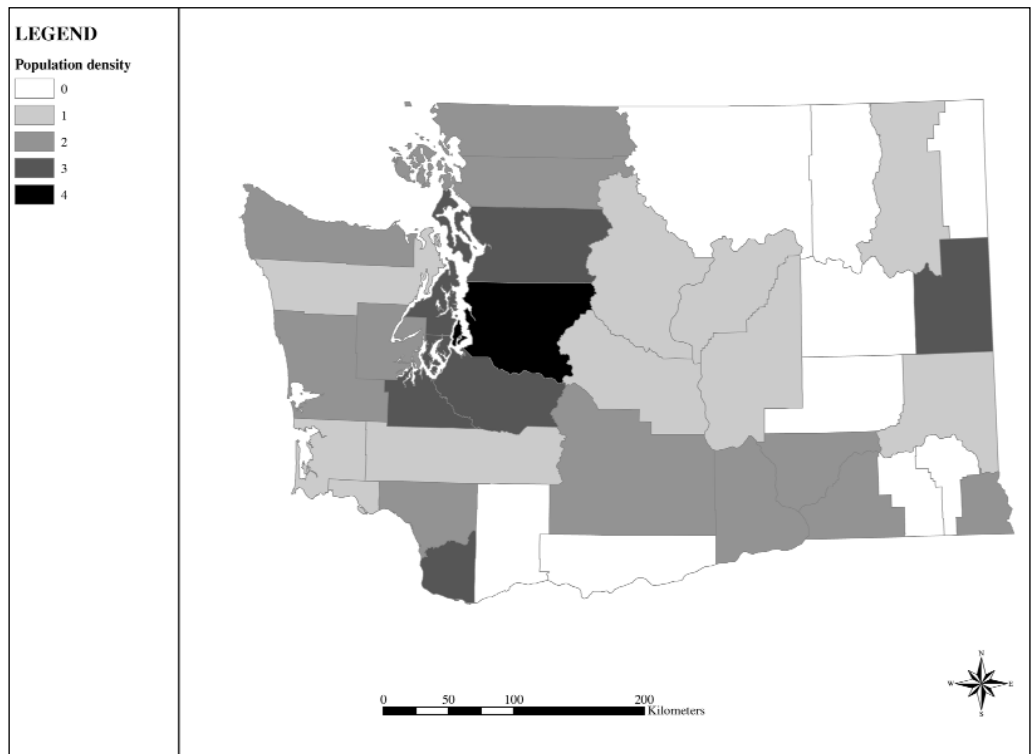


Figure 5—Population density ratings in Washington counties.

Socioeconomic Resiliency

For each Washington county, socioeconomic resilience values are calculated by using an unweighted average of lifestyle diversity, economic diversity, and population density ratings (table 7). The average socioeconomic resiliency value is 2.16 with standard deviation of 0.90. King County is the most resilient county in the state with an overall socioeconomic resilience value of 3.78. Next, Pierce and Thurston Counties tied for second highest with 3.39. Kitsap County, with a rank of 3.33, was the third most resilient county in the state. All counties in the top third of overall socioeconomic resilience ranks were assigned a rating of “high.” These counties are the most able to adapt to changes in their social and economic systems.

Counties containing the lowest third of socioeconomic resiliency ranks were assigned a rating of “low.” These are counties that may experience difficulty adapting after changes in social or economic systems. According to this analysis, Pend Oreille County, with a rating of 0.67, is the least resilient county in the state. Garfield, Lincoln, and Skamania Counties tie for next lowest with ratings of 0.78. Ferry County’s resiliency value of 0.83 is the third lowest in the state. The map in figure 6 displays socioeconomic resiliency ratings for all Washington counties.

Comparing socioeconomic resilience with areas designated by the state of Washington as distressed yields interesting results (fig. 7). Of the 14 counties with a “high” resilience rating, 3 appear on the 2003 distressed area list. Seven of thirteen counties with “medium” resilience are designated as distressed counties. Nine of the twelve counties receiving “low” socioeconomic resilience ratings were also identified as distressed. Three counties assigned low socioeconomic resilience ratings do not appear on the state’s list.

Table 7—Socioeconomic resiliency ratings for Washington counties

County	Socioeconomic resiliency	
	Value	Rating
King	3.78	High
Pierce	3.39	High
Thurston	3.39	High
Kitsap	3.33	High
Clark	3.22	High
Skagit	3.17	High
Snohomish	3.17	High
Spokane	3.17	High
Whatcom	3.17	High
Island	2.94	High
Yakima	2.89	High
Cowlitz	2.72	High
Benton	2.67	High
Franklin	2.67	High
Chelan	2.61	Medium
Clallam	2.50	Medium
Walla Walla	2.39	Medium
Grant	2.28	Medium
Grays Harbor	2.17	Medium
Asotin	2.11	Medium
Jefferson	2.11	Medium
Douglas	2.00	Medium
Lewis	2.00	Medium
Mason	2.00	Medium
San Juan	1.94	Medium
Whitman	1.89	Medium
Kittitas	1.72	Medium
Pacific	1.67	Low
Adams	1.44	Low
Stevens	1.44	Low
Okanogan	1.28	Low
Klickitat	1.11	Low
Wahkiakum	1.00	Low
Columbia	.94	Low
Ferry	.83	Low
Garfield	.78	Low
Lincoln	.78	Low
Skamania	.78	Low
Pend Oreille	.67	Low

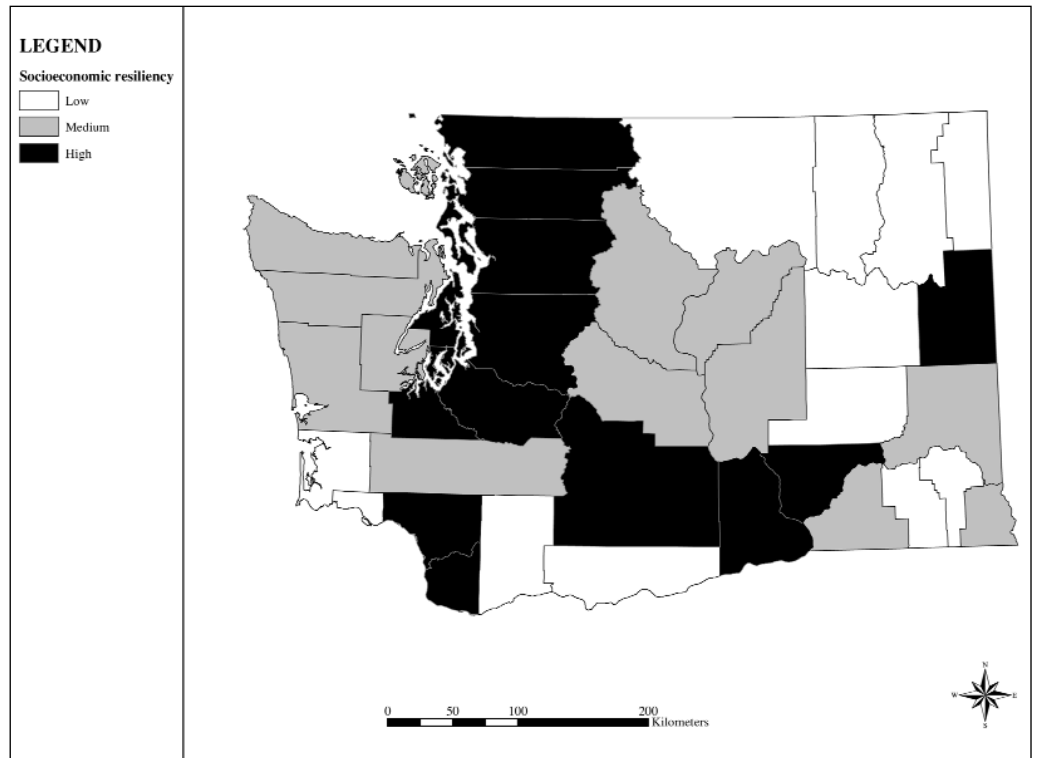


Figure 6—Socioeconomic resilience ratings in Washington counties.



Figure 7—Socioeconomic resilience ratings and 2003 distressed area designations.

Forest Dependence

The proportion of forest land per county sorted from highest to lowest values is presented in table 8. Washington state contains an average of 51 percent forest land. Counties with the highest proportion of forest land were Skamania, Grays Harbor, and Pacific, with 89.9 percent, 88.9 percent, and 88.8 percent, respectively. These counties are considered highly dependent on forest resources. At the other extreme, Adams, Benton, Franklin, and Grant Counties have no forest land, implying no dependence on forest resources.

Counties having 74 percent or more forest land were assigned a forest dependency rating of “high.” Those containing between 39 and 73 percent forest land were classified with a “medium” forest dependency rating. All counties containing 38 percent or less forest land were given a dependency rating of “low.” Observe that all counties in the “low” class are located on the east side of the state (fig. 8).

Counties of Concern

Table 9 combines socioeconomic resiliency ratings with forest dependence ratings for each Washington county. Ferry, Pacific, Pend Oreille, Skamania, Stevens, and Wahkiakum Counties all exhibit “low” socioeconomic resilience and “high” forest dependence and therefore are designated counties of concern. Ferry, Stevens, and Pend Oreille Counties are all located in the far northeast part of the state. Pacific and Wahkiakum Counties are situated along the west coast; Skamania County lies on the Oregon border (fig. 9).

**Washington
Department of Natural
Resources Reliance**

A base map of Washington west-side counties is provided in figure 10. Table 10 displays results after revision of the socioeconomic resilience ratings to include only west-side counties. More than one-third of the counties have a “high” rating owing to the three-way tie between Skagit, Snohomish, and Whatcom Counties. All counties having a socioeconomic resiliency rating greater than 3.00 are considered highly resilient. Counties rated as “medium” have a socioeconomic resilience value between 2.00 and 3.00. “Low” ratings are assigned to counties with a socioeconomic resilience value less than 2.00 (fig. 11).

The DNR reliance measures in west-side counties are displayed in table 11. Wahkiakum, Clark, and Thurston Counties contain the greatest proportions of DNR forest land ownership, with 27.04, 24.59, and 20.08 percent DNR ownership, respectively. At the opposite end, Pierce, Island, and San Juan Counties have the lowest proportion of DNR ownership of total county forest land, with 3.15, 2.01, and 1.39 percent, respectively.

Table 8—Forest dependence in Washington counties

County	Total area	Forest land area	Forest land area	Dependency rating
	<i>Acres</i>	<i>Acres</i>	<i>Percent</i>	
Skamania	1,060,160	953,994	89.99	High
Grays Harbor	1,227,072	1,090,765	88.89	High
Pacific	623,744	553,975	88.81	High
Jefferson	1,157,632	1,022,359	88.31	High
Ferry	1,410,560	1,224,035	86.78	High
Clallam	1,116,928	966,233	86.51	High
Mason	615,104	517,817	84.18	High
Cowlitz	728,768	612,863	84.10	High
Lewis	1,540,992	1,294,328	83.99	High
Wahkiakum	169,152	138,573	81.92	High
Pend Oreille	896,320	679,073	75.76	High
Stevens	1,586,112	1,200,530	75.69	High
Skagit	1,110,592	824,545	74.24	High
Pierce	1,072,320	761,776	71.04	Medium
Snohomish	1,337,728	939,869	70.26	Medium
Kitsap	253,440	165,472	65.29	Medium
King	1,360,704	877,928	64.52	Medium
Whatcom	1,356,864	871,009	64.19	Medium
Thurston	465,344	296,297	63.67	Medium
Okanogan	3,371,712	2,139,277	63.45	Medium
Chelan	1,869,824	1,172,636	62.71	Medium
San Juan	111,936	68,401	61.11	Medium
Island	133,504	80,206	60.08	Medium
Clark	401,856	218,280	54.32	Medium
Kittitas	1,470,272	746,863	50.80	Medium
Klickitat	1,198,400	507,325	42.33	Medium
Yakima	2,749,504	1,041,640	37.88	Low
Columbia	556,032	188,911	33.97	Low
Spokane	1,128,832	368,830	32.67	Low
Garfield	454,720	97,690	21.48	Low
Asotin	406,976	69,104	16.98	Low
Lincoln	1,479,168	66,777	4.51	Low
Walla Walla	813,120	17,934	2.21	Low
Whitman	1,382,016	14,862	1.08	Low
Douglas	1,165,184	4	0	Low
Adams	1,232,000	-	0	Low
Benton	1,089,984	-	0	Low
Franklin	795,008	-	0	Low
Grant	1,712,896	-	0	Low



Figure 8—Forest dependency in Washington counties.

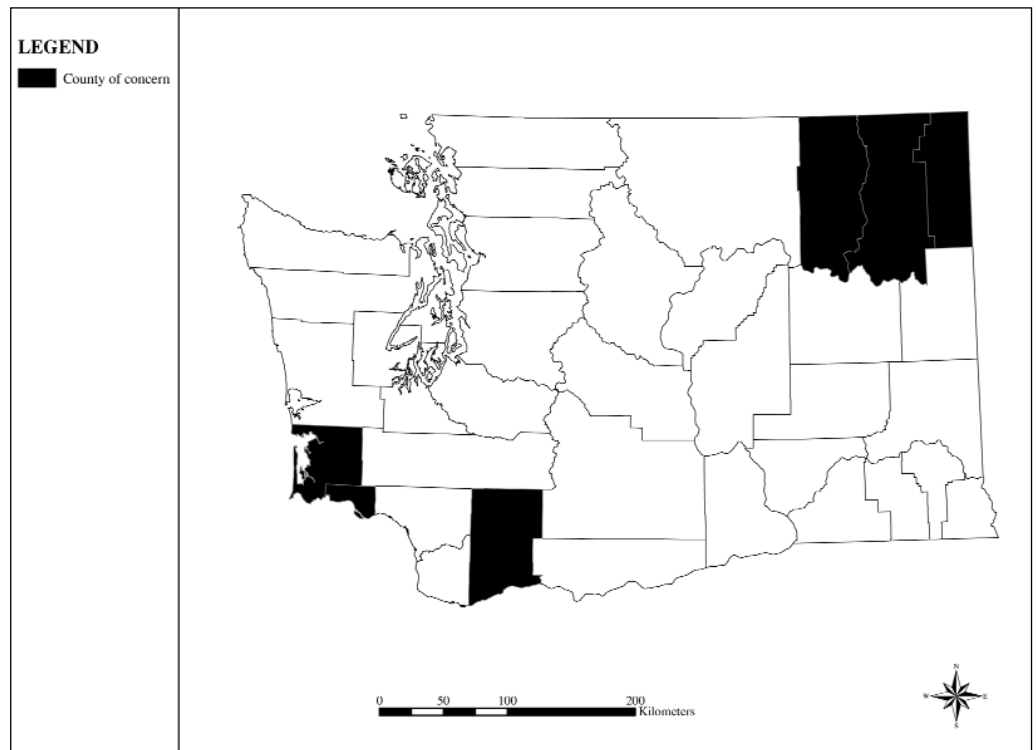


Figure 9—Washington statewide counties of concern.

Table 9—Statewide counties of concern

County	Socioeconomic resilience rating	Forest dependence rating
Adams	Low	Low
Asotin	Medium	Low
Benton	High	Low
Chelan	Medium	Medium
Clallam	Medium	High
Clark	High	Medium
Columbia	Low	Low
Cowlitz	High	High
Douglas	Medium	Low
Ferry	Low	High
Franklin	High	Low
Garfield	Low	Low
Grant	Medium	Low
Grays Harbor	Medium	High
Island	High	Medium
Jefferson	Medium	High
King	High	Medium
Kitsap	High	Medium
Kittitas	Medium	Medium
Klickitat	Low	Medium
Lewis	Medium	High
Lincoln	Low	Low
Mason	Medium	High
Okanogan	Low	Medium
Pacific	Low	High
Pend Oreille	Low	High
Pierce	High	Medium
San Juan	Medium	Medium
Skagit	High	High
Skamania	Low	High
Snohomish	High	Medium
Spokane	High	Low
Stevens	Low	High
Thurston	High	Medium
Wahkiakum	Low	High
Walla Walla	Medium	Low
Whatcom	High	Medium
Whitman	Medium	Low
Yakima	High	Low

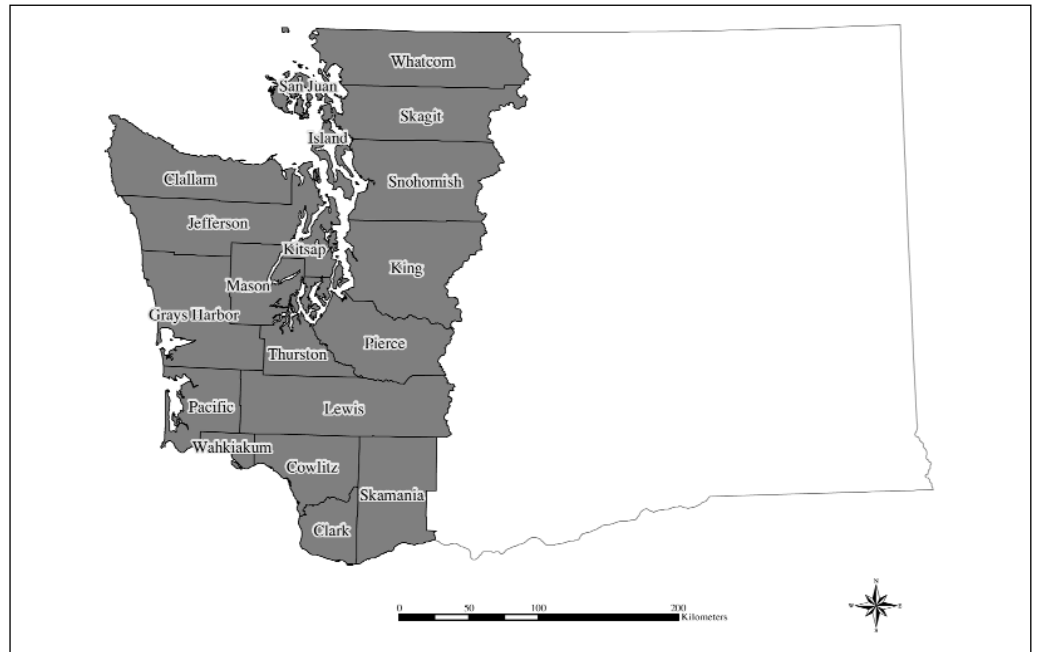


Figure 10—Washington west side counties.

Table 10—Revised west-side socioeconomic resiliency ratings

County	Socioeconomic resiliency value	Revised rating
King	3.78	High
Thurston	3.39	High
Pierce	3.39	High
Kitsap	3.33	High
Clark	3.22	High
Skagit	3.17	High
Snohomish	3.17	High
Whatcom	3.17	High
Island	2.94	Medium
Cowlitz	2.72	Medium
Clallam	2.50	Medium
Grays Harbor	2.17	Medium
Jefferson	2.11	Medium
Mason	2.00	Medium
Lewis	2.00	Medium
San Juan	1.94	Low
Pacific	1.67	Low
Wahkiakum	1.00	Low
Skamania	.78	Low

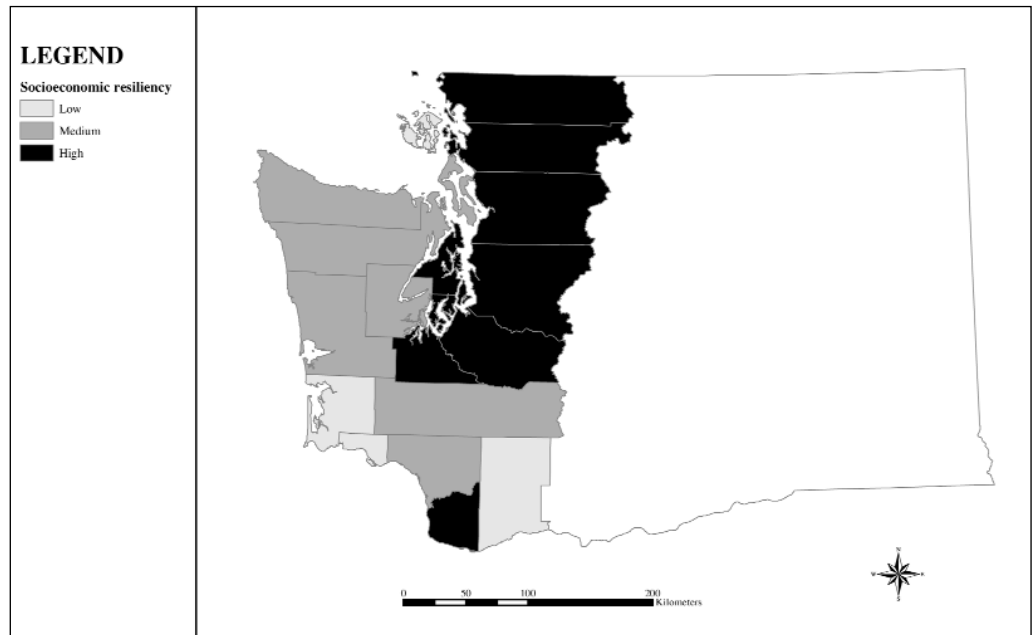


Figure 11—Revised west-side socioeconomic resiliency ratings.

Table 11—Department of Natural Resources (DNR) reliance in western Washington counties

County	Area of forest land	DNR ownership	Proportion of DNR forest land ownership	DNR reliance rating
	<i>Acres</i>	<i>Acres</i>	<i>Percent</i>	
Wahkiakum	138,573	37,468	27.04	High
Clark	218,280	53,685	24.59	High
Thurston	296,297	59,492	20.08	High
Jefferson	1,022,359	188,602	18.45	High
Clallam	966,233	151,284	15.66	High
Skagit	824,545	127,950	15.52	High
Pacific	553,975	78,979	14.26	High
Snohomish	939,869	121,181	12.89	Medium
Cowlitz	612,863	75,735	12.36	Medium
Whatcom	871,009	91,468	10.50	Medium
Mason	517,817	52,174	10.08	Medium
King	877,928	72,844	8.30	Medium
Kitsap	165,472	12,868	7.78	Medium
Lewis	1,294,328	95,972	7.41	Low
Skamania	953,994	69,795	7.32	Low
Grays Harbor	1,090,765	74,625	6.84	Low
Pierce	761,776	24,019	3.15	Low
Island	80,206	1,614	2.01	Low
San Juan	68,401	950	1.39	Low

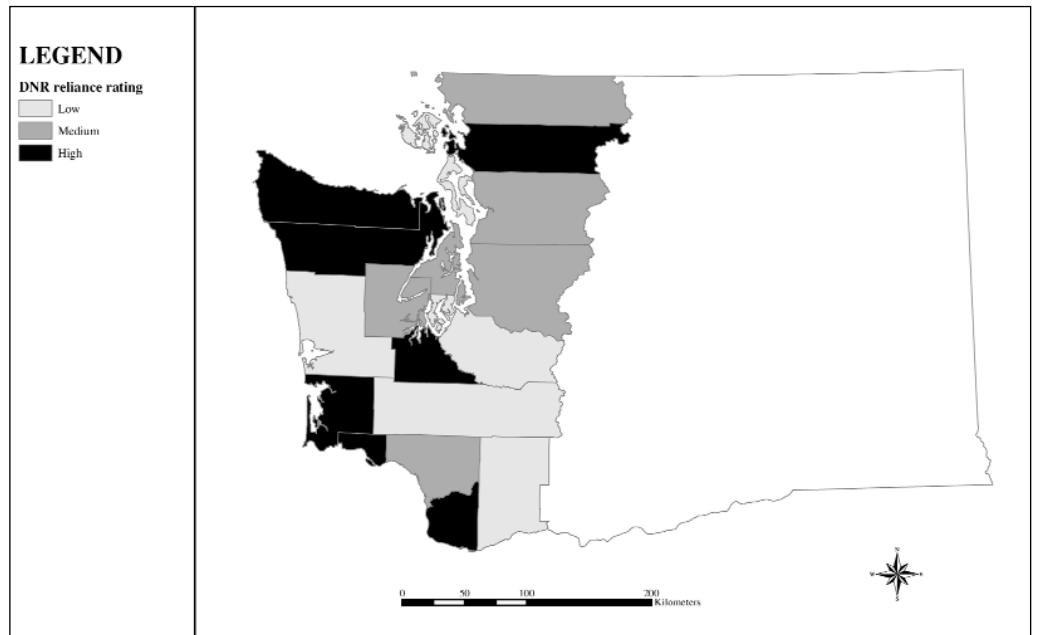


Figure 12—Department of Natural Resources reliance ratings, west-side counties.

Analysis of regional DNR reliance is based on the same assumption as statewide forest dependence; counties with the greatest proportion of DNR forest land ownership are considered the most reliant on DNR forest resources. Therefore, counties containing greater than 14 percent DNR ownership of forest land are assigned a “high” DNR reliance rating. Counties where the DNR owns between 7.5 percent and 14 percent of total forest land are rated with “medium” DNR reliance. Last, counties with less than 7.5 percent of forest land in DNR ownership have “low” DNR reliance. These counties are unlikely to be affected by changes in DNR forest management policies. A map of DNR reliance ratings in west-side counties appears in figure 12.

Of the seven counties identified as having “high” DNR reliance, one (Skagit County) is located in the Puget Sound Economic Area and four (Clallam, Jefferson, Pacific, and Thurston Counties) are in the Olympic Peninsula Economic Area. These findings are consistent with measures of mill timber supply dependency in the DNR mill survey. On the other hand, the two remaining counties (Wahkiakum and Clark) are positioned within the Lower Columbia Economic Area, which does not contain mills identified as highly dependent on state timber.

**Washington
Department of Natural
Resources Counties
of Concern**

Table 12 and figure 13 delineate DNR counties of concern by combining DNR reliance ratings with revised west-side socioeconomic resilience ratings. The DNR counties of concern are those western Washington counties with both a low socioeconomic resiliency rating and a high DNR reliance rating. Only two counties meet these criteria, Wahkiakum County and Pacific County. These are the two western Washington counties that may experience difficulty adapting to changes in DNR forest management strategies.

Table 12— Department of Natural Resources (DNR) counties of concern

County	Revised socioeconomic resilience rating	DNR reliance rating
Wahkiakum	Low	High
Clark	High	High
Thurston	High	High
Jefferson	Medium	High
Clallam	Medium	High
Skagit	High	High
Pacific	Low	High
Snohomish	High	Medium
Cowlitz	Medium	Medium
Whatcom	High	Medium
Mason	Medium	Medium
King	High	Medium
Kitsap	High	Medium
Lewis	Medium	Low
Skamania	Low	Low
Grays Harbor	Medium	Low
Pierce	High	Low
Island	Medium	Low
San Juan	Low	Low

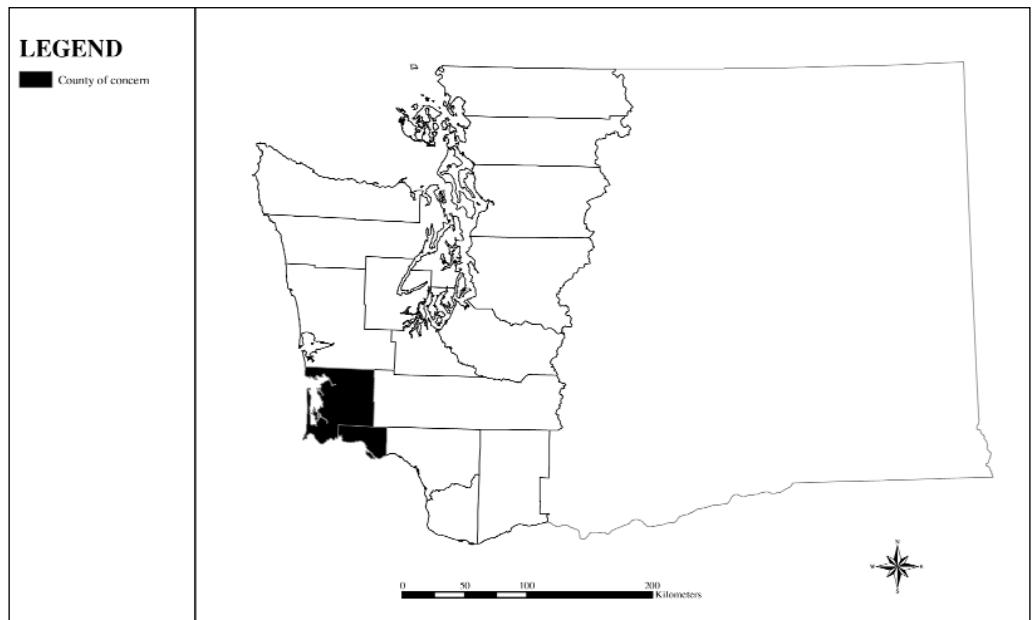


Figure 13—Department of Natural Resources west-side counties of concern.

Discussion

Washington counties receiving high socioeconomic resiliency ratings generally were close to urban areas. Seattle, Tacoma, Olympia, Spokane, and the Tri-Cities are all located in counties displaying a high degree of resiliency. In addition, highly developed transportation networks, including proximity to Interstate 5 and Interstate 90 and coastal ports, characterize highly resilient counties. Last, highly resilient counties contain a diversified industry mix with employment opportunities available in both services and manufacturing sectors.

On the other hand, the Olympic Peninsula and the far southeast and far northeast parts of the state have particularly low resilience. Remoteness, isolation, and poorly developed transportation networks are all factors contributing to low ratings, a result consistent with findings in Donoghue and Haynes (2002). In addition, the economies of these counties primarily center on manufacturing, timber and agricultural production, and natural resource extraction with relatively fewer jobs in the service sector than observed in highly resilient areas.

Forest-dependent counties may be vulnerable to changes in overall forest management. Since forest dependence incorporates nontimber values of forests, including tourism and recreation, these counties will be affected by a greater variety of land management decisions. As expected, forest dependence is greatest in areas containing the most forest cover. Consequently, west-side counties and the Tri-Counties region composed of Ferry, Stevens, and Pend Oreille Counties in the northeast corner of the state have the greatest forest dependency. On the west side, counties with greater proportions of residents living in urban areas are less forest dependent than those with significant rural populations. This observation can be interpreted in two ways; either it illustrates the industrial shift from manufacturing to services in urban economies or it reflects land use changes following the expansion of urban and suburban boundaries into areas formerly devoted to timber production. All counties with low forest dependence are located in eastern Washington, where no significant forest resource exists.

Of the 39 counties in Washington, only 6 were identified as “counties of concern,” which, for this study, is defined as low socioeconomic resilience combined with high forest dependence. Ferry, Pacific, Pend Oreille, Skamania, Stevens, and Wahkiakum Counties have several traits in common. The primary employer of residents in all of these counties has traditionally been the forest products industry. As a result of reduced volumes in timber harvesting, each is transitioning from an economy based on manufacturing of lumber and wood products to one dominated by trade and services. Each is relatively isolated and rural. All but Wahkiakum County appear on the 2003 state of Washington distressed county list. However, all six counties were listed as distressed in 2002.

Because of the relatively large proportion of DNR ownership of forest land, DNR reliance is high in Wahkiakum, Clark, Thurston, Jefferson, Clallam, Skagit, and Pacific Counties. Combining DNR reliance with low socioeconomic resiliency determines “DNR counties of concern.” Only Wahkiakum County and Pacific County fit this category. These two counties should be examined carefully when evaluating changes in DNR land management policies.

This assessment is an attempt to identify forest-dependent Washington counties that, for a variety of reasons, may experience difficulty adapting to changing forest management policies. Results demonstrate that combining social and economic indicators is a promising method for identifying such areas. Economic and social systems present in each county respond differently when faced with significant challenges. Taking a more comprehensive approach to evaluating well-being recognizes the inherent differences and individual challenges faced by county residents. Although change is a fact of life, land managers and the public should consider the differential effects among Washington counties to fully anticipate impacts during the transition to sustainable forest resource management on public lands.

Measures of socioeconomic systems are influenced by the size of the area measured and by time. Identifying the appropriate spatial and temporal scales for analysis requires further investigation. Readers are cautioned that potential limitations exist when analyses are performed at the county, rather than community, scale. This includes an “averaging over” effect that can mask severe distress in one community when it is offset by prosperity in another. In addition, a duplication of this study using 1990 data would provide insight into how county social and economic conditions have changed over time, a valuable aspect of monitoring consequences of public policies.

Acknowledgments

Many thanks to the Washington Department of Natural Resources for the opportunity to work on this project and for providing data, comments, and advice. Also, thanks to Richard Haynes and John Perez-Garcia for assistance and guidance and Phil Hurvitz for preparing the maps.

Metric Equivalents

When you know:	Multiply by:	To find:
Acres	0.405	Hectares
Square miles	2.59	Square kilometers
People per square mile	.386	People per square kilometer

References

- Donoghue, E.M.; Haynes, R.W. 2002.** Assessing the viability and adaptability of Oregon communities. Gen. Tech. Rep. PNW-GTR-549. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 13 p.
- Haynes, R.W. 2003.** Assessing the viability and adaptability of forest-dependent communities in the United States. Gen. Tech. Rep. PNW-GTR-567. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 33 p.
- Haynes, R.W.; Graham, R.T.; Quigley, T.M. 1996.** A framework for ecosystem management in the interior Columbia basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-374. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 46 p. [plus appendices].

- Horne, A.L.; Haynes, R.W. 1999.** Developing measures of socioeconomic resiliency in the interior Columbia basin. Gen. Tech. Rep. PNW-GTR-453. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 41 p.
- Larsen, D.N.; Hiserote, B.; Nguyen, Q. [N.d.].** Washington mill survey 2000. Series Rep. 16. Olympia, WA: Washington Department of Natural Resources, Office of Budget and Economics. On file with: David Larsen, Economist, Financial Management Division. dave.larsen@wadnr.gov.
- McCool, S.F.; Burchfield, J.A.; Allen, S.D. 1997.** Social assessment. In: Quigley, T.M.; Arbelbide, S.J., tech. eds. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 1871-2009. Chapter 6. Vol. 4.
- Moffat, A.S. 1996.** Biodiversity is a boon to ecosystems, not species. *Science*. 271(5255): 1497.
- Montreal Process Working Group. 1998.** The Montreal Process. <http://www.mpci.org>. (July 6, 2003).
- National Forest Management Act of 1976 [NFMA];** Act of October 22, 1976; 16 U.S.C. 1600.
- Society of American Foresters. 1989.** Community stability. SAF Resource Policy Series SAF 89-06. Bethesda, MD. 42 p.
- U.S. Department of Commerce, Bureau of the Census. 1999.** County business patterns—Washington 1997 [CD-ROM]. Washington, DC: U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 2002.** Census 2000 gateway. <http://www.census.gov/main/www/cen2000.html>. (January 2003).
- Washington Department of Natural Resources [DNR]. 1992.** Forest resource plan: policy plan, final. Olympia, WA: Forest Land Management Division. 53 p.
- Washington Employment Security Department [ESD]. 2001.** Washington State labor market information. Olympia, WA: Labor Market and Economic Analysis Branch. <http://www.wa.gov/esd/lmea>. (February 10, 2002).
- Washington Employment Security Department [ESD]. 2003.** List of distressed areas. Olympia, WA: Labor Market and Economic Analysis Branch. <http://www.wa.gov/esd/lmea/pubs/affirm/distco03.htm>. (August 12).

Appendix 1

Table 13—Forest land acreage by ownership in Washington counties

County	Federal	State	County and municipal	Private	Total
Adams	0	0	0	0	0
Asotin	42,256	450	0	26,398	69,104
Benton	0	0	0	0	0
Chelan	980,965	44,171	10,282	137,218	1,172,636
Clallam	468,447	144,482	88	353,216	966,233
Clark	7,387	58,813	1,490	150,590	218,280
Columbia	138,330	8,250	0	42,331	188,911
Cowlitz	22,051	71,016	220	519,576	612,863
Douglas	2	2	0	0	4
Ferry	480,690	38,665	5,959	698,721	1,224,035
Franklin	0	0	0	0	0
Garfield	88,748	0	0	8,942	97,690
Grant	0	0	0	0	0
Grays Harbor	132,043	87,260	49,037	822,425	1,090,765
Island	4,411	10,576	170	65,049	80,206
Jefferson	632,428	176,111	50	213,770	1,022,359
King	285,272	63,611	102,344	426,701	877,928
Kitsap	3,058	22,811	16,314	123,289	165,472
Kittitas	388,796	83,104	0	274,963	746,863
Klickitat	26,996	73,235	6,948	400,146	507,325
Lewis	457,658	118,174	7,809	710,687	1,294,328
Lincoln	2,320	2,209	0	62,248	66,777
Mason	142,535	74,041	18	301,223	517,817
Okanogan	1,410,985	222,884	0	505,408	2,139,277
Pacific	3,177	75,422	3,257	472,119	553,975
Pend Oreille	395,209	34,340	410	249,114	679,073
Pierce	320,496	31,683	9,250	400,347	761,776
San Juan	516	9,304	154	58,427	68,401
Skagit	395,053	131,464	7,927	290,101	824,545
Skamania	765,850	74,380	3,511	110,253	953,994
Snohomish	502,302	136,012	8,784	292,771	939,869
Spokane	12,426	44,368	3,940	308,096	368,830
Stevens	291,113	174,259	0	735,158	1,200,530
Thurston	8,553	64,397	67	223,280	296,297
Wahkiakum	0	36,907	0	101,666	138,573
Walla Walla	50	0	0	17,884	17,934
Whatcom	580,750	91,292	5,255	193,712	871,009
Whitman	0	0	210	14,652	14,862
Yakima	430,762	90,530	0	520,348	1,041,640
Total	9,421,635	2,294,223	243,494	9,830,829	21,790,180

Appendix 2

Table 14—Shannon-Weiner diversity index values for Washington counties

County	Mobility	Ethnicity	Urban/rural	Race	Income	Education
Adams	0.773	0.770	0.623	0.390	0.931	0.906
Asotin	.642	.485	.184	.137	.947	.866
Benton	.712	.694	.467	.322	.951	.936
Chelan	.732	.718	.784	.323	.963	.939
Clallam	.679	.638	.524	.274	.947	.894
Clark	.734	.674	.357	.294	.953	.886
Columbia	.643	.594	.580	.201	.936	.889
Cowlitz	.673	.613	.588	.229	.949	.864
Douglas	.713	.710	.526	.318	.940	.909
Ferry	.643	.587	.115	.371	.917	.858
Franklin	.807	.794	.582	.457	.956	.933
Garfield	.630	.553	.236	.076	.925	.901
Grant	.773	.754	.594	.401	.947	.919
Grays Harbor	.672	.594	.515	.278	.937	.869
Island	.727	.694	.522	.319	.952	.870
Jefferson	.692	.637	.530	.208	.957	.870
King	.773	.778	.150	.472	.967	.905
Kitsap	.714	.692	.457	.375	.958	.877
Kittitas	.707	.629	.571	.236	.936	.891
Klickitat	.690	.650	.603	.299	.933	.882
Lewis	.682	.618	.535	.207	.942	.875
Lincoln	.659	.540	.246	.143	.944	.870
Mason	.676	.645	.444	.299	.945	.864
Okanogan	.711	.683	.506	.434	.926	.909
Pacific	.674	.664	.546	.254	.931	.888
Pend Oreille	.647	.587	.077	.197	.935	.865
Pierce	.737	.730	.206	.454	.955	.885
San Juan	.684	.642	.100	.151	.977	.853
Skagit	.725	.696	.772	.312	.960	.913
Skamania	.661	.615	.064	.196	.944	.857
Snohomish	.728	.710	.351	.340	.943	.883
Spokane	.707	.646	.462	.242	.955	.900
Stevens	.657	.587	.488	.226	.936	.861
Thurston	.712	.705	.576	.352	.951	.901
Wahkiakum	.606	.560	.083	.157	.925	.851
Walla Walla	.743	.716	.474	.345	.943	.950
Whatcom	.729	.723	.772	.291	.958	.903
Whitman	.747	.695	.547	.281	.924	.894
Yakima	.722	.733	.801	.473	.950	.926

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

USDA is committed to making its information materials accessible to all USDA customers and employees.

Pacific Northwest Research Station

Website	http://www.fs.fed.us/pnw
Telephone	(503) 808-2592
Publication requests	(503) 808-2138
FAX	(503) 808-2130
E-mail	pnw_pnwpubs@fs.fed.us
Mailing address	Publications Distribution Pacific Northwest Research Station P.O. Box 3890 Portland, OR 97208-3890