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FOREST RESOURCE ACCESS, DEPENDENCY, AND VULNERABILITY IN SOUTHEAST AND SOUTHCENTRAL ALASKA

by

Mekbeb E. Tessema

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Human Dimensions of Ecosystem Science and Management

Approved:

Dr. Robert Lilieholm Co-Chair	Dr. Dale Blahna Co-Chair
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UTAH STATE UNIVERSITY
Logan, Utah

2011

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ABSTRACT

Forest Resource Access, Dependency, and Vulnerability in
Southeast and Southcentral Alaska

by

Mekbeb Eshetu Tessema, Doctor of Philosophy

Utah State University, 2011

Major Advisors: Dr. Robert J. Lilieholm and Dr. Dale J. Blahna
Department: Environment and Society

Rural communities in the western U.S. and Alaska are highly dependent upon surrounding publicly-owned forests for various economic and non-economic values. Historically, limited data has hampered the understanding of such community-resource linkages. As a result, community interests may not be adequately considered in forest management plan development and policy formulation. Addressing this imbalance is an important issue for the U.S. Forest Service (USFS), particularly as it shifts from timber-dominated goals to a more holistic ecosystem-based form of management.

This study seeks to understand community-resource use linkages, dependency, and vulnerability surrounding the Chugach and Tongass NFs using place-level socioeconomic data from the 2000 U.S. Census in combination with permit data from the USFS's Timber Information Management Data System (TIM) and Special Use Data System (SUDS).

Information on permittees' activities on forestland and socioeconomic profiles of permittee's community-of-origin are found to be valuable, not only for forest management and planning purposes, but also for community-level social assessment. An examination of 2007 permit data found that a majority of permit holders were local residents. These communities are found to be dependent on the two forests for various types of activities and are thus more likely to be vulnerable to changes in forest management and policies.

The analysis also identified some limitations that may affect the quality of permit data and its potential use in community impact assessments. Despite these limitations of permit data, the methodologies utilized here demonstrate how TIM and SUDS data, in combination with U.S. Census data, could be used to describe Alaska residents' socioeconomic profiles for communities located in close proximity to the Tongass and Chugach NFs. Such information can assist USFS managers in deriving community-level estimates of forest resource use, degree of dependency, and vulnerability to the likely impacts of alternatives management approaches.

Finally, recommendations are given to improve data recording, maintenance, and use in order to better understand communities that are dependent on forest resources in both the Chugach and Tongass NFs, and to specifically identify those communities potentially vulnerable to changes in forest management policies.

(281 pages)

PUBLIC ABSTRACT

Societal views of the appropriate management and use of publicly owned forestlands in the U.S. have undergone tremendous changes over the last 40 years. These changes have brought challenges to federal management agencies. In order to achieve balanced and sustainable land and resources management, understanding how different stakeholders use forest lands and resources is critical. In this study, we gave particular emphasis to rural communities' use of forest resources in Alaska and to federal land management policies regarding community residents' use of forest resources.

In Alaska, traditional extractive uses, including mining, logging, firewood cutting, and hunting support many rural communities, especially Native communities. The potential for conflict is particularly high in Alaska, where nearly 89% of the land base is publicly owned, 10% is under Native Corporation control, and just 1% is privately held. Understanding and monitoring resources uses, and community dependence on resources use, is important for addressing conflicts and designing sustainable use policies.

This research had two main objectives: (1) to investigate use of secondary data to improve resource use and social assessment for communities around the Chugach and Tongass National Forests in Alaska, and (2) to develop measures to estimate community use, dependency, and vulnerability as they relate to resource use and access.

We used place-level socioeconomic data from the 2000 U.S. Census in combination with permit data from the US Forest Service's Timber Information Management Data System (TIM) and Special Use Data System (SUDS). Permit and

Census data are readily available; and hence, it was possible to conduct the study with minimum cost (about $60,000 for the entire costs of the project, which include labor, travel, and supplies).

The results of the study show that the Forest Service permit databases are rich in information useful for forest management, planning, and policy formulation. Evaluation and expansion of such databases may contribute to the development of new approaches to study forest-dependent communities. Most social assessment research focuses on community characteristics, and the actual linkages to natural resources is unclear. But using permit data allows analysts to understand the direct linkages between community residents and forest resources. Using secondary data sources for social assessment allows resource dependent communities' interests to be better incorporated in agency decision-making in order to minimize impacts that may be caused by land management decisions or policy changes.

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Mekbeb E. Tessema

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LIST OF ACRONYMS AND DEFINITIONS

ANCSA –Alaska Native Claims Settlement Act of 1971

ANILCA – Alaska National Interest Lands Conservation Act of 1980

BLM –USDI Bureau of Land Management

CNF – Chugach National Forest

EP – Employment Proportion

FLPMA – Federal Land Planning and Management Act of 1976

HH – Household

INFRA – Forest Service Infrastructure Database System

LPL – Linkages to Public Lands Framework

NFS – National Forest System

NF – National Forest

PNWRS – Pacific Northwest Research Station

SUDS – Special Use Data System

TIM – Timber Information Management Data System

TNF – Tongass National Forest

USFS – USDA Forest Service

USU – Utah State University

CHAPTER I

INTRODUCTION

Background

Understanding how rural communities use and depend upon local natural resources is a critical factor in developing policies to sustain the long-term viability of human and natural systems. Such "community-resource" linkages are particularly important in Alaska, where rural communities—many of them comprised of indigenous Alaska Natives—are highly dependent upon local resources found on public lands. Alaskan communities utilize forests in many ways. To better understand these coupled "socio-ecological" systems, I used socioeconomic data from the 2000 U.S. Census, in combination with Timber Information Management (TIM) and Special Use Database System (SUDS) permit data from the USFS, to describe communities and their use of forest resources. The USFS permit databases are rich in information useful for social science research, forest management and planning, and policy formulation purposes. Evaluation of such databases may contribute to the development of new approaches in studying forest-dependent communities and their linkages to forests.

Social views of the appropriate management and use of public forest lands in the U.S. have undergone tremendous changes over the last 40 years (Kruger and Mazza 2006). During this transition, public land management has evolved from providing market commodities like timber, to incorporating the protection and maintenance of ecosystem services under the paradigm of ecosystem management (Kennedy and Koch 2004). The change manifests through a host of laws, including the National

Environmental Policy Act (1969), the Endangered Species Act (1973), the Resources Planning Act (1974), the National Forest Management Act (1976), and others. These laws—and their interpretations under the legal system—have profoundly altered the management of hundreds of millions of acres of public forests, perhaps none more so than the 191 million acres of land within the National Forest System (NFS) managed by the USFS.

Against a backdrop of changing attitudes toward public land management, forest use in the State of Alaska presents an interesting case study. There, growing demands for recreation and environmental protection increasingly conflict with long-standing demands for extractive uses. Traditional extractive uses, including mining, logging, firewood cutting, and hunting support many rural Alaskan communities, especially Native communities. The potential for conflict is particularly high in Alaska, where nearly 89% of the land base is publicly owned, 10% is under Native corporate control, and just 1% is privately held. For public lands, 27% are managed by the State, with the balance under federal control, including 6% managed by the USFS.

Nearly 38% of Alaskans live in rural communities with fewer than 10,000 residents. Moreover, nearly 17% of Alaskans are Alaska Natives, with 69% living in rural communities, most of which are within the vicinity of the Tongass and Chugach National Forests (Allen et al. 1998; USFS 2007). Alaska's many rural communities, combined with the dominance of public lands, makes local access to public resources a critical issue. Yet this historic connection between communities and public lands, managed by agencies like the USFS, is challenged by national trends that shift management away from the production of commodities like timber, and toward greater emphasis on cultural values (e.g., spiritual, recreational, and aesthetic) and ecological services (e.g., regulating and supporting services like wildlife habitat and water quality).

Study Purpose

This study has three main purposes: (1) to better understand and document how rural Alaskan communities access and use nearby publicly owned forest resources through a review of available literature on the nature of community resource use, dependency, and vulnerability; (2) to describe how the USFS manages private use of public lands by examining Forest Service permit database systems, including the Timber Information Management Database System (TIM) and the Special Use Permit Database System (SUDS); and (3) to develop a methodology that uses USFS permit data from the Tongass National Forest (TNF) in southeast Alaska and the Chugach National Forest (CNF) in southcentral Alaska, to describe the nature of resource-use at the community level. This approach is intended to contribute to an improved understanding of resource-use linkages at the community level as a way to better foster the health and long-term sustainability of human and natural systems.

Dissertation Organization

Chapter I introduces the study and discusses the rationale of the research. Chapter II synthesizes the various literature on resource access, use, dependency, and vulnerability. Chapter III describes the two study areas, focusing on communities' characteristics and lifestyles, the status of forest resources, nature of landownership, and laws and regulations applied to manage federally owned lands in Alaska. Chapter IV presents details on the methodology used. Chapters V and VI present results from the analyses using tables and figures and discuss implications of the findings for current forest management policies focusing on the major conceptual pieces (community access to resources, use level, dependency, and vulnerability). Finally, Chapter VII presents conclusions and recommendations by summarizing the main findings of the study, including its contribution to forest management and the existing academic literature.

CHAPTER II

LITERATURE REVIEW

This chapter reviews key literature on rural communities' resource access, use, dependency, and vulnerability. Also included are important concepts of scale, as well as issues on methodological approaches related to social science studies. The purpose of this literature review was to understand how the key concepts on these topics are applied in different contexts and to adapt it to this research and the two study areas.

Resource Dependency and Rural Communities

The welfare and sustainability of rural resource-based communities is an important social goal for land management agencies. A detailed understanding of how resource-dependent communities are connected to local natural resources also helps to determine adverse policy impacts on communities' socioeconomic conditions. However, the key issue in studying resource dependent communities is defining the term "resource dependency." Past literature (e.g., Schallau and Polzin 1983; Burch and DeLuca 1984; Schallau and Alston 1987; Burch 1988; Schallau 1989; Freudenburg and Gramling 1994; Force et al. 2000; Stedman et al. 2004) defined natural resource dependence using economic, technological, and socio-cultural metrics.

The sociocultural metrics refer to communities' historic linkages to land as they continue earlier generations' activities such as hunting and fishing. Such historic linkages describe communities' unique relationships to their lands and resources (Burch and

DeLuca 1984; Burch 1988; Beckley and Sprenger 1995; Stedman 1999). Because of these unique economic and sociocultural linkages, resource dependent communities are distinct from other societies where lifestyles are either loosely linked to natural resources or have no direct linkages.

A characteristic trait of rural economic dependency on natural resources is the production of primary commodities directly linked to the extraction and harvesting of natural resources such as minerals, timber, agriculture, and fisheries (Field and Burch 1988; Krannich and Luloff 1991). As a result, most efforts to describe resource dependence have utilized economic approaches based on employment and income statistics to measure the proportion of economic activity linked to specific sectors. For example, Kaufman and Kaufman (1946) studied forest dependence more than a half-century ago, focusing on sustained yield's role in supporting forest sector employment and local economic development. This is due to the fact that economic dependency is relatively easy to measure.

Other literature, however, defined forest dependency both in terms of economic and/or noneconomic aspects, indicating the expanding conceptualization of the term forest dependency (e.g., Drielsma 1984; Elo and Beale 1985; Kusel and Fortmann 1991; Overdevest and Green 1994; Korber et al. 1998; Stedman 1999; Stedman et al. 2004). Even when examining economic dependency alone, forest dependency is not homogeneous in terms of economic returns to a given community or county (Overdevest and Green 1994), linking dependency to level of income accrued from the various forest sectors. This suggests that differences in economic gain must be taken into consideration in forest management and policy.

As a result, there are two different arguments on how community forest resource dependency should be defined in terms of economic dependency. Some give more emphasis to the percentage of employment. For example, Elo and Beale (1985) defined forest dependency as a minimum of 20% of total employment being in forest sectors. This definition ties dependency directly to forest sector employment regardless of the amount of forested lands existing in a given community or county. Elo and Beale argue that for a small community, the percentage of forest sector employment matters most since the sector supports many households that could be affected if more jobs are lost from the forest sectors, which in turn affects the entire local economy by reducing income. On the other hand, Overdevest and Green (1994) caution that defining forest dependency based on total percentage of employment may be misleading because not all sectors equally affect the local economy. Overdevest and Green's argument builds on the findings of Drielsma (1984), which indicates that forest dependency is linked to higher incomes and benefits because it is tied to high-paying forest products manufacturing such as pulp and paper. Drielsma argues that if a community or a county loses these forest sectors, which he terms "core sectors," the local economy is greatly affected despite the fact that a lower percentage of people are employed therein. On the other hand, low paying (periphery) forest sectors such as logging and tourism are considered to have a low impact on the local economy because they provide fewer benefits.

Fortmann et al. (1991) linked forest dependency to the amount of public land (timberland under public jurisdiction) and the concentration of private timberland available. They found that community economic well-being was negatively correlated with concentrations of public and private timberland, whereby the core forest sectors did not necessarily predict high levels of economic well-being. This finding is supported by Overdevest and Green (1994). Fortmann et al. (1991) argue that higher percentages of timberlands by any ownership are correlated with lower per-capita income and higher poverty rates. They conceptualize the term “timberland” as forests, regardless of ownership, whose primary objective is growing timber for the purpose of wood sectors. This is of potential significance to Alaska, where more than 89% of the land is publicly owned and in the past wood production has been the major management objective on National Forests.

In recent years the scope of “forest dependency” has expanded, and many social scientists (e.g., Stedman 1999) argue that studying forest dependency at the community level should not be confined to economic aspects only. Forest dependency at the community level has multifaceted characteristics. Today, many researchers agree that understanding and measuring forest dependence requires multiple approaches. Common to these approaches is the search for indicators that, once identified, are easy to measure, compare, and monitor. Examples include indices based on socioeconomic variables, researcher-identified and process variables, and subjective self-reports (Kusel 2003). Others have developed indicators that include community resilience, social capital, and sense-of-place concepts (e.g., Harris et al. 1998; Beckley et al. 2002; Parkins and MacKendrick 2007; Charnley et al. 2008).

Resource Access and Community Vulnerability

Access to forests and other natural resources is critical for the economic well-being of many rural resource-dependent communities. The ownership and management of resource-rich lands, whether they are forests or other ecosystems, is a key determinant of economic sustainability (Leach et al. 1999; Gunderson and Holling 2002; Fraser 2003), and has a direct effect on rural communities.

In many parts of the world, rural poverty and lack of access to natural resources are positively correlated (Cook 1995; Arnold and Townson 1998; Arnold 1999; Woodhouse 2002). A community may lack access to resources for two major reasons. First, physical exclusion may result from a shift in the valuation of natural resources or in the types of natural resource management (Carroll 1991; Lee 1991) or zoning for tourism or second home development. These occurrences may also increase land values and further exclude local people from access (Geisler and Mitsuda 1987; Fitchen 1991). In addition, these policies may limit local peoples' livelihood strategies. Both state and federal governments may establish resource use regulations, fees, and often taxes that affect the local livelihood and quality of life. Game laws, the establishment of parks and nature reserves, and the protection of endangered species have all reduced communities' access to subsistence and economic uses of natural resources (Ives 1988).

As a result, evaluating public land management policies and measuring community vulnerability in the context of access to resources is crucial because of the impact on communities' social, economic, and cultural well-being (Knutsson and Ostwald 2006).

The relationship between poverty and lack of access in resource dependent communities is also explained by multiple theories that focus on the general characteristics of rural communities. Stedman (1999) and Stedman et al. (2004) reviewed sociological theories developed by the Rural Sociological Task Force on Rural Poverty concerning what factors contribute to rural poverty, and highlighted the issue of access. These factors include: (1) lack of human capital (rural areas often have under-skilled populations); (2) low income and benefits because of the "peripheral" nature of industrial structures (e.g., the seasonality of jobs such as those in tourism); (3) power and natural resource bureaucracy (i.e., large extractive sectors are often owned by powerful interests which may limit rural communities' access to resources and decision-making concerning how and when resources are used); and, (4) moral exclusion (i.e., popular sentiment may run against some forms of resource extraction). See Humphrey et al. (1993) for details on each of these theories.

In Alaska, the issue of access to natural resources is critical because about 38% of residents are rural by nature and highly dependent upon Alaska's publicly owned lands to provide various uses and services (Allen et al. 1998). Limited or barred access to resources threatens not only rural and/or Native communities' livelihoods, but also cherished cultural practices. Therefore, understanding how access is regulated by institutions like the U.S. Forest Service and the potential impacts of limiting access to forest resources is crucial for rural community sustainability and public lands management.

The Link between Resource Dependency and Community Vulnerability

The literature on resource dependency describes patterns of dependence that emerge in a variety of settings, but primarily involves communities in which economic activity revolves around capitalizing on key features of the local natural environment—typically agriculture, forestry, fisheries, mining, oil and gas extraction, or recreation and tourism (Krannich and Luloff 1991; Field and Burch 1998; Reed 2003; Thellbro 2006). Such communities have a history of economic insecurity due to market fluctuations in various economic sectors, technological change, globalization, and shifting state and federal resource policies (Krannich and Luloff 1991). Other factors that may exacerbate vulnerability include isolation from population centers and small and/or aging populations.

In the past, discussions of the link between forest-resource dependent communities and vulnerability focused only on timber dependent communities, arguing that sustainable timber harvest is necessary for community economic stability. More recently, however, the relationship between sustained timber yield and community stability, a term commonly used in the past to equally denote sustainability, has been questioned. Studies have found that dependence on logging may expose communities to high unemployment and increased poverty rates (Bliss et al. 1992; Howze et al. 1993;

Nord 1994; Cook 1995; Fisher 2001), related social ills (Drielsma 1984; Freudenburg and Gramling 1994;), and higher crime rates (Force et al. 1993). Indeed, most social scientists (e.g., Beckley and Sprenger 1995; Kusel 1996, 2003; Stedman 1999; Charnley et al. 2008) today view the concept of "*community stability*" as overly simplistic, noting that social communities—like their ecological counterparts—experience constant change. As a result, community research increasingly seeks to understand the factors that underlie community resilience and adaptation to change (Donoghue and Haynes 2002; Haynes 2003; Kruger 2003; Tsournos and Haynes 2004; Charnley 2006; Magis 2010).

Moreover, as the discussion in various literatures reveals, resource dependent communities, assessed by all measures of socioeconomic conditions, find themselves at a disadvantage that increases their sensitivity to unwanted changes occurring in land and resource management. As described below, this has implications, particularly for Alaskan communities.

Conceptual Definitions of Vulnerability and the Issue of Scale

Defining the concept of "vulnerability" is an ongoing debate. At issue is the identification of standard indicators to measure the concept at different geographic scales. Indicators are commonly used to monitor trends at regional, national, county, and sub-county/place level. However, the use of indicators at the lower end of the geographic scale—i.e., at the community level—has been difficult due to lack of data. Despite data constraints, a growing number of studies recommend a place-based measure of community vulnerability (e.g., Morrow 1999; Cutter et al. 2000, 2003, 2008; Turner et al. 2003; Parkins and MacKendrick 2007). The use of place-based approaches in defining community vulnerability is very important for the specificity of place that could be used to develop specific mitigation measures and increased public involvement and collaborative assessment (Turner et al. 2003).

Parkins and MacKendrick (2007) attempted to test the applicability of some of the global level vulnerability indicators developed by the Intergovernmental Panel on Climate Change (IPCC) for use in community level analysis. The IPCC defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC 2001, 2007). However, such definitions are subject to wide debate because this conceptualization of vulnerability focuses on the impact of the damage caused by various natural factors (Brooks 2003; Adger et al. 2004; O'Brien et al. 2004; Parkins and MacKendrick 2007). Moreover, the IPCC definition primarily focuses on climate change impacts and various adaptive capacities, which include: technology, social capital, resource availability, human capital, and institutional decision-making capacity (IPCC 2001, 2007; Parkins and MacKendrick 2007).

Other than the IPCC definition, a wide variety of conceptual frameworks have been developed to address the vulnerability of human and ecological systems to perturbations, shocks, and stresses (e.g., Watts and Bohle 1993; Blaikie et al. 1994; Davidson 1997; Bohle 2001; Bollin et al. 2003; Wisner et al. 2004; Birkmann 2006). Recently, sustainability science efforts have been attempting to frame vulnerability within the context of coupled socio-ecological systems (Turner et al. 2003). Such a framework seeks to capture the totality of the different elements that have been in risk, hazards, and vulnerability studies, and to frame them in regard to their complex linkages. It also recognizes that the components and linkages in question vary by the scale of analysis undertaken, and that the scale of the assessment may change the specific components but not the overall structure (Chambers and Conway 1992; Turner et al. 2003). The framework identifies two basic parts to the vulnerability problem and assessment: *perturbation-stresses* and the *coupled socio-ecological system*. Perturbations and stresses can be both human and environmental and are affected by processes often operating at scales larger than the event in question (e.g., climate changed drought) (Kasperson et al. 2001).

Focusing on the adaptive capacity of a system, human or ecological, Cutter et al. (2008), Downing et al. (2006), Carreno et al. (2005), Vogel and O'Brien (2004), and Cannon et al. (2003) also discussed the issue of scale and vulnerability in relation to how adaptive capacity can be measured using variables at different scales. They further explain that vulnerability assessment should not focus only on exposure to perturbations and stresses, but also the sensitivity and resilience of the system experiencing such perturbations and stresses—a point highly relevant to this study in Alaska. Along these same lines, Anderson and Woodrow (1989) suggest three categories that are used to understand and identify dimensions of vulnerability and capacity, including physical and material, social and organizational, and motivational and attitudinal. Even though some of these attributes are not covered by this study, vulnerability could be viewed as a continuum from resilience to susceptibility (Vogel 1997).

Moreover, the definition of vulnerability given by Downing et al. (2006), Wisner et al. (2004), Cannon et al. (2003), Bohle et al. (1994), and Blaikie et al. (1994) has particular relevance for Alaska, where resource linkages are central to rural identity, yet subject to changing state and federal natural resource policies. Downing et al. (2006), Wisner et al. (2004), and Blaikie et al. (1994) defined community vulnerability as *"the lack of capacity to anticipate, cope with, resist, and recover"* from some stress or impact. The concept has been examined within many contexts, including susceptibility to climate change and adaptive responses, food insecurity, and natural hazards. The relevance of this concept for Alaska is that it focuses on the coping capacity of a community measured by factors such as the economic, socio-demographic and cultural aspects of a community which may predispose it to risks and thus require close examination. The term "coping capacity" is defined as the availability of resources and the manner in which people or organizations use these resources to face the negative consequences of any adverse impacts—this is a key concept in vulnerability assessments (Billing and Madengruber 2006).

The Concept of Community

According to Machlis and Force (1988), there has not been a standard definition given to the term "community" reflecting the variation in the conceptualization of the term community. This variation has been noted by Magis's (2007) synthesis of the literature on the concept of community. She noted that the concept of community has been described in both the community development and natural resources literatures. Hence, according to Gusfield (1975), a community can be defined in terms of both a territorial and a relational component. The relational component refers to relationships between people who live in the same geographic area and share similar beliefs, interests, social attributes, or a sense of belongingness to the community with a high level of commitment to solve problems and access resources (Chaskin et al. 2001). However, other social scientists, e.g., Carroll and Lee (1990), conceptualize the term community differently because they place less emphasis on human-territorial relationships. They believe that because the boundaries of many towns are arbitrarily defined, geographical boundaries may not accurately define a community. Instead, they posit that a community is best described as groups of people who strongly bond with each other, the land, and share common lives and values. This is typical of many rural communities which, while unincorporated, are still considered communities (Donoghue and Sutton 2006).

Other social scientists; e.g., Bradford (2005), Flora et al. (2004), Raco and Flint (2001), Kepe (1999), and Kretzmann and McKnight (1993), also support Gusfield's definition of community. According to Flora et al., "community" is often based on a shared "sense of place" which involves relationships between people, cultures, and environments—both natural and built—associated with a particular area. Such notions of "place dependence" convey the view that a location is unique in its ability to satisfy the economic and non-economic needs of individuals or communities.

On the other hand, Allen et al. (1998) and Jakes et al. (1998) support the definition of community given by Carroll and Lee (1990) and Donoghue and Sutton (2006). Accordingly, a community can be defined as a "community of interest," where people are linked by a common interest, activity, or set of values. Further, a community can be defined based on functional characteristics of its residents, which include social, demographic, economic, and cultural bonds (Kruger 2003; Jakes et al. 1998).

The most comprehensive definition of community, however, is given by Wilkinson (1991), who described community as having three components: (1) a "*locality*" where people live and meet their daily needs; (2) a "*local society*" embodying a network of associations for meeting common needs and expressing common interests; and, (3) a "*community field*" where residents meet and express issues of shared concern related to the locality. These attributes of geography, networks, and interests are widely accepted in the literature (Force et al. 2000).

Focusing on forest dependent communities, Kusel (1996) defines a community based on three perspectives: first, as those communities immediately adjacent to forest and/or dependent on forest-based sectors, e.g., tourism and timber; second, he refers to the nested nature of communities, existing as part of the larger society. This means that the linkages that communities have to larger society affect the opportunities available to them and the pressures placed on them. A final but important dimension is the existence of external conditions—e.g., political, social, ecological and cultural—in the larger society within which the community is nested (Chaskin 2001; Jackson et al. 1997; Kusel and Fortmann 1991).

Based on my review of the extensive literature on the concept of community, I note that the term is broadly defined. Therefore, using the term for a particular study requires specificity. For Alaskan communities, place dependence and local use of nearby resources are powerful forces that shape the notion of community. Whether based on tribal custom or economic necessity, local use of public lands is central to everyday life for many Alaskans. Therefore, my emphasis is on the geographic based definition of community, especially focusing on those communities within and adjacent to federally managed forests. And hence, my definition is closely aligned with definitions used by Kusel (1996), Gusfield (1975), Flora et al. (2004), and Wilkinson (1991). Taking the vast and unique geographic nature of Alaska into consideration, and relatively large distances between towns and cities, adopting the geographic/placed-based definition of community is appropriate for my study. This is also supported by Reed and Brown's (2003) study on the quality of life of neighboring communities surrounding the Chugach National Forest. Based on their survey, the majority of the residents defined their communities in terms of geographic boundary instead of political boundary or shared values. In Alaska, many rural communities live in isolation, separated from one another by physical barriers such as rugged terrains and vast bodies of water.

The Importance of Scale in Describing Resource-use Linkages

Cash et al. (2006) define scale as "the spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon."

In the past, except for a few studies, the concept of scale has received limited attention in the literature, especially in the context of community-resource-linkages. This is because social scientists are usually limited in their choice of scale by the availability of data. Most focused on county-level data. In recent years, however, there seems to be a growing literature focusing on the community level, a finer geographic scale than a county. Examples include: Charnley et al. (2008), Donoghue and Sutton (2006), Blahna et al. (2003), Sullivan (1997), Beckley (1998), Harris et al. (1998), and Kusel (1996). These studies examined resource-use linkages and dependency at the community level—an indication of a growing interest in community social impact assessment by researchers, federal and state government agencies, and other policymakers.

From a forest management perspective, the spatial aspect of scale is important because it helps in understanding what forests mean to people, and is critical in the understanding of community impacts and institutional linkages between government agencies and other entities (Morse et al. 2009a, b; Berkes 2008; Blahna et al. 2003; Lovell et al. 2002; Beckley 1998). For instance, Beckley (1998) noted that forest dependency changes at a finer scale, suggesting the importance of scale for the development of appropriate forest management plans and other public lands resource management. Morse et al. (2009a, b) also suggest that instead of using a single scale, often a larger, multi-scale, focusing on a multi-scale approach which includes a finer scale gives a better understanding of how public lands management policies affect various user groups. Sullivan's (1997) study on the Dixie National Forest also indicated that differences in forest resource use are very high at the community level of analysis.

This is because each community is uniquely attached to its surrounding forests. Indeed, some use forests for grazing, and some for firewood, while others depend on employment related to recreation and tourism. However, a county-level analysis reveals almost no differences between these communities (Sullivan 1997).

In the context of Alaska, putting emphasis on community-level analysis is critical for two main reasons: (1) there are many small and isolated communities in and around the Tongass and Chugach National Forests—strongly connected to forests and resources for various uses; and (2) it is an area that is seldom researched due to lack of secondary data and the high cost of collecting primary data. While understanding the lack of community-level data, conducting a study on Alaska community use of land and forest resources is critical to determine use levels and dependency on the forests and resources.

Here I use the terms *place* and *community* interchangeably in my discussion of scale. This, however, should not confuse the reader. Community is my unit of analysis and at the same time communities in Alaska are defined in terms of place because of the clear geographical distinction between communities.

In the case of Alaska, my investigation focuses on traditional market-based commodity resource dependence, which includes forest products and tourism. However, I recognize that many rural Alaskans have engaged in subsistence practices for generations. In subsistence economies, the forests are used as life support systems providing food, shelter, and a place available to satisfy a host of material and spiritual needs that makes community-level analysis so important. In contrast, the USFS has a national mandate to manage Alaska's national forests at a broader scale where resources are defined and valued by both local and non-local interests. Hence, the USFS must juggle the mixed mission of satisfying state and national interests while fostering the sustainability of Alaska's rural communities and local ecosystems.

The Use of USFS Permit Data for Describing Community Resource Access and Use Linkages

As discussed above, the concept of access to resources and linkages to public lands is multifaceted and includes both economic and non-economic uses. Economic use linkages include both market-based and non market-based economic uses. Examples of market-based economic uses include commercial outfitting and guiding, and timber harvesting. Subsistence uses represent non market-based economic dependencies. On the other hand, aesthetic and recreation, tribal or cultural and spiritual use linkages are examples of non-economic uses of forests.

Therefore, understanding the nature of community-resource linkages in the context of the private use of public lands is critical to sustaining human and natural systems. These linkages can vary considerably, depending on the resources available, land management policies (Blahna et al. 2003), and the community's cultural, demographic, and economic characteristics (Jakes et al. 1998).

Community-resource linkages on public lands are not well studied, largely due to the lack of community-level data. This dearth of information challenges public land managers and social scientists alike when it comes to understanding local use and needs and developing sound policies that protect both communities and natural resources.

Indeed, monitoring resource use and how policy decisions affect use is especially important at the community level, where rural residents dominate the landscape and have unique cultural and natural attachments to nearby lands (Brehm et al. 2006; Kruger 2005).

Few studies have used USFS permit data to examine community-resource linkages and their implications for forest resource management and community sustainability. Sullivan (1997) used U.S. Census data and USFS permit data from Utah's Dixie National Forest to: (1) evaluate the use of community as an appropriate unit of social analysis; and (2) evaluate the usefulness of secondary data sources—mainly USFS permit data—in describing relationships between individual communities and a variety of commodity and amenity-based resources on nearby public lands. The impetus for the Dixie study was a desire to improve the integration of social science into ecosystem management (Sullivan 1997). Using Census and permit data, Sullivan was able to identify useful variations among communities' uses and reliance upon public resources. For example, across study area communities, local use of Dixie resources varied significantly for grazing, firewood, and timber products. Most importantly, these variations were not discernable at the county level. Sullivan's work was important because it highlighted the need for community-level data and identified USFS permit data as a low-cost and readily available data source for understanding how local communities access and use resources on nearby public lands.

Blahna et al. (1998) expanded on Sullivan (1997) to examine how USFS permit data and U.S. Census data could be used to measure three aspects of community-resource linkages: resource use, dependency, and vulnerability. First, Blahna and his colleagues used a mapping exercise with USFS staff to identify communities within the five counties surrounding the Dixie National Forest. Using zip code and Census boundaries, they grouped nearly 60 towns and rural areas into 13 community clusters. They then standardized the USFS's Special Use Data System (SUDS) and Timber Information Management Data System (TIM) commercial and personal use permits by community to create a typology to identify "high" and "low" measures of community-resource use, dependence, and vulnerability. Blahna et al. (1998) used subjective judgment in determining the "high" and "low" cutoff categories. The study, however, provides a useful model to assess resource use, dependence, and vulnerability, and provides an important starting point for the work presented here.

Endter-Wada and Blahna (*forthcoming*) used USFS permit data to examine community-resource linkages for the Dixie, Fishlake, and Manti-La Sal National Forests in Utah. Based on their work, they developed a generalized theoretical framework they called "Linkages to Public Lands" (LPL) for studying human-resource linkages on public lands. In their framework, they identified five basic categories of linkages: Tribal Linkages, Interest Linkages, Neighboring Linkages, Decision-making Linkages, and Use Linkages (Table 1).

Table 1. Types of community-resource linkages from Endter-Wada and Blahna (*forthcoming*).

Linkage	Description
Tribal Linkages	Based on treaty rights, these are unique and special relationships that have existed over generations between indigenous peoples and the lands and resources they use.
Interest Linkages	Generalized linkages among groups of people that share a common interest in how public lands are managed. These linkages give people a say in how resources are managed, even if they do not actually use the resources. A good example is wilderness and roadless areas.
Neighboring Land Linkages	Public and private interests that are linked to NFS lands through the ownership or management of lands either within or adjacent to National Forest boundaries. Examples include state, private, and corporate lands.
Decision-making Linkages	Institutional and jurisdictional linkages over land and/or resources that are important because they imply shared management authority. Examples include cooperation with local boroughs and tribes over emergency services and fire control.
Use Linkages	Established uses that imply a direct physical use of public lands that are often based upon legal agreements, regulations, or commonly accepted norms. Examples include timber harvests, gathering wild fruits, camping, hiking, and fishing.

(Source: Endter-Wada and Blahna *forthcoming.*)

Whereas most community assessments used in resource planning describe characteristics of nearby communities and then assume some generalized resource-use linkages, LPL differs in that it first lists actual resource-use linkages and then identifies the communities where the people in those linkages reside.

While each of the community-resource linkages described in Table 1 is important in the Alaskan context, two are prominent. For instance, “tribal linkages” to public lands are central to the existence and identity of many Native communities and are recognized by the Alaska Native Claims Settlement Act (ANCSA) of 1971 and the Alaskan National Interest Lands Conservation Act (ANILCA) of 1980. Under these laws, Alaskan tribes enjoy access rights to National Forest System (NFS) lands and resources, as well as a “government-to-government” relationship with state and federal entities. Land management agencies such as the USFS and others are charged with protecting these rights, as well as consulting with tribes over land management activities. Some of these activities include the right to hunt, fish, trap, and gather various materials on NFS lands.

However, while the tribal linkages are important, they are not the focus area of this study because data related to these linkages are not available through the Forest Service permit system. “Use linkages” are also important in the Alaskan context and are studied closely in this dissertation. Here, three subcategories were identified by Endter-Wada and Blahna (*forthcoming*):

- <u>Open access</u> describes a condition of free access to resources that are available to all. In the U.S. and Alaska, open access is typically allowed and is best portrayed by recreational and aesthetic enjoyment of forests and access to many ecosystem services.

- Permitted uses require a permit allowing specified users access to resources. These often include fees for the product or service received. In Alaska, this subcategory is unusual in that Alaska Natives can acquire permits without charge to engage in cultural and subsistence uses. In such cases, permits are primarily issued for monitoring and planning purposes.
- Illegal uses occur when individuals or groups use resources that are not allowed under open access, or when people engage in permitted uses without a permit.

This framework is particularly relevant to Alaska's study with respect to permitted activities. I used permit data to identify the different types of permitted activities that are presented in Chapter V. Alaska represents a good case study to evidence the applicability of the LPL framework to multiple situations and places. The framework was used as a guide to identify potential data sources, i.e., the Forest Service's TIM and SUDS permit data.

Oschell and Nickerson (2008) used recreational outfitter and guide data from the SUDS database to determine commercial recreational supply and demand on national forests within the Forest Service's Region One—an area that includes national forests and grasslands in Montana, North Dakota, and parts of Washington State and South Dakota. By comparing the number of permit-allocated use days versus actual use, they attempted to assess the supply and demand among this type of permit user but were hindered by incomplete data within the SUDS database. Interestingly, they also found that some outfitter and guide activities were denied by the USFS due to a lack of accurate information regarding supply and demand pressures on the resource by outfitter activities. Examples of activities denied because of a lack of a needs assessment included hunting and fishing. In general, their examination of SUDS data found that improper data recording and maintenance limited the usefulness of permit data in land management.

Charnley et al. (2008) used timber and nontimber special forest products permit data from the USFS's TIM data, particularly Automated Timber Sale Accounting System (ATSA) and the Bureau of Land Management (BLM) data, to examine how declining timber harvest levels under the Northwest Forest Plan affected the well-being of forest communities in the Pacific Northwest (Charnley 2006a, 2006b). Charnley and her colleagues also used recreation data from the INFRA database, the central and corporate database system to which the TIM and SUDS databases are linked. In order to measure policy impacts, they used a multi-scale approach that examined community, county, state, and regional impacts. For the community-level analysis, Charnley et al. (2008) used USFS permit data because they felt it was the best source of information. Using these data, they found that the effects of declining timber harvests on local communities varied as a function of: (1) the importance of the timber sector in a community in the late 1980s; (2) the extent to which the timber sector depended upon local residents; and (3) the degree to which local residents depended on USFS jobs. They also noted that community effects depended on the unique circumstances of a community such as a lack of diversified employment opportunities and distance from major urban areas, which resulted in isolation and reduced options for diversified employment opportunities.

These studies suggest many potential uses for permit data when studying community-resource uses on forests and other public lands. Indeed, while many social scientists acknowledge community as an important unit and scale at which to study resource dependent communities, the lack of community-level data limits such research efforts (Charnley et al. 2008; Beckley 1998; Blahna et al. 2003; Endter-Wada and Blahna *forthcoming)*. As a result, many past studies on community-resource use linkages have used data gathered at higher scales such as county, Census tract, State and regions as proxies. However, as shown by Charnley et al. (2008), Donoghue et al. (2006), Sullivan (1997), Kusel (1996), and others, these data may not accurately describe community uses. While community-level data possesses many advantages in community-level work, very little secondary data is available, and the cost of gathering primary data through surveys and various qualitative methods is high. This problem is particularly acute in Alaska, where rural communities are widely scattered, remote, and operate within unique political and administrative structures. In contrast, permit data is readily available, costs relatively little to gather and analyze, and is current and oftentimes relevant at the community level.

The studies described above evidence past efforts to identify the relevant data sources for community-level analysis and, in doing so, try to understand the various kinds of linkages people have to public lands. By recognizing the advantages of using existing secondary data and the growing interest in community-level analysis, conducting similar studies in a place like Alaska is timely and appropriate. It also makes a beneficial contribution to the existing literature.

CHAPTER III

STUDY AREAS

Alaska Region

The State of Alaska has many unique features when compared to the rest of U.S. culture and tradition. Small populations located in primarily rural areas, unique government structures and geographic boundaries, abundant natural resources, a wide range of local and nonlocal user groups, and rural Native and non-Natives' linkages to the land all combine to make the state unique. Another noticeable difference, described below, is the way subsistence use operates—Alaska Natives have exclusive rights on their corporate lands, while at the same time they enjoy access to exercise similar activities on many public lands. Rural non-Natives also have subsistence rights under the Alaska Constitution.

Land Ownership

Land ownership in Alaska largely determines the state's economic and social structure. It also determines the interaction between the various stakeholders (e.g., Alaska Natives, governmental entities, and non-Native residents). In 1980, the Alaska National Interest Lands Conservation Act (ANILCA) introduced a new land management system that created a complex mosaic of federal, state, and Alaska Native ownership (Gallagher 1988). Within this mosaic, management entities often have different management goals that guide substantially different land management programs. The existence of different programs can potentially alter the amount and types of access to resources on public land (Gallagher 1988).

About 236 million acres (64.48%) of the state's land is owned and managed by the federal government, 90 million acres (24.6%) by the state, 38 million acres (10.38%) by Alaskan Natives, 1.4 million acres (0.38%) by private or non-Native owners, and just 0.6 million acre (0.16%) by boroughs/local government (Table 2) (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002). These lands are the actual size of lands currently being managed by the different entities listed and do not include entitlement acres owned by them. Entitlement acres are lands set aside for future use, but not currently being used by the respective entities listed in Table 2. Currently, most of the unclaimed lands are under federal management, although some of the unclaimed Alaska Natives' lands are managed by the state.

Federal lands are owned by the American people and managed by various agencies, including the National Park Service, the USFS, the Bureau of Land Management (BLM), and the Fish and Wildlife Service (Kruger and Mazza 2006). The federal government is the largest land owner and manager in Alaska with 64% of the total area (236 million acres). Of these total federal lands, National Forest System lands managed by the USFS cover 22.7 million acres of land. These include both the Tongass and Chugach NFs.

State lands are owned and managed by the State of Alaska for various economic and social values. The state currently holds patent rights to 90 million acres of lands of its

Table 2. Land ownership in Alaska.

Ownership class	Entitlement acres	Unclaimed acres	Current acres
Federal	n/a	n/a	236 million (64.48%)
State	105 million	15 million	90 million (24.6%)
Alaska Native	44 million	6 million	38 million (10.38%)
Private, Non-native	n/a	n/a	1.4 million (0.38%)
Borough/Local Government	1.4 million	0.8 million	0.6 million (0.16%)
Total	150.4 million	21.8 million	366 million (100)

(Source: Western Governors Association Cadastral Conference State Profile Outline, 2001: www.asgdc.State.ak.us/cadastral/WGA_out.pdf)

total selections (105 million acres) from the federal government (Table 2). Alaska chose lands to meet demands for settlement, resources use, and recreation.

Alaska Natives lands are also private lands. The Alaska Natives Claims Settlement Act, passed by the U.S. Congress in 1971, mandated the creation of regional and village Native corporations for the disbursement of the 44 million acres and payment of $1 billion mandated to Native ownership (Alaska Department of Natural Resources 2000). However, out of the 44 million entitlement acres, 38 million are managed by Alaska Natives (Table 2).

Private lands are owned by non-Native residents of Alaska. They include just 1% of Alaska's total land; however, many of these lands are prime development lands (Table 2). Private lands are used to meet people's needs by providing various services including places to live, work, shop, and recreate. It also provides a tax base for cities and communities to help support public services (Alaska Department of Natural Resources 2000).

Borough/local government lands comprise less than one percent of Alaska's lands and are owned and managed by local cities and boroughs (see Table 2 above). Because local governments in Alaska have individual methods of transferring land into private ownership, lands currently owned by them are also considered private lands. Alaska's unique land ownership patterns—especially the federal ownership of nearly two-thirds of the state—results in a special land and resource management system. Demand for access to different resources on public lands may come from various groups of people including rural residents and Alaska Natives. Therefore, agencies need to fully understand the types of activities people engage in on public lands as they develop policies that affect use.

Climate and Land Cover

Alaska is roughly one-fifth the size of the contiguous lower 48 States. It covers 366 million acres equal in size to Wyoming, Montana, Washington, Oregon, Idaho, and Utah (McVehil-Monnett Associates 2006). The State covers an area roughly 20° in latitude by 58° longitude (Jones 2008) (see Figure 1). Such a wide span running both north-to-south and east-to-west (longitude and latitude) contributes to the large variation in climate across the state. Currently, there are four major climatic zones identified by climatologists: maritime, transitional, continental, and arctic (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002).

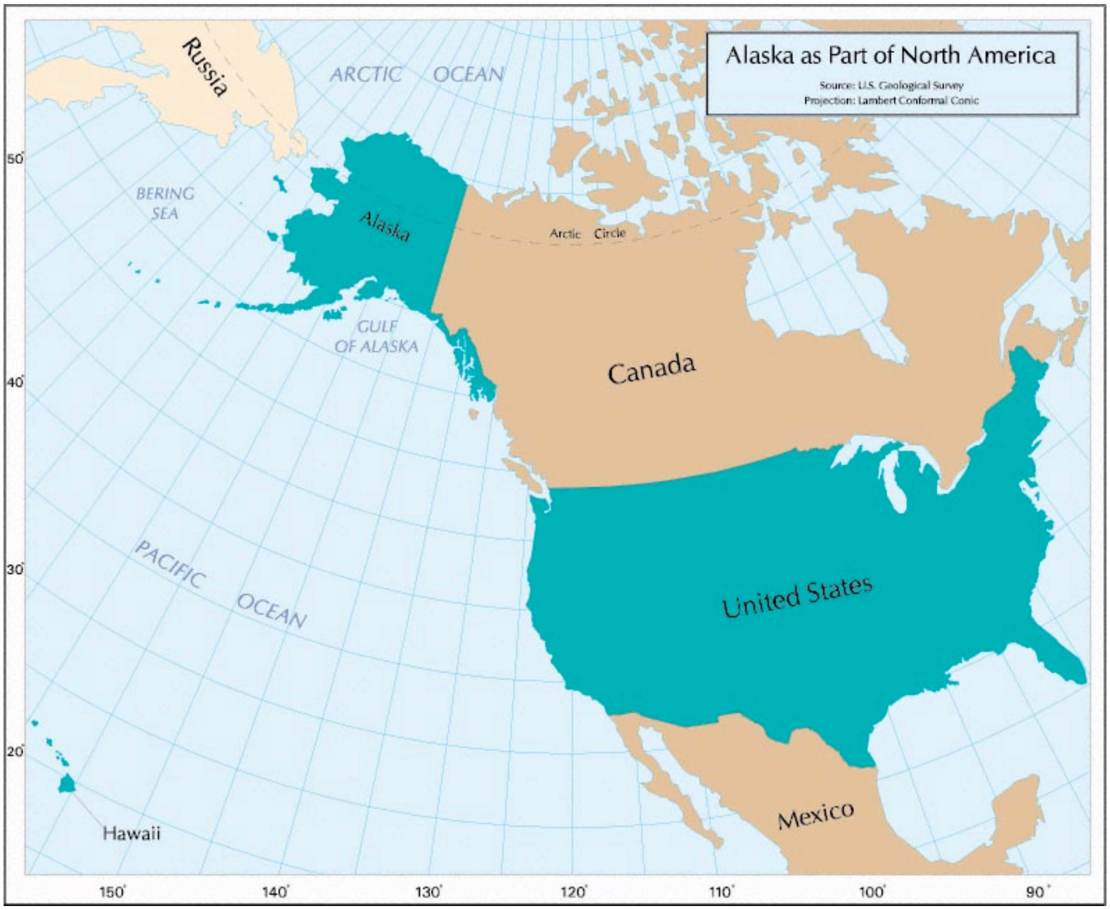

Figure 1. Location of Alaska in North America.

In turn, these diverse climatic zones, together with topographic variation, result in the creation of various ecological regions (Bailey 1995). For instance, variation in topography ranges from sea level up to 1,969 feet (600 meters) (Ricketts et al. 1999). Such variation in altitude determines the types of flora and fauna found in an area.

About 129 million acres (34.4%) of Alaska's land is covered by forests (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002).

These forestlands are characterized by two distinct types: (1) the coastal rainforest, which is found in south and southeast Alaska, and (2) the boreal forest, which covers interior and southcentral Alaska (Alaska Forest Association 2009). The Tongass and Chugach National Forests, the focus areas of this study, are situated in the coastal rainforest region. The State's forests contain 33 natives species of trees across 17 genera. Major genera include: willow (*Salix*), spruce (*Picea*), poplar (*Populus*) and alder (*Alnus*). In terms of distribution, of the 33 species, 20 thrive in the South Coastal region. The remaining 13 grow in the Interior part of the State (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002).

The coastal rainforest harbors a disproportionately high number of the species when compared to the state as a whole. For example, even though it covers just 20% of the state, the coastal rainforest provides habitat for 70% of Alaskan vascular plant species (Whitesell 1996). Moreover, cottonwood (*Populus trichocarpa*), Alaska paper birch (*Betula papyrifera*), and alder (*Alnus rubia*) forests are often considered keystone forest types due to the large number of specialized species occurring there and the important linkages between physical and biological processes that occur in these areas (Schoonmaker et al. 1997).

The Interior forest covers 115 million acres and is spread primarily around the river valleys of the interior areas of the state. This forest type is comprised of 61% softwood and 39% hardwood species (Russell 2009; Alaska Forest Association 2009). The Interior forests contain approximately 34 billion board feet of timber, 23% of Alaska's total timber inventory (Russell 2009). Of these 34 billion board feet, most are hardwood species—mainly brush alder, birch, aspen, and cottonwood (Russell 2009). In contrast, the coastal forests, located primarily in southeast Alaska, cover just 14 million acres but contain 77% of Alaska's timber inventory, making it the dominant source of supply for the state's timber sector (Alaska Forest Association 2009). About 99% of the coastal forest is comprised of softwood species, with just 1% hardwood. Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla)* are the dominant timber species in Alaska, representing 26% and 34% of the statewide timber inventory, respectively. Western red-cedar (*Thuja plicata*) and yellow-cedar (*Chamaecyparis nootkatensis)* have high market values but low stumpage volumes (typically just 1% of total inventory), preventing them from being major commercial species.

Transportation Systems

Alaska has few road systems as compared to other regions of the U.S., with the state's main road system covering only a small portion of the state. Only around 60% of Alaska's population is connected by road or ferry to the continental road network (Alaska Department of Transportation and Public Facilities 2009). The western part of the state has no road connection at all between communities. Water and air are the only means of transportation for many communities. The state's capital, Juneau, is accessible only by boat, ferry, or airplane. One main highway links the state to other U.S. states via Canada. There is also a railway system within the state, but service is localized in southcentral and interior Alaska. Other transportation systems used in areas not served by road, rail, or ferry include all-terrain vehicles in summer, and snowmobiles and dogsleds in winter.

Unlike other states, rural Alaskans use air and marine transport systems much more than residents in other states and region. For example, if we look at differences in total road miles between the Chugach in southcentral Alaska and the Tongass in the southeast, we find 3,708 road system miles throughout the southeast, where most of the area is within the boundary of the Tongass NF, with only 442 of those miles operational for passenger vehicles. On the other hand, in the Chugach NF, there are only 86 total road system miles with only about 57 of those miles open for passenger vehicles (USFS 2007). In contrast, the contiguous lower 48 states contain approximately 3.9×10^6 miles of public roads of all types (U.S. Department of Transportation 2002), placing approximately 80% of all land within 1 km of a road (Riitters et al. 2004; Riitters and Wickham 2003). In Alaska, the unique transportation situation and limited road networks contribute to the State's rural nature—a situation that likely makes people more dependent on local natural resources.

Alaska's Native Peoples

Alaska's indigenous people are referred to as Alaska Natives (Langdon 1987). They are divided into five major groups: Aleuts, Northern Eskimos (Inupiat), Southern Eskimos (Yupik-Inuit), Interior Indians (Athabascans) and Southeast Coastal Indians (Tlingit and Haida). These five groups do not represent political or tribal units; rather, the grouping is based on broad cultural and linguistic similarities (Langdon 1987).

Based on the 2000 U.S. Census, about 16.6% of the Alaska population consists of Alaska Natives. Yupik and Inuit constitute about 8% of the state's total population, Indians (Athabascans, Tlingit, and Haida) about 6%, and Aleuts about 2% (Alaska Department of Labor and Workplace Development 2001). Of these indigenous peoples, 69% reside outside of the four major cities of Anchorage-Girdwood, Fairbanks, Juneau, and Ketchikan.

Other Residents

The first large number of non-Native people immigrated to Alaska during the Gold Rush between 1890 and 1900. Within 10 years, Alaska's population doubled, with a seven-fold increase in non-Native peoples (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002). Based on data from the 2000 U.S. Census, about 62% of Alaska's population are concentrated in large cities such as Anchorage-Girdwood, Fairbanks, Juneau, and Ketchikan—the only settlements in the state with populations greater than 10,000. The remaining 38% of the state's population live in 144 incorporated and unincorporated areas. Table 3 shows Alaska residents by community size category.

Human Relationships with the Land

Subsistence Uses

Subsistence is a very important aspect of resource use among Native and rural non-Native Alaskans (Robbins 1988; Crone et al. 2002). Subsistence harvest activities including fishing, hunting, and the gathering of special forest products have been part of Alaska Native's traditions for many generations. Most rural non-Native

Table 3. Distribution of Alaska communities by population.

Community size category	Number of communities in category
100 or fewer residents	97 villages
101-1000 residents	197 villages
1,001 – 10,000 residents	51 towns and cities
> 10,000 residents	4 cities

(Source: ISER 2000.)

Alaskans also practice subsistence activities. Since subsistence harvesting is part of the identity of Alaska Natives, it has both social and economic implications for the sustainability of Native communities. Cultural and economic connections to the land through various subsistence use activities are higher in Alaska than in other states (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002).

Given Alaska's unique land ownership, access to resources is a concern for subsistence-based Native people. Indeed, loss of access to these resources threatens Native autonomy (Weeden 1985). Subsistence activities are fundamental to the Native material needs (e.g., food and shelter), perpetuation of culture (Berger 1985), and to the broader rural economy that relies on recreational guiding, hunting, firewood gathering, etcetera (Robinson and Ghostkeeper 1987).

Since most rural areas of Alaska are far from cities and often have limited road connections to the rest of the state, dependency on land resources for both economic and cultural purposes is very high. As a result, many rural communities combine both subsistence and cash economies to survive. The cash economy is generated through commercial wage employment and wild resource harvests (Wolf 1998). Oftentimes, jobs are scarce and seasonal in rural Alaska, and cash incomes are low. Hence, rural residents have to rely largely on subsistence harvests—the most reliable sector of the rural/village economy. Based on reports by the Alaska Division of Forestry (2010), Wolf (1998), and the Alaska Division of Parks and Outdoor Recreation (2002), averages of subsistence harvests were about 354 pounds of food per person per year in rural Alaska, compared to about 19 pounds for residents in Anchorage-Girdwood, 16 pounds for Fairbanks, and 35 pounds in Juneau. Table 4 compares the volume of subsistence harvests to sport and commercial fisheries harvests.

The Legal Meaning of Subsistence in the Alaskan Context. In Alaska, “subsistence” has special legal meanings. In the past and still today, defining the term "subsistence" has been controversial in Alaska. Complicating matters is that the Alaska Natives Claims Settlement Act (ANCSA) did not resolve issues of recognizing, continuing, or restricting Native subsistence hunting, fishing, and gathering. Subsistence use is still and important and unsettled issue despite provisions to provide protection for subsistence activities included in the ANCSA and in Alaska National Interest Land

Table 4. Volume of fish and wildlife harvests in Alaska by harvest category.

Harvest category	Percent of total	Annual harvest
Subsistence	2.5%	53.5 million lbs. (est. useable weight)
Sport	< 1%	18 million lbs.
Commercial fisheries	96.5%	1.95 billion lbs. (est. based on 1994 harvest all spp. Except Pollock)

(Source: ISER 2000.)

Conservation Act (ANILCA). ANILCA stipulated that, for rural residents on public lands and for Alaska Natives on tribal lands, the opportunity for subsistence harvesting is essential to continued physical, economic, traditional, and cultural (i.e., Native) or social (i.e., non-Native) existence (Title VIII, Sec. 801 or 16 USC 3111). As a result, ANILCA in part established subsistence use of forest resources as a priority.

Until 1989, Title VIII of ANILCA provided that all "rural" residents of Alaska have a priority for "customary and traditional uses" of fish and game. Initially this section had been used as a management guideline to manage fish and wildlife subsistence resources on all Alaska public lands including the Chugach and Tongass National Forests. In 1989, Alaska's Supreme Court ruled in *McDowell vs .The State of Alaska* that Alaska's rural subsistence priority system was unconstitutional–upsetting long-standing state and federal definitions of the term "rural" in the Alaskan context. For example, federal agencies defined the term "rural" based on community population (i.e., less than 2,500 people) as determined by the U.S. Population and Housing Census Bureau, and excluded economic considerations such as income. In contrast, the State of Alaska defined the term based on a community or region's noncommercial or cultural way-of-life. Both definitions came under fire from long-term rural residents and Alaska Natives living in urbanized areas who feared that their subsistence use rights would be eroded under the state's definition.

The Alaska Supreme Court ruled against both definitions, overturning the state's subsistence statute as unfairly discriminating against urban populations in violation of Article VIII of the Alaska Constitution, which directs that: (1) fish and wildlife resources must be reserved for the common use of all Alaskans; (2) subsistence laws cannot create an exclusive right or special privilege of fishery; and (3) State laws must apply to all persons similarly situated.

The Court's decision against rural subsistence priority threw the state out of compliance with ANILCA. Since both state and federal governments were bound by the ruling, the federal government continued with its own definition of subsistence, which is based on rural community population and sets criteria for subsistence hunting and fishing on federal lands, while the state continues to recognize all Alaska residents as potential subsistence users and allows them to exercise subsistence activity on state-owned and privately managed lands and waters. As a result, a dual fish and wildlife management system has been created that continues to this day—a unique situation found only in Alaska. For many Alaskans, controversy over the decision lingers, with the new standard for "rural" allowing some Alaskans to automatically qualify for subsistence use, while others do not.

Although the primary motivation of ANILCA was to designate more protected areas in Alaska, it also included strong provisions for continued subsistence use. For instance, in times of resource scarcity, or when demand exceeds biologically sustainable harvest levels, subsistence would have a priority over other consumptive uses of resources. In practice, this means that commercial, sport, or other harvests would be curtailed by state or federal fish and wildlife management authorities before subsistence harvests would be limited. As a result, ANILCA and the corresponding level of federal involvement in subsistence issues make the Alaska situation unusual in the U.S., where states typically have significant autonomy over wildlife management policy.

A second important provision of ANILCA establishes special procedures to be followed when federal land use actions might restrict subsistence use (Title VIII, Sec. 810 or 16 USC 3120). Under these procedures, guarantees for subsistence use are weakened. As a result, ANILCA gave a priority for subsistence harvests to rural residents. However, as discussed earlier, because of the state's failure to comply with federal law, the Federal Subsistence Management Program was established in 1990 to manage wildlife hunting on federal public lands under the terms of ANILCA. The program was expanded in 1999 to include fisheries in navigable waters. As federal land management agencies, the National Park Service, Bureau of Land Management, Bureau of Indian Affairs, Fish and Wildlife Service, and Forest Service coordinate policy through the inter-USFS Federal Subsistence Management Program (Allen et al. 1998).

Cultural and Spiritual Uses. For Alaska Natives, land is more than an economic asset—it is a cultural foundation closely tied to personal identity. In addition to representing self-sufficiency and cultural values, land has spiritual and religious overtones to Alaska's indigenous people. As part of this special relationship, Alaska Native cultures hold certain geographic locations as sacred. These sites are viewed as places of power and embody many of the values, beliefs, spirits, and ceremonies of Alaska Natives. Sacred sites may take many forms, including mountains, rivers, forests, canyons, mineral deposits, rock formations, and ancestral burial grounds (McConnell 1994). Long-standing customs of reciprocity create a practice where Alaska Natives freely share subsistence forest products and fish and game to support relatives and neighbors who cannot engage in harvests themselves due to old age, disability, or other circumstances (Endter-Wada and Levine 1996). These exchanges, together with other traditions that govern who can hunt what species and where, as well as the way people prepare and preserve fish and game, are an integral part of Native cultures throughout Alaska (Alaska Division of Forestry 2010; Alaska Division of Parks and Outdoor Recreation 2002).

The Political and Legal Context of Forest Land Management. Alaska's local government system differs from other states. The regional governments are called boroughs instead of counties, and about half of the state has no organized borough governments. In addition to the common level of government structure (i.e., state, borough, city), there are tribal government services, created separately by tribal rules and procedures. Such tribal governments are recognized by the federal government and generally represent local groups of Alaska Natives including: Tlingits, Haidas, Tsimshians, and Athabaskans (Langdon 1987). Natives are also represented by regional and village corporations formed under the ANCSA. However, such corporations are not a form of government; instead, they are private non-profit and for-profit corporations.

On the other hand, the non-Native residents living in both rural and metropolitan areas are uniquely situated and connected to forest lands. Unlike the lower 48 states, the metropolitan areas such as Anchorage-Girdwood and Juneau are located within the periphery of the Chugach and Tongass NFs, respectively, which makes forest management and relations with these communities important because of an increasing demand for recreation and outfitter and guide permits. This unique setting requires a customized management approach tailored to fit the area.

Southeast Alaska and the Tongass National Forest (TNF)

Southeast Alaska is comprised of a narrow strip of coastline and offshore islands next to the Canadian province of British Columbia, sometimes referred to as the Alaska Panhandle. The Panhandle has a land area of 35,138 miles (56,549 km), comprising six entire boroughs and three Census areas, in addition to the part of Yakutat Borough lying east of 141° West longitude. Approximately 91% of southeast Alaska is managed by the federal government, with about 77% located within the TNF and managed by the USFS, and the balance managed by the National Park Service and the Bureau of Land Management. The remaining 9% of the land area is in state, Alaska Native Corporation, and Private Land ownership (Table 5) (Schoen and Albert 2009; USFS 2007).

The Tongass NF occupies 16.7 million acres—about 7% of the area of Alaska (Figure 2). It includes a narrow mainland strip of steep, rugged mountains and icefields, and more than 200 offshore islands known as the Alexander Archipelago. Extending 500 miles (805 km) north-to-south, the Tongass is the largest National Forest in the NFS. The Tongass is managed as a single Administrative Area. To manage resources and better serve the public, the forest has nine Ranger Districts, with offices located in Yakutat,

Table 5. Land ownership in Southeast Alaska.

Landowner classification	Approximate acres	Percent
Tongass National Forest	16,700,000	77.5
National Park Service	2,700,000	12.5
ANCSA Corporation	577,000	2.7
Haines State Forest	534,000	2.5
State of Alaska (other)*	444,000	2.1
Bureau of Land Management	370,000	1.7
Private lands	186,000	0.9
Municipal lands	51,000	0.2
Total	21,562,000	100

(Source: Southeast Alaska Conservation Council 2009.)

* includes tidelands and navigable waters

Figure 2. Map of the Tongass National Forest in southeast Alaska.

Juneau, Hoonah, Sitka, Petersburg, Wrangell, Thorne Bay, Craig, and Ketchikan. The Tongass represents one of the largest intact coastal temperate rainforests in the world—an ecosystem thought to be even rarer and more threatened than tropical rainforests (Alaback and Juday 1989; Southeast Alaska Conservation Council 2009). The diverse forests on the Tongass provide important habitat for grizzly bear (*Ursus arctos*), black bear (*Ursus americanus*), mountain goat (*Oreamnos americanus),* Sitka black-tailed deer

(*Odocoileus hemionus*), and wolves (*Canis lupus*). Additionally, their role in protecting water quality is critical to five species of wild salmon (Alaback and Juday 1989; Southeast Alaska Conservation Council 2009). Many fish and wildlife species are critical to sustaining subsistence lifestyles, sport and commercial hunting and fishing, as well as recreation and tourism.

Forest Management on the Tongass National Forest

The TNF supports rural communities' livelihoods and economies in many ways. It also plays a vital role for the economy of southeast Alaska. For example, the forest provides a wide range of natural resource uses such as fishing, timber harvesting, recreation, tourism, mining, and subsistence (Sisk 2009; USFS 2007). The timber and tourism sectors support year-round and seasonal employment with benefits being important employment contributors in a region of high unemployment.

On the Tongass, forest products include timber (e.g., firewood, timber, construction poles) and nontimber forest products (e.g., mushrooms, conks, limbs and boughs, cones, leaves, burls, roots, wildflowers, and berries). Nonbiological extractive use is best exemplified by mining. Under USFS management, the Tongass has a long history as a commercial, working forest. The historic focus on timber harvests, which have greatly diminished in recent years, was long seen as a means of providing local jobs and economic development. Currently, about 57%of the forest land in the TNF is classified as productive forest land, previously called timberland or commercial forests.

Out of this, approximately 0.5 million acres (9%) of the productive forests on the Tongass have been harvested to date. Timber harvests decreased in the 1990s as a result of high harvest costs coupled with declines in global market demand. At the same time, there has been growing demand for nonextractive uses of Alaskan forests (Brooks and Haynes 1997). As a result, large areas of the Tongass have been removed from the commercial timber base (Kruger and Mazza 2006). In 1990, 6.4 million acres of the forest was set aside by Congress as Wilderness within the National Wilderness Preservation System. While this equals 40% of the TNF's total acreage, the vast majority of these acres are not commercial forests. Out of the total 3,708 miles of road networks on the Tongass, only 11.9% are operational for passenger vehicles, an indication of the limited commercial and human activities on the forest. The forest also includes two National Monuments—Admiralty Island and Misty Fjords—which were designated in 1978 and are currently being managed by the USFS (USFS 2007).

Southeast Alaska Communities

Southeast Alaska is largely undeveloped. In 2005, the region's population was 70,822 people; most residents live in 31 rural communities located on islands or along the mainland coast (USFS 2007; Alaska Department of Labor and Workforce Development 2001; U.S. Census Bureau 2000). The largest community in terms of population and economic activity is Juneau—Alaska's capital—followed by Ketchikan, Sitka, and Petersburg. These four communities are the only ones in southeast Alaska that met the U.S. Census Bureau's definition of urban in 2005 (population greater than 2,500). Most of these 31 communities are surrounded by the Tongass National Forest. Three communities are connected to the mainland via road: Haines and Skagway to the north, and Hyder to the south (USFS 2007). Figure 3 shows major southeast Alaska communities within and surrounding the Tongass National Forest.

A number of Alaska Native tribes live throughout southeast Alaska (Figure 3), including the Tlingit, Haida, and Tsimshian. Subsistence activities are part of Alaska Natives' culture and tradition passed down from generation to generation and contribute to sustaining livelihoods. Though a large percentage of Alaska Natives live in Angoon, Craig, Hoonah, Kake, Klawock, and Yakutat, they are spread throughout the 31different communities located within the Tongass National Forest study region.

Alaska Native village boundaries demarcate as a statistical entity (i.e., a geographic unit) that represents the densely settled extent of Alaska Native villages. These boundaries were delineated for the Census Bureau by Alaska Native officials or Alaska Native Regional Corporations for the purpose of gathering decennial Census data (U.S. Census Bureau 2000).

Southeast Alaska's overall population declined between 2000 and 2005, although losses varied across communities (Table 6). Relatively large declines occurred in Prince of Wales-Outer Ketchikan, Skagway-Hoonah-Angoon and Wrangell-Petersburg, respectively (Table 6). These communities historically relied upon the logging, lumber, and pulp sectors. This decline in population is believed to result from emigration in search of jobs in response to lower timber harvest levels in the forest (Sisk 2009),

Figure 3. Major communities in and around the Tongass National Forest.

(Source: Kruger 2005.)

Table 6. Southeast Alaska population by borough.

Community	Change (1990-2000)	1990	2000
Haines Borough	275	2,117	2,392
Juneau City and Borough	3,960	26,751	36,011
Ketchikan Gateway-Borough	231	13,828	14,059
Prince of Wales-Outer-Ketchikan Borough	-121	6,278	6,157
Sitka City and Borough	247	8,588	8,835
Skagway-Hoonah-Angoon-Borough	-244	3,680	3,436
Wrangell-Petersburg	-358	7,042	6,684
Yakutat City and Borough	103	705	808
Southeast Region Total	4,093	68,989	73,082

(Source: U.S. Census Bureau 2000; Alaska Department of Labor and Workforce Development 2006.)

although the declines have likely been moderated to some extent by increases in amenity-based economic activities.

Based on Table 7, there is little median income variability among the small rural communities. The exceptions are Point Baker and Hyder, which have relatively large income variability but low median annual household income levels (i.e., $28,000 and $11,719, respectively). This is due to low-paying and seasonal jobs in commercial fishing in Point Baker, and tourism-related sectors in Hyder. Meyers Chuck and Skagway both have relatively high median annual household incomes (i.e., $64,375 and $62,188, respectively).

The most probable justification for the two communities' higher income could be the presence of retirees and commercial fishing sectors in Meyers Chuck, and tourism and government (e.g., National Park Service) in Skagway. Many residents in these two communities, however, depend upon subsistence activities. The 2000 U.S. Census shows the median income of those only involved in the commercial fishing or retirees.

Examples of more economically diverse communities include Juneau, Petersburg, Ketchikan, Sitka, Wrangell, and Haines. These communities also have larger populations. Juneau is the largest city in the region with a population of 36,011, followed by Sitka (8,835), Ketchikan (7,922), and Petersburg (3,258) (see Table 7).

Communities with large percentages of Alaska Natives include Angoon (81%), Kake (75%), Hoonah (69%), Klawock (58%), Yakutat (47%), Craig (31%), and Pelican (26%). Based on the 2000 U.S. Census, unemployment is relatively high in communities such as Hyder (27.3%), Kake (16.7%), Hoonah (12.5%), Klawock (11.2%), Skagway (11.2%), Thorne Bay (10.1%) and Tenakee Springs (10%) (Table 7). There is a positive relationship between higher unemployment rates and a high percentage of service sector employment. Communities that had higher unemployment and higher service sector employment show an interesting employment pattern that is probably influenced by high levels of seasonal employment.

Employment in the natural resources sector is dominated by commercial fishing and fish processing, mining and mineral development, and forest-related sectors such as timber and other wood products. Communities with the highest percentage of employment in natural resource-related sectors include: Coffman Cove (50%), Point Baker (40%), Yakutat (31%), Elfin Cove (30%), Pelican (26%), Craig (24%), and Hoonah (24%) (Table 7). These communities are characterized by small populations. Petersburg and Wrangell have larger populations, yet they still have high levels of

Table 7. Demographic and employment profile of TNF communities ranked by employment dependence on natural resource sector (2000 U.S. Census).

	Income & Demographic Profile					Employment by industry (percent)											
Community	2000 Population	Total number of HHs	Alaska Native (%)	Median HH Income 2000($)	Unemployment (%)	**Natural Resources**	**Service Sectors**	Construction & Manufacturing	Wholesale & Retail Trade	Transportation, Warehousing & Utilities	Information	Finance, Insurance, Real Estate, Rental & Leasing	Professional, Scientific, Management, Administrative & Waste Mgmt.	Non-Public Administration Services	Public Administration	Total Employment	Employment Diversity Index
Coffman Cove	208	63	6	43,750	7.8	50	6	17	6	0	6	0	5	3	7	111	1.60
Point Baker	35	13	9	28,000	0	40	34	0	13	0	0	0	0	0	13	100	1.26
Yakutat	683	265	47	46,786	6.7	31	24	13	5	14	1	2	0	3	7	440	1.81
Elfin Cove	36	15	6	33,750	11.1	30	20	0	0	50	0	0	0	0	0	10	1.03
Pelican	253	70	26	48,750	5.5	26	20	33	4	9	0	0	2	0	6	81	1.63
Craig	1,424	523	31	45,298	6.9	24	27	13	14	6	2	2	1	6	5	719	1.93
Hoonah	892	300	69	39,028	12.5	24	28	14	7	13	0	2	2	1	9	317	1.84
Petersburg	3,258	1,240	12	49,028	7.3	20	26	14	11	7	4	2	2	6	8	1,518	2.03
Thorne Bay	576	219	5	45,625	10.1	20	26	18	10	5	1	1	5	2	12	269	1.94
Wrangell	2,305	907	24	43,250	5.8	16	28	16	9	7	3	2	5	4	10	1,079	2.04
Kake	715	246	75	39,643	16.7	14	30	18	9	7	0	1	0	8	13	248	1.86
Klawock	846	313	58	35,000	11.2	13	22	17	23	5	2	2	1	9	6	372	1.98
Tenakee Springs	85	59	5	33,125	10.0	11	14	5	11	18	0	0	9	7	25	44	1.97
Sitka	8,835	3,278	25	51,901	5.5	9	41	10	12	6	2	3	4	7	6	4,352	1.90
Haines	1,794	752	19	39,926	8.8	6	30	14	13	7	3	4	7	9	7	772	2.08
Angoon	573	184	86	29,861	7.4	5	53	9	12	5	0	5	1	1	9	188	1.57
Juneau	36,011	13,770	18	62,034	4.0	5	27	7	11	7	3	4	8	5	23	16,537	2.04
Ketchikan	7,922	3,197	23	45,802	5.7	5	29	13	13	11	2	6	6	5	10	3,888	2.08
Gustavus	425	199	8	34,766	8.9	4	45	16	4	10	1	1	5	5	9	190	1.75
Hyder	98	47	17	11,719	27.3	0	33	42	8	17	0	0	0	0	0	24	1.23
Meyers Chuck	21	9	10	64,375	0	0	0	0	0	0	0	0	100	0	0	3	0.00
Skagway	870	401	5	62,188	11.1	0	27	15	15	24	1	3	5	3	7	475	1.86

Note: **Service sector includes:** education, health and social services, arts, entertainment, recreation, accommodation, and food services.

Natural resources sector includes: agriculture, forestry, fishing, and mining.

employment in natural resources-related sectors. Communities with a large percentage of jobs in natural resources-related sectors are likely to be economically dependent on nearby natural resources.

Service-related sector employment includes tourism-related activities such as hotels and lodging, food services, etcetera. However, the service sector data reported in Table 7 also includes non-tourism jobs in education, professional services, entertainment, and public administration. The percentage of jobs in the service-related sector is high in many small communities, e.g., Angoon (53%), Gustavus (45%), Point Baker (34%), Hyder (33%), Kake (30%), and Hoonah (28%) (Table 7). However, with the exception of Hyder, Gustavus, and Hoonah, the service-related jobs in these communities are not primarily related to recreational activites. Instead, service employment is related to activities like education, and logging and lumber-related services (Alaska Department of Commerce 2009). Nonetheless, in most rural communities, tourism-related employment contributes to the local employment.

Southcentral Alaska and the Chugach National Forest (CNF)

Southcentral Alaska is home to most of Alaska's population. This diverse region includes a rugged coast with fertile bays and fjords, two national parks (the Kenai Fjords National Park and the Wrangell-St. Elias National Park), one National Forest (the Chugach National Forest), limited agricultural lands, oil and natural gas fields, forests, and glaciers. Also important are the region's many lakes and streams that are important spawning grounds for salmon and other aquatic species. The region is a popular destination for outdoor recreation activities, mainly fishing, hunting, camping, and other forms of nature-based tourism.

The Chugach National Forest (CNF), created in 1907, covers 5.4 million acres, which is about the size of New Hampshire (Figure 4). The Chugach National Forest is the second largest National Forest in the U.S., only eclipsed by the Tongass National Forest. It is located in the mountains surrounding Prince William Sound and includes the eastern Kenai Peninsula and the Copper River Delta (USFS 2007). The forest is classified as a temperate rainforest in the Pacific Temperate Rainforest region (Sierra Club 2009). However, one main distinction between the Tongass and Chugach National Forests is that each contains two different eco-regions. The Tongass is comprised of larger coastal hemlock-Sitka spruce, very suitable for timber growth and harvesting, while the Chugach contains Pacific coastal mountain forests of Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and mountain hemlock (*Tsuga mertensiana*). Other tree species less suitable for timber but common in the area include black spruce (*Picea mariana*), white spruce (*Picea glauca*), quaking aspen (*Populus tremuloides*), black cotton-wood (*Populus trichocarpa*), and paper birch (*Betula papyrifera*).

Forest Management on the Chugach National Forest

CNF management focuses on the maintenance of ecosystem services and forest biodiversity. Closely related is the forest's other main goal of providing recreational opportunities to a diverse and growing range of interests. A major area of emphasis is the maintenance and enhancement of fish and wildlife habitat. The forest is world-renowned

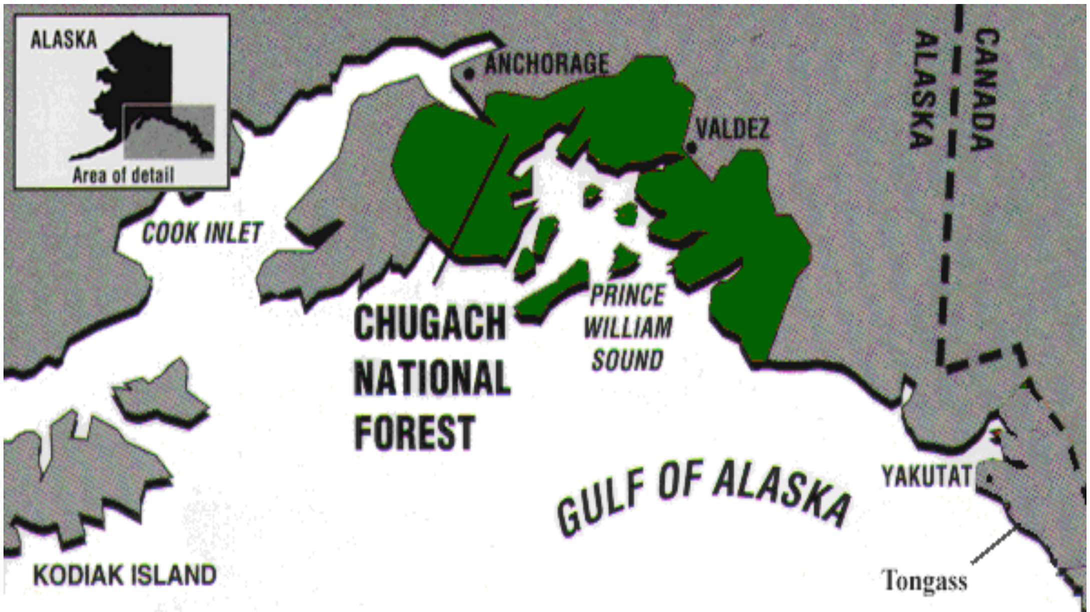

Figure 4. Map of the Chugach National Forest in Southcentral Alaska.
(Source: Alaska Rainforest Campaign.)

for its abundant salmon populations, along with Dolly Varden, lake and rainbow trout, and others species. The most popular sport fishery in Alaska, the Russian River, is located within the CNF and draws anglers by the tens of thousands each year (USFS 2006). Sport hunters are also drawn to the forest in search of trophy-sized moose in the Copper River basin, brown bear (*Ursus arctos*) in Prince William Sound, Dall sheep (*Ovis dalli dalli*) and mountain goats (*Oreamnos americanus*) in the Chugach Mountains, caribou on the Kenai Peninsula, and Sitka black-tailed deer found throughout the region. In addition, numerous non-game species, including waterfowl and marine mammals, attract large numbers of wildlife viewers each year. CNF management works in cooperation with a host of private and public sector partners to support maintenance of hunting, fishing, and wildlife viewing opportunities (USFS 2006).

The Chugach National Forest manages its lands for a wide spectrum of quality recreational experiences by incorporating principles of accessibility in both facilities and programs. Though 99% of the CNF is roadless and qualifies for wilderness protection under federal law, only a 2.1-million-acre wilderness study area, Nellie Juan-College Fjord, is under consideration for future inclusion within the National Wilderness Preservation System (Sierra Club 2009). Similarly, out of the total 86-mile road network, only 66% is operational for passenger vehicles, limiting human activities on the Forest.

Although the Chugach is primarily a recreation, fish, and wildlife forest, a few small timber sales and mining operations round-out the forest's varied activities. Commercial timber species include western hemlock, Sitka spruce, cottonwood, white spruce, and other mixed species. Mining operations include almost 3,000 gold mining claims, and a dozen gravel/stone permits (Sierra Club 2009; USFS 2006; GORP 2006). Because of the low commercial timber harvest levels, more than 90% of the income generated by the Chugach National Forest comes from campground fees, recreation fees, and mineral lease permits (USFS 2007).

Southcentral Alaska Communities

Until recently, it was generally believed that Chugach communities were more diverse in terms of socioeconomic conditions as compared to communities surrounding the Tongass. However, that changed with the decline of timber harvesting in southeast Alaska beginning in the 1980s. The majority of Chugach communities have larger populations as compared to the Tongass. Larger and more economically diverse communities include Anchorage-Girdwood, Wasilla, Sterling, Palmer, Valdez, Homer, Soldotna, and Seward (Table 8). Anchorage-Girdwood is Alaska's largest city, with a population of 260,283—40% of the state's total. Anchorage-Girdwood is also the center of the state's economy and is situated in close proximity to the CNF. The Kenai Peninsula Borough and the Valdez-Cordova Census Area together contain 10% of the state's population (Crone et al. 2002).

Examples of small communities that are less diverse in terms of socioeconomic activities include Hope, Whittier, Moose Pass, Cooper Landing, and Kasilof. These communities each have populations less than 500 residents (Table 8). Communities such as Copper Center, Gakona, Port Alsworth, Seward and Cordova have Alaska Native populations greater than 15% (Table 8).

Examples of the Alaska Native populations in southcentral Alaska include the Ahtna, Athabaskan, and the Alutiiq people in Seward and Valdiz; the Eyak in Cordova; and the Alutiiq in Tatitlek.

Based on the 2000 U.S. Census, communities with the highest annual median incomes include Moose Pass ($87,291), Valdez ($66,532), Anchorage-Girdwood ($55,546) and Cordova ($50,114) (Table 8). Moose Pass has the highest annual median income but a population of just 206 residents and only 10.7% classified as Alaska Natives. Moreover, the town's unemployment rate is very high at 31.2% (Table 8). This disparity may reflect a large percentage of high-income retirees, although employment within the traditionally high-paying natural resources sector is also high. Finally, Table 8

Table 8. Demographic and employment profile of CNF communities ranked by employment dependence on natural resource sector (U.S. Census Bureau 2000).

	Income & Demogrpahic Information					Employment by Industry (Percent)											
Community	2000 Population	Total number of HHs	Alaska Natives (%)	Median Household Income ($)	Unemployment (%)	**Natural Resources**	**Service Sectors**	Construction & Manufacturing	Wholesale & Retail Trade	Transportation, Warehousing & Utilities	Information	Finance, Insurance, Real Estate, Rental & Leasing	Professional, Scientific, Management, Administrative & Waste Mgmt.	Non-Public Administration Services	Public Administration	Total Employment	Employment Diversity Index
Moose Pass	206	84	10.7	87,291	31	39	7	24	0	14	9	0	6	0	0	97	1.78
Port Alsworth	104	34	22.1	58,750	4	17	14	21	0	0	7	0	7	17	17	29	1.80
Cordova	2,454	958	15	50,114	5	14	23	16	11	10	2	4	3	8	8	1,154	2.11
Kasilof	471	180	6.2	43,929	0	12	28	17	13	8	0	2	4	12	4	181	2.08
Sterling	4,705	1,676	4.6	47,700	10	11	26	17	21	5	0	2	3	8	6	1,926	1.91
Soldotna	3,759	1,465	6.9	48,420	6	8	36	8	19	6	1	5	3	7	7	1,687	1.96
Homer	3,946	1,599	6.2	42,821	6	7	38	10	13	10	2	5	5	6	5	1,761	1.96
Seward	2,830	917	20.9	44,306	9	5	38	7	14	7	2	3	6	5	14	998	1.82
Wasilla	5,469	1,979	9.1	48,226	5	4	29	13	17	8	3	4	4	6	11	2,443	2.09
Palmer	4,533	1,472	12.5	45,571	7	4	36	8	16	6	2	5	6	7	10	1,818	1.93
Valdez	4,036	1,494	10.2	66,532	3	3	24	11	14	20	2	2	9	7	8	2,043	2.16
Anchorage-Girdwood	260,283	95,643	10.0	55,546	5	3	29	8	16	9	3	6	10	6	10	125,735	2.11
Cooper Landing	369	162	4.9	34,844	0	0	26	9	4	19	0	0	13	9	20	159	1.69
Copper Center	362	132	50.6	32,188	27	0	37	9	12	8	2	8	0	13	11	90	1.91
Gakona	215	84	17.7	33,750	15	0	35	19	13	8	0	3	10	5	8	63	1.99
Hope	137	77	5.8	21,786	6	0	15	15	0	38	0	0	0	0	31	39	0.94

Note: **Service sector includes:** education, health and social services, arts, entertainment, recreation, accommodation, and food services.

Natural resources sector includes: agriculture, forestry, fishing, and mining.

shows that communities with high annual median incomes have high employment percentages in either the natural resource or service sectors—a good indication of the economic importance of the forest to the local economy.

Similar to the southeast Alaska region, some of the communities in southcentral Alaska are also located within the boundary of the Chugach National Forest (Figure 5) indicating the need for community-oriented forest management approaches.

Community-Resource Linkages and National Forest Management

Land management issues surrounding the TNF and CNF are complex, dynamic, and multi-faceted. For example, various user groups, including many locals, depend upon these forests for subsistence purposes; others desire access to timber harvests or recreational activities. Environmental groups and the various agencies responsible for managing the public lands and resources in the area may have different management objectives.

These varied uses and interests require careful management approaches in an effort to accommodate various demands. For instance, on the TNF, environmental groups oftentimes accuse the USFS of giving preference to the timber sector at the expense of recreational opportunities and fish and wildlife habitat. They charge that taxpayer money should not subsidize logging on the TNF. However, in the TNF's Record of Decision (ROD) for the 2008 Forest Plan, a list of revised plan activities were approved to address competing demands for forest resources and to ensure that the TNF would be managed in a sustainable manner such as limited timber harvesting, recreation and tourism, etcetera.

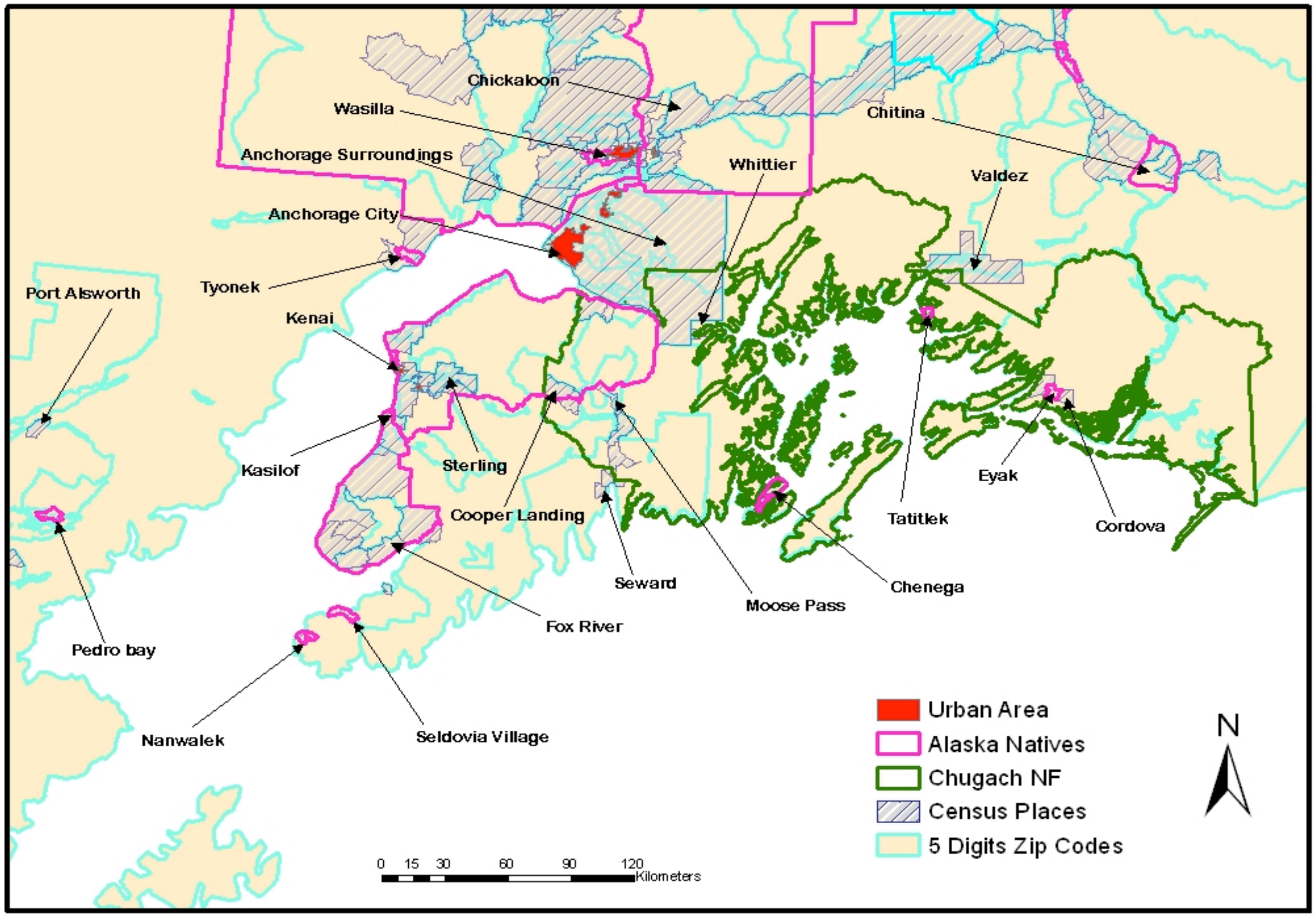

Figure 5. Communities in and around the Chugach National Forest.

Sustainable management of consumptive uses of natural resources is necessary in order to ensure high levels of value into the future (USFS 2007).

The Tongass NF and Community Resource Dependence

The communities of southeast Alaska depend on the TNF in various ways, including employment in wood products, commercial fishing and fish processing, recreation, tourism, and mining and mineral development. Many residents also depend on subsistence and recreational hunting and fishing to meet their basic needs (Alaska Department of Commerce 2009). The TNF plays a large role in meeting communities' needs (e.g., recreation, jobs, and subsistence uses), which is especially critical given the paucity of private land in the region. This dependence makes the assessment of social and economic conditions and trends an important input in managing the forest. Indeed, for many communities, 50% to 75% of employment is located within the natural resources and services/tourism sectors (Table 7). The high concentration of jobs within these sectors, coupled with subsistence, recreation, and quality-of-life components, suggests that the USFS needs to carefully consider community-resource linkages in developing TNF policies in order to avoid negative impacts on local community well-being.

Given the importance of natural resources sector jobs in the region, TNF policies affecting forest management are of great interest to local people. For example, upon statehood in 1959, the region's timber sector was growing, and by 1974 the annual harvest from the Tongass National Forest reached a peak of nearly 600 million board feet (MBF) (Sisk 2009). Since then, harvests declined to 30 MBF in 2008 (Warren 2009; Miller, personal communication, 2008) (see Table 9). The decline in harvest is due to three main factors: (1) price fluctuations in the global market; (2) a decline in the demand of timber and other forest products from the region; and, (3) a transition in USFS policies from a timber economy to ecosystem-based goals and related amenity-based economic development opportunities (Brooks and Haynes 1997; Che 2003). In addition, because high-value timber is widely scattered and road access is limited, logging costs are high, with additional timber stocks accessible at ever-increasing costs. In the past, the USFS subsidized logging to sustain forest-based jobs—a practice increasingly less-viable with time.

Timber harvests on the TNF have also declined due to pressures from environmental interests to protect old-growth forests. Activists supported passage of ANILCA in 1980 largely due to its designation of 5.4 million acres of wilderness in the TNF and increased regulation of timber harvests (Southeast Alaska Conservation Council 2009).

However, based on Table 9, there has been an increase of harvesting on state-owned lands, an indication of the efforts made by the State of Alaska to provide jobs and keep mills open in light of harvest declines in all other land ownerships. Additionally, in 2007 and 2008, the increase in harvest on the Chugach was largely due to the removal of beetle-kill timber and hazard trees for use as firewood (Warren 2009).

Table 9. Alaska timber harvests by land ownership, 1998-2008 (in thousands of board feet).

				Bureau of Land Management			National Forest			
Year	State	Private	Bureau of Indian Affairs	Free use	Cut	Total	Tongass	Chugach	Total	Total
1998	12,600	388,800	0	224	21	245	120,491	1,038	121,529	523,174
1999	12,800	378,900	0	128	212	340	153,229	356	153,585	545,625
2000	61,700	216,900	0	0	364	364	119,318	163	119,481	398,445
2001	55,300	191,100	2,400	0	315	315	44,077	335	44,411	293,526
2002	57,700	184,700	1,300	0	336	336	31,898	198	32,096	276,132
2003	49,700	137,900	0	75	0	75	48,107	15	48,122	235,797
2004	28,200	120,200	0	295	0	295	49,180	17	49,197	197,892
2005	46,200	162,893	0	131	0	131	46,583	61	46,645	255,869
2006	45,300	74,300	0	803	0	803	40,045	24	40,069	160,472
2007	44,600	50,100	0	516	0	516	22,481	213	22,694	117,910
2008	NA	NA	NA	NA	NA	NA	30,002	225	30,227	NA

(Source: Warren 2009.)

For the past decade, the TNF operated under the May 1998 Record of Decision (ROD), with an Allowable Sale Quantity (ASQ) annual ceiling of 267 million board feet (MMBF)/yr (Alexander et al. 2010; Warren 2009). However, the forest is currently operating under the TNF's 2008 ROD, which further reduced the ASQ to 200 MMBF/yr—a level thought sufficient to sustain the region's remaining sawmills for the next 15 to 20 years.

The TNF's significant shift away from timber harvests has affected many local communities. For example, closure of the pulp mill in Ketchikan eliminated more than 500 jobs (Alaska Department of Labor and Workforce 2001). The closure affected logging jobs, which were already declining from the end of the logging boom that accompanied the rapid liquidation of timber held by Native village and regional corporations. Although smaller sawmills still operate, the pulp mill closure significantly affected the economic well-being of the greater Ketchikan area (Sisk 2009). Employment and income generated by the timber, fishing, mining, and tourism sectors, which all are directly or indirectly related to the natural resources and service sectors—is important to the social and economic well-being of southeast Alaska.

In many communities individuals rely on subsistence use of forest resources to supplement incomes and provide food. In such cases, lower timber harvest levels can sustain the economic well-being and traditional lifestyles of rural communities. In some situations, an increase in one sector may negatively affect another. For instance, competition from nontraditional activities (e.g., recreation and tourism, commercial fishing, and timber harvesting, etcetera.) can reduce access to subsistence resources such as deer harvest or fishing, thus harming subsistence lifestyles. Dependence on the land and natural resources is an economic fact of life throughout much of southeast Alaska. Because of this dependency, TNF management is closely tied to the issue of regional and community socioeconomic development and structure. Therefore, minor changes in forest programs can sometimes cause major impacts to communities (USFS 1997, 2007).

The Chugach NF and Community Resource Dependence

In small rural communities in and around the CNF, employment largely depends on forest-related activities. This is true to a lesser extent in larger communities such as Anchorage-Girdwood and the Kenai-Soldotna area (Crone et al. 2002). In contrast to the Tongass, less than 2% of CNF lands are classified as suitable for commercial timber harvesting. As a result, the CNF lacks a significant forest products sector and offers just a handful of small commercial timber sales that account for the forest's timber-related activities (Sierra Club 2009).

As a result, CNF communities do not rely on Chugach timber, but rather depend far more on forest-related recreation activities, along with commercial fishing. The CNF's emerging amenity-based economy has been the focus of several studies. For example, Brooks and Haynes (2001) and Colt et al. (2002) assessed recreation and tourism activities on the CNF and found an increase in economic activities related to both commercial and noncommercial recreational use of the forest. They found that recreational demand had increased from both local and nonlocal people. As a result, tourism and recreation, along with the fishing and seafood processing sectors, are the primary forest-related employment sectors in CNF communities. Here, seafood processing is considered a forest-related activity due to the central role that CNF streams and oceans play in sustaining the salmon fishery (Crone et al. 2002).

Similarly, forest-related tourism and recreation activities are the basis of many service sectors in communities within or near the CNF. For instance, visitor sectors support an estimated 13.4% of total employment in communities like Cooper Landing, Cordova, Girdwood, Hope, Moose Pass, Seward, Valdez, and others (Crone et al. 2002). In comparison, mining operations, which include gold mining claims and a dozen gravel/stone permits, are very minor (USFS 2006; GORP 2006).

According to Crone et al. (2002), changes in forest management policies have the potential to impact the recreation and tourism sectors just as they do resource extraction. First, the number of businesses engaged in recreation and tourism activities is higher than either the timber or mining sectors. Second, the high economic cost of resource extraction associated with accessing, extracting, and transporting timber and mineral resources limits the economic feasibility of extraction and lowers the incentives for forest management policies practices.

Crone et al. (2002) assessed the socioeconomic impact of changing CNF policies on 14 CNF communities. They found that while forest policies had relatively little economic impact on larger communities like Anchorage-Girdwood, Kenai, Soldotna, and Sterling, the impacts with respect to a broader range of social benefits were large. This is because these communities' economies are large and diverse—especially as compared to smaller communities such as Cooper Landing, Moose Pass, Wales, and Hope, so that direct economic impacts were limited as a percent of overall activity (Crone et al. 2002). In contrast, smaller communities were more likely to experience both social and economic impacts. This is because smaller communities often have less-diverse economic activities—concentrated on one or two sectors while at the same time their economic activities are embedded with their culture. As a result, they have less capacity to adapt to policy changes that may affect their socioeconomic well-being.

In general, for communities surrounding the Chugach National Forest, wildlife and fish resources are important. For instance, based on an Alaska Daily News Story (2010) in the southcentral Alaska region, 162 million salmon were caught in 2009, an indication of high employment dependence in fishery-related sectors. Fishing includes subsistence, or commercial and recreational activities. According to the Alaska Department of Fish and Game, most of the recreational activities in the region depend upon fishing activities. For instance, the region accounts for about 70% of the statewide sport halibut harvest, a possible indication of a higher number of outfitter and guide use permits.

These distinctions between the southeast and southcentral Alaska communities in terms of lifestyle, economic characteristics, resource use, and forest management form the key areas of interest for this study. Moreover, Forest Service permit data, together with 2000 U.S. Census data, can help describe and understand the existing situation, and help answer whether variations in forest management between the TNF and CNF result from differences in geographic location (e.g., CNF's proximity to a much larger city like

Anchorage), existence of more diverse user groups surrounding the CNF, types of resources available, and communities' socioeconomic characteristics.

CHAPTER IV

MATERIALS AND METHODS

The primary task of this study was to explore the potential use of USFS permit databases—i.e., the Special Use Data System (SUDS) and the Timber Information Manager Database System (TIM)—for describing community resource use linkages. The second task was to go beyond simple description of permit data and assess its potential for measuring community resource dependence and vulnerability by linking permit information to 2000 U.S Census data. Census data were very important in describing communities' socioeconomic profiles and in linking this information to different types of forest uses.

In this study, I compared 2007 permit data for communities surrounding the Tongass and Chugach National Forests. I did this because the management on Tongass National Forest historically has differed from management on the Chugach. Prior to 1990, management of the Tongass focused more on resource extraction (e.g., timber harvesting and firewood collection), while the Chugach has since its inception been focused more on recreation. In this regard, a snapshot of recent permit data may indicate whether such differences in management between the two forests still exits. And also, together with Census data, it can be used to identify user groups and socioeconomic characteristics of user group's place-of-origin.

Figure 6 shows the conceptual schematic of methods followed throughout the study.

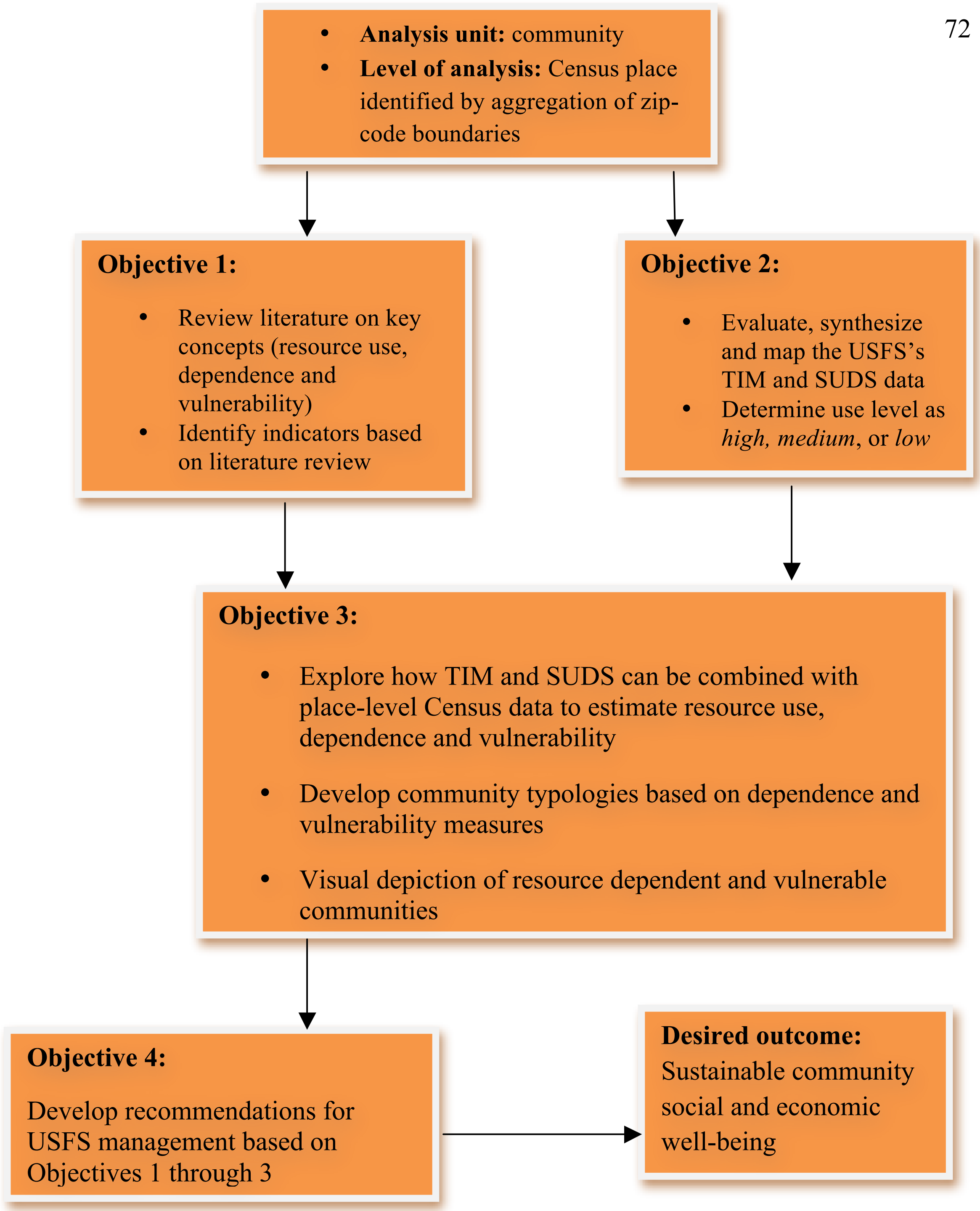

Figure 6. Conceptual schematic of methods used to assess community-forest use, dependence, and vulnerability.

The USFS Permit System

The USFS uses permits to facilitate, regulate, and monitor resource uses on federal lands. Permit systems operate through written agreements that allow various activities by specified persons under certain pre-established conditions. The USFS has long required permits for private uses of public lands. Permits also play an important role in educating permittees about the resources they access and conditions of use. Applications are carefully reviewed by USFS employees who work with permit data. Access may be granted, especially if the request falls within USFS guidelines and the requested use cannot be met on nonfederal lands.

Permits are required for both land occupation and resource uses where significant impacts are possible or where rationing of use is required. For example, each year the USFS receives thousands of requests from businesses, Non-Governmental Organizations (NGOs), municipalities, individuals, and various community groups to access NFS lands for a wide and growing range of uses. Uses vary greatly and can range from the establishment of infrastructure (e.g., utility corridors and telecommunications towers) and the cutting of timber, to commercial outfitting and guiding operations and video productions. Noncommercial uses include research and recreational events like boat races and fairs. Group uses commonly include organized activities of youth groups, service clubs, churches, and private clubs and associations (USFS 2004).

The USFS began to manage permit data systems beginning in the late 1980s. Permit information is stored in two main centralized database systems: (1) SUDS, which regulates non-extractive forest activities commonly known as special uses; and (2) TIM, which regulates the cutting of timber and firewood. In recent years, the USFS has made efforts to standardize and computerize its permit systems. This, along with the internet, has vastly expanded the potential utility of permit systems and data. Both SUDS and TIM are linked through the USFS's corporate Infrastructure Database System—INFRA.

Special Use Database System (SUDS)

SUDS was developed in the 1990s. The main purpose of SUDS is to control and monitor: (1) public land that is occupied for an extended period of time; (2) commercial uses of land; and (3) group and other noncommercial uses. In Alaska, various legislative acts authorize uses on public lands, including National Forest System (NFS) lands, such as the 1971 Alaska Natives Claims Settlement Act (1971: PL 92-203) and the 1980 Alaska National Interest Lands Conservation Act (1980). Nationally, some of the more important acts include the Organic Act of 1897; American Antiquities Act of 1906; the Act of March 4, 1915; the Mineral Materials Act of 1947; the Granger–Thye Act of April 24, 1950; the Federal Land Planning and Management Act of 1976 (FLPMA); and the American Indian Religious Freedom Act of 1978.

SUDS has two major permit categories: land use permits and recreational use permits. Both permit types can be either commercial or noncommercial. Examples of land use for commercial purposes include corridors for power transmission, oil and gas pipelines, and transportation networks, as well as sites for telecommunications facilities and helicopter landing pads. Also included are sites for the construction of lodges and cabins. Some examples of special land use permits include activities like construction sites, railroad right-of-ways, sewage transmission lines, hydroelectric projects, wind power facilities, power plants, airport concessions, helicopter landing sites and hangers, service facilities, isolated cabin permits, commercial filming and TV location permits, still photography, research and study areas, solid and liquid waste disposal areas, etcetera. Also included are ANILCA-related use permits, including permits for activities such as the continuation of cabins pre-dating ANILCA, shelters, set-net camps and associated cabins, and temporary camps. SUDS permits are also issued for private and non-exclusive uses, which include both land and recreational uses as long as the use of one permit holder does not materially interfere with that of another. Examples of non-commercial uses include group uses, religious facilities, camping, certain forms of recreation such as accessing some wilderness areas and backcountry cabins, outfitter camps, day use areas, trails, and many others (Endter-Wada and Blahna *forthcoming*; USFS 2004). However, some of the special use permits are forest-specific. For example, in national forests having designated wilderness, permitted activities such as hiking, horseback riding, photography, rafting, canoeing, kayaking, etcetera, are common. On the other hand, in national forests without wilderness areas, permitted activities are different.

Some of the above-listed special use activities are granted under SUDS permits. Commercial recreational use permits are mainly allocated to outfitter and guiding enterprises. In contrast, noncommercial recreational use permits are allocated to activities like camping and all noncommercial group use applications such as group events and other organized recreational activities.

The SUDS database includes information like land use records, accounting records, Geographic Information System (GIS) location data, resource data, and other administrative information. SUDS data is entered at the field or Ranger District level, including documentation of completed inspections, land use fees billed, and status of the terms of authorization. In general, SUDS is used as a repository for information on Lands Special Use Authorizations (SUA) (USFS 2004).

Complete SUDS data coverage exists only since about the year 2002. Data collected before then, while entered in the SUDS database, were not always recorded properly, and much data are missing or incomplete. Beginning in 2002, the USFS made special efforts to ensure proper collection and recording of all types of permit data, including permittee information. One main reason for this increased accuracy is that the USFS realized the potential usefulness of such data for management and reporting, especially in trying to address societal needs through ecosystem management. Since 2004, SUDS has been modified to collect data for administration with a set of standards, which determine the overall authorization process and includes the amount of resource use, time of use, amount of fees charged, information required during permit issuing, and data storage. It also automatically captures the specific data needed to evaluate completed authorizations that are administered to standards (USFS 2004).

Timber Information Manager (TIM)

The TIM system—used to automate business functions associated with the harvest and sale of timber and special forest products such as burls, bark, berries, ferns, and mushrooms—was developed beginning in 1995, with full-scale operation in 2002. In 2006, TIM integrated with the Forest Service's I-Web application—software that can allow entering data and accessing databases from any USFS computer to ensure compatibility among multiple program modules. This was done to reduce overall USFS costs for development, maintenance, training, and documentation (USFS 2007). The TIM database includes three major types of permits:

1. Free Use Permits: No fees are charged by the USFS for these types of permits. Permits allow access to firewood, sawlogs, and nontimber special forest products. Forest products under this category are for household consumption only. Free use permits allow Alaska residents to harvest up to 10,000 boards of feet (10 MBF) of green standing sawlogs of timber/person/year, and up to 25 cords of firewood/person/year (USFS 2004; Miller 2008). There are no standard limits on the amount of special forest products that can be harvested. The main purpose of issuing free use permits is to monitor the amount and location of resources harvested each year, as well as the number of people involved in harvesting these resources.

2. Personal Use Permits: This permit type is similar to free use permits in the sense that both can be obtained without fee from the USFS. However, one key difference is that in rural areas, subsistence users may continue to practice customary trade, engaging in their traditional cottage sectors using forest resources without fee requirements, unlike commercial users (USFS 2007). Forest resources extracted under personal use permits include both timber (sawlogs and firewood) and nontimber products (e.g., mushrooms, burls, conks, bark, and wildflowers) (USFS 2007).

3. Commercial Use Permits: Commercial use permits are issued to commercial use harvesters—entities that harvest products from NFS lands for subsequent sale to second parties. Fees are collected for all types of forest products, including firewood,

sawlogs, and special forest products. Determining the amount of harvest offered for commercial purposes varies from year-to-year. Since 2008, the Allowable Sale Quantity (ASQ) of commercial timber for the TNF has been reduced from 267MBF/year to 200MBF/year (Warren 2009). On the CNF, the ASQ used to be 16.9MBF/year. However, in 2002, the Chugach Forest Plan Revision Record of Decision stated that no lands were determined suitable for timber production, and hence the revision eliminated the ASQ for the Chugach (Warren 2009; ROD 2002). The ASQ represents an upper limit on harvests; however, recent years have seen much lower harvest levels as USFS management objectives have shifted from a focus on timber extraction to a more ecosystem-based approach. For example, in 2008 the two forests harvested just 30.2 MBF (see Table 9 in Chapter III). Again, there is little biological data on which to base sustainable harvest levels of nontimber forest products and, as a result, permits are issued without standard specifications on the amount of harvest allowed (Miller 2008).

The USFS considers TIM a showcase data management system due to its ability to manage data across broad applications and automate the development of timber sale contracts. TIM data are entered at the Ranger District level at the time of permit issuance, providing real-time data for a variety of uses, including monitoring the attainment of the ASQ level for forest products. Product Plan, an annual document produced from TIM data, determines harvest volumes and areas where permit holders can harvest. TIM also guides Agency personnel in collecting and summarizing data, and preparing reports. One function, Worksheet, is used to summarize data for final reports. Once the report is prepared, information is sent to Washington, D.C., and Regional Offices for Planning and

Budgeting. TIM's utility stems from its ability to enter and query permittees' information, including amount, location, and time of use. This and other relevant data sets are all integrated into forest management practices. Finally, TIM data is used to respond to public requests for information regarding forest products and can also be used for a host of resource allocation decisions such as budgeting and the allocation of agency personnel. All these functions reflect on-site analysis of forest use, which provides a valuable but currently under-utilized source of information about community-resource use linkages.

The USFS Permit System and Community Resource Use

In order to describe community-resource linkages on the Tongass and Chugach National Forests, I began with Endter-Wada and Blahna's (*forthcoming*) Linkages to Public Lands (LPL) framework. The LPL framework, described in Chapter 2, provides a comprehensive approach for systematically identifying and assessing a variety of community-resource linkages on public lands. Identifying community-resource linkages is a critical step in forest planning and policy formulation. Here, USFS permit data is used to provide a direct means to describe some of the resource use and interest linkages of the LPL framework.

I first obtained special use permit data (SUDS) and timber harvest permit data (TIM) for Region 10 (Alaska) from the USFS's centralized INFRA database, and then selected SUDS and TIM permits issued by Ranger Districts on the Tongass and Chugach National Forests. These data were then sorted by issue and expiration date to identify permits active during CY 2007—the most recent year to have relatively complete data. Data were then sorted by use type, issuing Ranger District, and permittee zip code. This process allowed us to gain familiarity with the data and assess overall data quality.

Exploration of SUDS and TIM data was aided by a series of meetings with 11 USFS personnel from various levels within the NFS (i.e., Regional, Supervisors, and Ranger District offices) who work with these permit database systems in order to clarify questions raised during the data evaluation phase (see Appendix A). I also used these meetings to learn more about how permit data are gathered, entered, stored, accessed, and used, as well as some of the strengths and weaknesses of the systems.

The next task was to more fully explore 2007 TIM and SUDS data to identify relationships between communities and the two Forests. TIM data were aggregated into three major permit categories: free use, personal use, and commercial use. To simplify the SUDS analysis, the 79 original use categories issued on the TNF and the 39 use categories issued on the CNF were collapsed into six common-use categories across the two forests: (1) Land Occupancy and Recreational Use; (2) Outfitter and Guide Use; (3) Isolated Cabin Use; (4) ANILCA-related Use; (5) Federal Land Policy and Management Act (FLPMA) Use; and (6) Research and Educational Use. These simplified use categories represent the full spectrum of SUDS uses but combine similar uses and consolidate uses with limited levels of activity. Each category is further described in Table 10. Following data aggregation, the frequency of permits in each major category was calculated for comparison.

Table 10. Collapsed SUDS use categories created from original SUDS data.

SUDS use category	Description
Land Occupancy and Recreational Uses:	This category includes both commercial and noncommercial land occupancies. Examples of commercial uses include: commercial recreational activities, filming and still photography, commercial mobile radio service, helicopter landing sites, utility corridors, parking lots, etc. Examples of noncommercial uses include all group uses (often recreation-related), community residences, and temporary land improvements.
Outfitter and Guide Use:	These permits include all commercial outfitting operations that provide personal services, equipment, and materials for guests. Permittees can be both local and non-local businesses.
Isolated Cabin Use:	This category includes permits for isolated recreation cabins located on sites not planned or designated for recreational cabin purposes. Most cabins originated from historic claims and, in most circumstances, these cabins are to be phased-out after 15 years from the date a permit is issued. The large number of permits and potential sensitivity of the phase-out process led us to keep this as a separate category in the analyses.
ANILCA-Related Use:	These permits are issued to rural subsistence users—mainly subsistence anglers and hunters. ANILCA use permits are unique to the State of Alaska and include: ANILCA set-net fishing camps (a commercial use but income generated is only for household consumption), and temporary hunting and fishing camp and shelter permits. All are temporary structures.
FLPMA Use:	FLPMA uses include road and trail easements, grazing allotments, mining, right-of-ways, sewage pipelines, etc. Land occupancy is achieved through easement or permit.
Research and Educational Use:	Examples in this permit category include experimental and demonstration activities, weather stations, education centers, research study sites, weather modification devices, site survey and testing, and observatories.

Note: The above 5 categories (Outfitter and Guide, Isolated Cabin, ANILCA-Related Use, FLPMA, and Research and Educational Use) are subsets of the two main SUDS categories, i.e., Land use permit and Recreational use permit. They are described here separately for analysis purpose only.

The Use of USFS Permit Data in Public Land Management

USFS manages 191.6 million acres of National Forests and National Grasslands within the NFS. Growing population, increased mobility, changes in lifestyles, and expanded second home and resort development in exurban and periurban areas has brought new demands on public lands in recent years (Mazza 2004; Alig et al. 2004). Demands for access to public lands originate from different social groups that may be situated proximate or geographically removed from desired resources. The activities driving these demands are diverse, including the extraction of economic resources like timber and subsistence use resources, and/or non-economic uses including recreational, cultural, and spiritual uses.

In order to accommodate a myriad of growing demands, the USFS issues permits for many uses and activities on forests. Activities requiring permits often have potential impacts to the land, involve for-profit or commercial uses, and require rationing due to limited supplies. On the other hand, many activities do not require permits. Examples include scenic drives, rock climbing, hiking, etcetera.

As described earlier, the USFS controls use through two permit systems, the Timber Information Management Database System (TIM), and the Special Use Database System (SUDS) (USFS 2007). In Alaska, both TIM and SUDS permits are issued and data are collected at different Ranger District Offices on the TNF and CNF. Information collected includes: type of use and activities, length of use, permittees’ place-of-residence, permittees’ personal information such as name and gender, etcetera. Such information holds promise for analyses that examine the relationships between local communities and nearby public lands—a level of detail missing from more commonly referenced county and state-level data. USFS permit data are currently underutilized and have great potential for use by management—especially in Alaska. Indeed, given the rural nature of the state, the predominance of public lands, and the rural and subsistence lifestyles of many Native and non-Native communities, understanding community-resource use linkages is very important.

By utilizing permit data in this analysis, it was possible to gain insight into local communities' use of forest land and resources and permittees' place-of-residence. Permittees' place-of-residence was determined by the zip code entered for each permitee. This allowed us to trace permitted use activities on the forests back to the community level. The numbers of permits by use type were then tallied for each community.

The number of permits issued to residents within a particular community provides aggregate information about community-resource use linkages. Note, however, that the total number of permits issued to residents within a community is generally positively related to population—i.e., as population increases, so too do aggregate permit numbers. To offset differences in community size, I also calculated the number of permits issued to local residents on a per-1,000 households basis based on the place-level 2000 Census data presented above in Tables 7 and 8:

$$Permits\ per-1{,}000\ households = \left(\frac{Total\ number\ of\ permits}{Total\ number\ of\ households}\right) * 1{,}000 \qquad (Eqn.\ 1)$$

Expressing community-resource use linkages on a 1,000 household basis gives additional insight into how communities access and rely upon public land resources. While the total number of permits gives a good measure of aggregate use, using the permit-to-1,000 household ratio is perhaps a more effective way to assess the relative level of resource use by household at the community level. Finally, ArcGIS v9.3 was used to visually display the use types and number of permits for both SUDS and TIM data. This process provides a visual display of community-resource use linkages for the two forests, and is consistent with assessing social data for subsequent use in resource planning and ecosystem management efforts.

Measuring Community Resource Dependency

The previous section discussed how USFS permit data could be used to directly describe community-resource use linkages on the TNF and CNF. Measuring community dependency takes this assessment one further step by placing use levels within a broader social and economic context for each community. Here, I explore dependency using two methods: the classic "proportional approach" of economic base theory, and a second approach developed here and based on USFS's SUDS and TIM permit data.

The proportional approach is a standard method used to describe resource dependency (Stedman et al. 2007; Leake et al. 2006; Robertson 2004; Parkins et al. 2003). The approach, relying on classic economic base theory, uses employment and/or income as the measurement unit to describe how dependent (in terms of jobs and/or income) a community is on one or more economic sectors of the economy. Because measuring forest dependency solely from an economic perspective may miss important information that can help to understand the unique linkages of rural communities, I also developed a supplemental approach that uses USFS permit data to give additional insight into resource dependency issues in both study areas.

Describing Community Resource

Dependency using the Proportional Approach of the Economic Base Theory is a commonly used approach to quantitatively describe how communities are dependent upon natural resources or some other economic sector. Proportional approaches calculate the percent of total income and/or employment at a given geographic scale that results from some sector of interest in the economy. As an example, Stedman et al. (2007) used this approach to identify forest-dependent communities at different geographic scales in Canada.

The proportional approach to describing community dependence offers some obvious advantages. First, data are generally available—especially employment data by economic sector. Moreover, the proportion of jobs or income derived from some sector of the economy is a compelling indicator of local economic dependence. And while either income or employment can be used as the defining metric, utilizing both has the advantage of creating a more complete understanding of the economic importance of a given sector to a community. For example, the level of employment and income can vary greatly across sectors. Jobs within a sector could be low-paying and seasonal, thus limiting overall economic impact. On the other hand, some sectors could create few jobs, but these may pay well—characteristics associated with high multipliers in local economies (Stedman et al. 2004, 2007; Leake et al. 2006; Crone 2004; Robertson 2004; Parkins et al. 2003; Elo and Beale 1984).

Unfortunately, due to wage confidentiality, income data were not available for most of the sectors in my two study areas, even at the Census tract and borough levels. This is especially true for natural resource-based sectors—a result that precluded calculation of an income-based proportion. As a result, this discussion and analysis focuses on employment-based economic dependency only.

Table 11 shows the list of sectors identified from the 2000 U.S. Census place-level data and information on forest use from the Alaska Department of Commerce.

Place-level proportional employment (*EP*) was then calculated by taking the total employment in various relevant sectors and dividing it by the total employment across all sectors, multiplied by 100:

$$EP_j^i = \left(\frac{E_i}{E_I}\right) * 100 \qquad (Eqn.\ 2)$$

where:

$i = 1,\ldots,$ i economic sectors;

j = 1,…, j communities within the geographic region of study;

E_i = number of full-time equivalent jobs within economic sector i;

E_I = total number of full-time equivalent jobs across all sectors and communities; and

$\left(EP_j^i\right)$ = employment proportion in sector i across all communities j.

Table 11. Selected socioeconomic variables to measure community forest dependency**.**

Employment by sector		**Description and rationale for inclusion**
Non-natural Resource Sectors:	Finance, information, public administration, transport, warehouse and utilities, retail trade, wholesale trade, etc.:	These variables reflect the relative importance of the non-natural resource base sectors in providing employment opportunities to local communities. Generally, by identifying the major employment sectors it is possible to determine whether there are more forest-based sector jobs in a given community, which may indicate strong linkages to forestlands.
Natural Resource-Related Sectors:	Forestry and logging:	This includes all employment in forest-related activities such as logging, commercial harvesting of nontimber forest products, and wood product manufacturing.
	Fishing and hunting:	Refers to all employment in commercial fishing and sport hunting both on federally- owned USFS lands and other public lands not managed by the Forest Service, including state-owned lands, BLM managed lands, and U.S. Fish and Wildlife lands.
	Mining:	Employment in any direct mining and mining-support jobs.
	Tourism-based services:	Any employment in recreation and tourism-based service jobs such as accommodations and food and drink services.
Forest Resource Use:	Percent of households using firewood as primary home heating:	In Alaska, many households use firewood for home heating. The percentage of households using firewood may indicate one dimension of direct use of forest resources, and also the importance of personal and/or commercial firewood use in a given community.

(Sources: U.S. Census Bureau 2000; Alaska Department of Commerce 2009.)

EP was calculated for each community and each sector. These sectors included: (1) all the natural resources-related sectors (i.e., forestry and logging, mining, mining support, extraction of oil and gas, oil and gas support), and (2) recreation-and tourism-related service sectors, which include accommodations and food and beverage services. Employment data from some sectors were aggregated because of similarities between sectors and limited employment levels (See Appendix B). For example, the service sector employment proportion could not be calculated for food and beverages or accommodation alone because of limited data. Instead, both were combined as the "recreation and tourism-related services" sector. Once the proportion of employment in each sector was calculated for each Census place, dependency was assessed by ranking each community from highest to lowest *EP* based on natural resource sector employment. These *EP* metrics were later compared to community-level permit-use metrics (i.e., permits per-1,000 households by community) in order to explore the commonalities and differences between the two approaches for measuring natural resource dependency.

Describing Community Resource

Dependency Using USFS Permit DataI supplemented the proportional approach to estimating community dependence with a second method based on USFS permit data. Here, I used the standardized SUDS and TIM permit community-level data (i.e., permits per-1,000 households) and ranked communities from highest to lowest in permit usage. In order to explore the community characteristics that were associated with high per-household levels of USFS permit usage, a set of place-level socioeconomic and demographic variables identified in the literature were assembled and used to examine the relationship between the socioeconomic variables and per-1,000 households permit use. I used this hybrid approach—community-level permit data combined with U.S. Census information—because it comprised the most complete set of secondary data available for measuring community-resource dependency.

Comparing Dependency Measures Based on EP and Permit Usage

Communities identified with the highest numbers of permits per-1,000 households were compared with the findings from the traditional employment dependence measure (proportional employment base approach). This method was used to evaluate the use of permit data by examining whether similar communities are identified by both methods. By doing this, it was possible to assess how permit data might be used as a supplemental source of information in studying the unique aspects of communities' resource use levels—in short, a different way of measuring resource dependency.

Developing a Typology of Resource Use and Dependency

Determining use level and developing a typology of community-resource use and dependency was achieved by using the number of permits per-1,000 households. These results were verified using the socioeconomic variables identified by reviewing literature and Rank Order Correlation methods described below. Next, communities' economic diversity indices were developed using the Shannon's index method to determine whether communities with high forest-use levels are related to lower economic diversification. Shannon's Diversity Index is one of the many statistical methods used to measure the diversity of a set of attribute data consisting of various types of objects. In this case, the objects are jobs within the various sectors of a community. Shannon's index method is used in many fields of study including social science (e.g., Crone et al. 2002), although it is most commonly used in the field of ecology to measure species diversity.

Below is the formula used to calculate Shannon Index:

$$H' = -\sum_{i=1}^{S} p_i \ln(p_i) \qquad (Eqn.. \ 3)$$

H' = Shannon's diversity index

p_i = relative employment within each sector, calculated as the proportion of jobs in a given sector to the total number of jobs across all sectors: $\frac{n_i}{N}$

n_i = number of jobs in sector i;

N = total number of jobs in all sectors

S = number of sectors

Shannon's index values generally range between 0 and 1, though values beyond these limits may be encountered because the index gives a measure of both sector numbers and their evenness in distribution. Therefore, communities having all employments within a single sector as identified by U.S. Census data will score an index value of 0. In contrast, communities having jobs created by more than one sector would score a higher index value. There could be many sectors in a community regardless of the number of jobs created in each sector. When the number of jobs is spread equally across all possible U.S. Census job sectors, communities would achieve whatever is the maximum index score. Shannon's index thus provides an additional mechanism to rank communities based on employment diversity across economic sectors, which may in turn reveal a community's dependence upon particular sectors of the economy.

Next, a matrix was prepared that shows standardized numbers of permits (permits per-1,000 households) versus the key socioeconomic variables identified based on the literature. After sorting communities by use level, employment diversity index, and other socioeconomic variables from highest to lowest, cutoff points were first calculated for each variable using the formula described below:

$$L_y = (n+1)\left(\frac{y}{100}\right) \qquad (Eqn.\ 4)$$

This equation was used to calculate quartiles for the position of an observation at a given percentile, *y*, with *n* data points sorted in ascending order.

This procedure helps to determine whether dependency on forest resources is related to permit use level by creating a typology of high, medium, and low permit use. There is no universal agreement in the literature determining cutoff points. However, by dividing communities' resource use and other variables' indices' score into quartiles, communities' characteristics were broken into comparable subsets. Though this method is imperfect, it is widely used in many studies that focus on the application of statistics (e.g., Altman et al. 1994; Poterba and Rueben 1994; Hosking et al. 1985).

This approach, however, is generally used for relatively complete data. In my study, because the permit data are somewhat skewed with some missing data points, I used subjective judgment to make a logical decision as to which category—the next higher or lower—a community should fall into. I did this by rounding-off values that had statistically insignificant variation but fell within different categories. In such circumstances, I examined the next higher and lower values to change cutoff points, and then assigned them in the same category—an approach supported by the literature (Buettner et al. 1997). Buettner et al. assert that data are a limiting factor in defining cutoff points. As a result, each researcher can employ his/her own "optimal" cutoff points, although this makes it difficult to compare results between different studies. The various approaches they suggest to determine cutoff points include both the standard quartiles method discussed above—which is widely used and believed to produce unbiased results although it is purely data-dependent—and the subjective or logical method that requires somewhat subjective decisions to be made by the researcher. However, the use of the subjective or logical method is dependent on acceptance by research colleagues (Buettner et al. 1997).

Hence, by adopting the quartiles and subjective or logical judgment methods, the following cutoff points were determined for each variable identified to measure communities' permit use level and degree of employment dependency on natural resource-related sectors:

(1) Cutoff points used to describe local communities' forest permit use level (per-1,000 households):

a. $\leq$ 99.99 = Low

b. 100.00 to 199.99 = Medium

c. $\geq$ 200 = High

(2) Cutoff points used to describe employment dependency on natural resource sectors (percent):

a. < 17 = Low

b. 17 to 34 = Medium

c. > 34 = High

(3) Cutoff points used to describe communities' employment diversity based on averages of calculated Shannon's index method:

a. < 0.72 = Low

b. 0.72 to 1.44 = Medium

c. > 1.44 = High

(4) Cutoff points used to describe communities' firewood use for home heating (percent):

a. < 34.4 = Low

b. 34.4 to 67.2 = Medium

c. > 67.2 = High

Note that the use of firewood as an independent variable in conjunction with the other variables to measure resource use and dependency is for the purpose of determining if there is a direct relationship between communities' firewood use and the number of permits issued.

Statistical Analysis

Spearman's Rank Order Correlation

Using the R statistical software environment, I ran a Spearman's Rank Order Correlation Coefficient analysis (see Appendix C) to determine the strength of association between the dependent variables (i.e., number of permits per-1,000 households and employment dependency in natural resource-related industries) and the "dependence" and "vulnerability" indicators (i.e., dependent variables) listed in Tables 11 and 12. The theoretical indicators identified by reviewing literature listed in Tables 11 and 12 served as the basis for a statistical approach to identify specific variables that gave relatively better predictive power of the dependent variable of permits per-1,000 households. By conducting this analysis, it was possible to determine the nature of association (positive or negative) between key socioeconomic variables and the numbers of permits issued and employment in the natural resource sectors for particular use type.

The R statistical software performs many of the same statistical analyses as SAS (Peter 2008; Crawley 2007; Everitt and Horthron 2006), with the difference being that R is available free-of-charge. The following R packages were used:

Spearman's Rank Order Correlation Coefficient **(r_s)** is calculated as:

$$r_s = 1 - \frac{6\left(\sum D^2\right)}{N(N^2 - 1)} \qquad (Eqn.\ 5)$$

where 6 is a constant, D refers to the difference between a subject ranks on the two variables, and N is the number of subjects.

Measuring Community Vulnerability to Forest Policy Changes

As compared to communities in metropolitan areas, many rural communities in the U.S. and across the globe are less integrated into political and social support systems and rely more directly on local natural resources to maintain their socioeconomic well-being. As a result, they are likely to be more sensitive to the consequences of adverse environmental and/or anthropogenic impacts, in this case, changes in resource use, access, or allocation policies.

Assessing rural communities' potential vulnerability to both environmental and human-induced impacts is critical not only for their sustainability but also for natural resource management strategies. Studies on human vulnerability over the last few decades have followed two approaches to measuring vulnerability. The first has concentrated on the field of natural hazards research, looking at human vulnerability related to physical threats and disaster risk reduction (Turner et al. 2003; Cutter et al. 2000, 2003; Cutter 1995; Morrow 1999). This work has focused on vulnerability in relation to environmental threats, such as flooding, hurricanes, droughts, and earthquakes.

Vulnerability to such extreme events depends both on the threat's likelihood and the place where they occur (Kok et al. 2009).

The second research approach has looked at how socioeconomic factors such as income, education level, poverty level, etcetera, contribute to human vulnerability (e.g., Adger and Kelly 1999; Blaikie et al. 1994; Bohle et al. 1994; Watts and Bohle 1993). This past work has shown that, in the face of both environmental and non-environmental threats, socioeconomic factors are important in assessing vulnerability. Poverty, marginalization, lack of entitlements, and access to resources are some of the principal determinants of vulnerability (Adger et al. 2004; Dolan and Walker 2003; Turner et al. 2003; Morrow 1999). Sensitivity to both kinds of threats is to a large extent determined by socioeconomic factors, as is the ability to cope with those threats. This has been demonstrated in many comparable cases, where the exposure to similar threats has resulted in substantially different impacts for different communities and individuals (see Turner et al. 2003; Dolan and Walker 2003; Morrow 1999; Cannon 1994).

Focusing on the anthropogenic-origin impacts (e.g., a change in forest management policy), I followed the second strand of vulnerability study approaches. Particular emphasis was given to how limited/lack of access to forest resources may affect resource dependent communities in southcentral and southeast Alaska. Many communities in these regions are rural by nature, and their economic activities are highly affected by USFS policies that determine opportunities available on the two Forests. This characteristic makes many rural communities vulnerable to potential risks (e.g., lack of access to the use of lands and resources as a result of changes in USFS policies).

Moreover, given the nature of public land management in the U.S., policy changes are often shaped by nonlocal interests.

Using available place-level socioeconomic data, particular interest of the research was studying communities' vulnerability profile to assess their capacities for potential resilience. Also examined here is the trend of the USFS's resource management approach, which has changed from resource extraction to a more ecosystem management approach. Many argue that the change put many rural communities potentially at risk, making it necessary to identify those which might have been affected negatively. In doing so, the first step was to identify existing community resource-use linkages using the USFS permit data. Chapter V discusses this topic in detail.

Since the study relied largely on secondary data, it focused primarily on community economic indicators to assess how lack of access to forest resources might affect the economic well-being of forest-dependent communities. Economic well-being was chosen for measuring potential risk because economic data are widely available and used in many studies to measure employment in natural resources-related sectors and the income generated therein. Table 12 presents a list of key socioeconomic variables identified from the literature to calculate a composite vulnerability index for each community.

The five variables in Table 12 are commonly used in many vulnerability studies that focus on resource dependent communities (e.g., Charnley et al. 2008; Magis 2007; Donoghue and Sturtevant 2007; Stedman et al. 2007; Daniels 2004; Parkins and Beckley 2001; Jackson et al. 2004; Harris et al. 2000). The findings from this and other similar

Table 12. Socio-economic variables selected to describe community vulnerability.

Small Population Size	Most rural communities in Alaska are characterized by small populations. Small communities are usually isolated from developed infrastructure and social services. Often they depend on natural resource-related activities such as forestry, fisheries, mining, agriculture, etc. Such economic linkages to natural resources make small communities vulnerable to adverse changes caused by humans and nature.
High Poverty Rates	This variable is used to determine the proportion of people living below the poverty line – i.e., the number of people (households) who have incomes less than the poverty level, divided by the total population. High poverty rates directly or indirectly link to lack of other opportunities and choices. Lack of other opportunities and choices means dependence on a particular type of resource or activity—an important measure of vulnerability.
High Percent of Alaska Natives	The percent of Alaska Natives in a given geographic area is a good indicator of community vulnerability because Alaska Natives living in forested parts of Alaska are uniquely linked to forestlands. Any change in forest management policy directly affects Native lifestyles. Therefore, using this variable helps to identify communities with potential vulnerability in terms of their unique way of life.
Education Attainment (percent with low education attainment)	Education attainment is an indicator of human capital in a given community. Education is used as one measure of community capacity, as well as an indirect measure of a community's resource dependence. Those age 25 and above who hold at least a high school diploma and above are used as a measure of vulnerability (i.e., the higher the percentage, the lower the vulnerability, and vice versa).
Low Median Household Income	In many rural Alaskan communities, median household income is believed to be lower than the national- or state-level medians. However, there is variation in median household income across the different communities due to the type of sectors in which people are employed. Therefore, median income is used in conjunction with poverty rate to measure community vulnerability.

literature have been used in the selection process of appropriate variables for Alaska's situation.

Indices are commonly used in vulnerability studies. For example, Bollin and Hidajat (2006), Nygatan (2005), Villagran de Leon (2006), and Cutter et al. (2000, 2003) have created vulnerability exposure indices by calculating a composite vulnerability index. Three general methods have been used for calculating a composite vulnerability index. The first and most commonly used approach is a normalization procedure. This approach normalizes and sums the chosen indicators. The components of the vulnerability index are often measured in different units, making a straightforward summation invalid. However, the observation can be "standardized" or "normalized" to permit additive or multiplicative averaging, with the average typically called a composite index.

A normalized procedure adjusts the observation to take a value of between 0 and 1 using the formula:

$$Vij = {(Xij - MinX)}/{(MaxXi - MinXi)} \qquad (Eqn.\ 6)$$

where:

- Vij is for the standardized vulnerability score with regard to vulnerability component i, for community j;
- Xij is for the observed value of the same component for the same community;

- MaxXi and MinXi are the maximum and minimum value of the observed range of values of the same component, for all communities in the index. Vij will therefore vary between 0 and 1. If Xij (the observed value) is the minimum in the range of values, Vij would be zero. If Xij is the maximum in the range, Vij would take a value of 1. This method was also used by Crowards (1999), Briguglio (1997), and Chander (1996).

All the components of the index can then be summed on the basis of equal or varying weights assigned to each component. The shortcomings of this method, however, are that the weights for averaging the components of vulnerability are arbitrarily chosen, and the distributions of the normalized variables are heavily influenced by outlier observation (Briguglio 2002, 2003).

The second method of measuring vulnerability is scoring on a multi-point mapping scale, which involves categorizing an occurrence (in terms of intensity or frequency) along a scale of say 1 to 7, with 1 being the lowest possible occurrence and 7 the highest. This approach is useful when data are qualitative and when the researcher desires to transform data into a quantitative format. This approach was used by Kaly et al. (1999, 2002, 2003) in the construction of environmental indices.

The third method of measuring vulnerability is the regression method. The basic assumption in this method is that a dependent variable can be found as a proxy for vulnerability, and this is then regressed on a number of explanatory variables which represent vulnerability index components. This method lets the data produce the weights and does not require "normalization" of the observations. The coefficients on the explanatory variables of the estimated equation are taken as weights for averaging the components of the index. Others using this method include Saaty and Vargas (Saaty 1980; Saaty and Vargas 1998), where multi-criteria analysis techniques were used such as the analytical hierarchy process for weighting each vulnerability indicator. Stephen and Downing (2001) used a multi-variate statistical technique to count vulnerability indicators that exceed a threshold, and Gladwin (1989) established a decision tree among the variables as in the elimination-by-aspect model. The regression method has a number of methodological problems, which limit the operationality and the reliability of the index. The most important is that if the dependent variable is considered to be a proxy for the variable to be measured, one need go through a cumbersome regression procedure to compute the index (Briguglio 2003).

In my approach, I chose to follow the normalization method to develop a composite vulnerability index for each community because it was the ideal method for my data sets and for the purpose of my analysis (see description on vulnerability below for the variable identification procedure used in developing the composite index). Once the composite index was calculated for each community in each Forest, I ran two separate analyses: (1) a community typology approach, which used cutoff points to determine a community's vulnerability category as high or medium or low (see Appendix D); and (2) a community ranking approach to validate the typology approach (see Appendix E). The ranking approach was also supplemented by reviewing available literature on the general characteristics of Alaska communities (see Chapter III). The ranking approach is a more transparent way of presenting data because no cutoff points are used. Instead, each community was simply ranked from highest-to-lowest, and then scores were assigned based on each variable's direction of association toward vulnerability before averaging (see Table 13 below).

The (+) and (-) signs in Table 13 indicate each variables expected association in determining a community's vulnerability to forest policy changes. Negatively associated variables such as population, communities' employment diversity index, median income, and percent of population age 25 and above holding high school diploma are generally believed to be inversely related to vulnerability. This means that as the index values increase for these variables, vulnerability decreases, and vice versa. On the other hand, variables positively associated with a high vulnerability score indicate that as their index values increase, vulnerability also increases.

Determining Cutoff Points

For the typology approach, the standard (quartiles) method and logical (subjective judgment) method described earlier were used to determine cutoff points for each socioeconomic variable. These data later were used to develop a composite community vulnerability index. The same method was also used to determine cutoff points for the calculated community vulnerability index. Unlike the dependency measure, I used a normalized index for each variable to determine cutoff points because that way it was possible to calculate a composite vulnerability index for each community.

Table 13. Community vulnerability to forest policy changes scoring system and variables association in predicting community vulnerability.

Association	(-)	(-)	(-)	(+)	(+)	(-)
Vulnerability typology	Population index typology weight scoring	Communities' employment diversity index typology weight scoring	Median annual HH income index typology weight scoring	Population below poverty index typology weight scoring	Alaska Natives index typology weight scoring	Population age 25 and above hold high school diploma index typology weight scoring
Low	3	3	3	1	1	3
Medium	2	2	2	2	2	2
High	1	1	1	3	3	1

(1) Cutoff points used for all socioeconomic variables from the calculated index:

a. < 0.333 = Low

b. 0.333 to 0.666 = Medium

c. > 0.666 = High

(2) Cutoff points used for the employment diversity index:

a. < 1.348 = Low

b. 1.348 to 1.751 = Medium

c. > 1.751 = High

(3) Cutoff points used to describe community vulnerability based on the composite index:

a. < 1.534 = Low

b. 1.534 to 1.957 = Medium

c. > 1.957 = High

Then, scores were assigned for each variable's categories (high, medium, or low) based on the association of each variable in predicting a community's potential vulnerability (see Table 13 above).

Communities were then ranked based on the dependence and vulnerability measures and displayed on maps to visually depict the geographic proximity of each community to the Tongass and Chugach NFs. ArcGIS 9.3 software was used to overlay geographic boundaries of zip codes with Census places to link zip code information with communities.

Next, I compared resource-dependent communities identified by the standard measure of dependence to communties identified by the permit data approach. I did this to examine whether the same communities appear in each of the three main measures, that is: resource use level, dependency, and vulnerablility.

Finally, a hypothetical matrix was prepared to show distribution of communities across the three measures, i.e., permit resource use, employment dependency, and vulnerability (see Table 14). Using the cutoff points, communities were categorized as “high” or “medium” or “low” in terms of permit use level, employment dependency, and vulnerability. For the permit use and employment dependency typology, percentage values were used to determine the cutoff points, whereas for the vulnerability typology, indices calculated using the selected socioeconomic variables described in Table 12 were used. The process gave insight to the strengths and weaknesses of each approach—i.e., the permit data approach used to measure community resource-use level, and the economic base approach that used employment data to measure employment dependency, and finally the vulnerability index approach used to measure community vulnerability. Table 14 is also used as a showcase for methodological assessment of potential relationships between permit and Census data for measuring community resource-use and dependence—the main objective of this study.

Table 14. Hypothetical relationship between permit use level, employment dependency, and vulnerability using the typology approach.

Rank	Community permit use	Community employment dependecy	Community vulnerability
1	Low	Low	Low
2	Low	Medium	Low
3	Low	High	Low
4	Medium	Low	Low
5	Medium	Medium	Low
6	Medium	High	Low
7	High	Low	Low
8	High	Medium	Low
9	High	High	Low
10	Low	Low	Medium
11	Low	Medium	Medium
12	Low	High	Medium
13	Medium	Low	Medium
14	Medium	Medium	Medium
15	Medium	High	Medium
16	High	Low	Medium
17	High	Medium	Medium
18	High	High	Medium
19	Low	Low	High
20	Low	Medium	High
21	Low	High	High
22	Medium	Low	High
23	Medium	Medium	High
24	Medium	High	High
25	High	Low	High
26	High	Medium	High
27	High	High	High

Note: Each community vulnerability rating (i.e., 1 through 27) could include none, one, or several communities (Ranking Key: 1= Low vulnerability, 27 = High vulnerability).

CHAPTER V

COMMUNITY-RESOURCE USE LINKAGES IN THE TONGASS AND CHUGACH NATIONAL FORESTS

Permit Use and Public Lands Management

In this chapter, I present the findings from the analyses made to demonstrate the usefulness of both the SUDS and TIM databases for understanding of community-resource use linkages on the Tongass and Chugach National Forests. Particular emphasis is given to understanding and describing how USFS data are collected and maintained on the two Forests, as well as at the national level. As a result, the approach here is more descriptive than analytical. An exploratory analysis of community characteristics is found in Chapter VI.

Permit Usage on the Tongass and Chugach National Forests

Permittees' State-Of-Residence and Type of Use

Based on permit zip codes, permittees' place-of-residence included 40 states across the U.S., along with 46 (2%) permittees residing in Canada. The majority of all permits (79%) were issued to permittees residing in Alaska. The remaining 21% of permittees were distributed across the rest of the United States, of which the major contributors were New Jersey (5%), Washington (4%), and (3%) California (Figure 7). On the Tongass, 78%, and on the Chugach, 82% of the permittees were from Alaska.

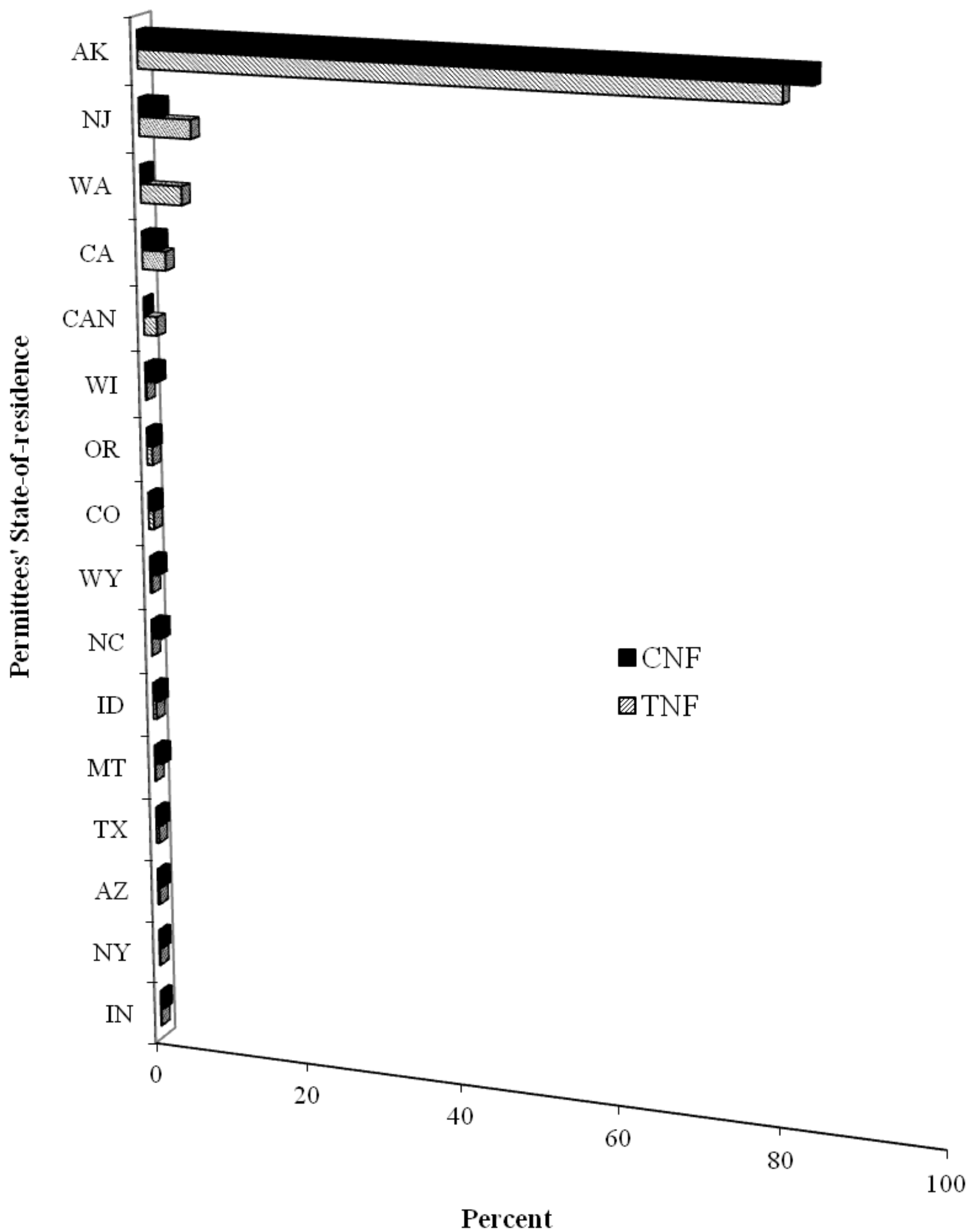

Figure 7. Active TNF and CNF SUDS permittees' State-of-residence, CY 2007.

During calendar year (CY) 2007, the combined Tongass and Chugach National Forests had a total of 3,648 active SUDS permits, of which 2,769 were issued by the Tongass and 879 by the Chugach (Table 15).

In CY 2007, the TNF issued SUDS permits for 79 different types of commercial and noncommercial uses, while the Chugach issued 39 different SUDS types of permits. In order to conceptually group similar permits for data analysis, the permit uses from the two Forests were aggregated into six major use categories displayed in Table 15. On the TNF, the largest number of permits—1,374 or 49.6%—were issued for land occupancy and recreational use categories, followed by commercial outfitter and guiding permits (22.5%), and isolated cabin permits (14.2%). Similarly, on the CNF, 362 permits

Table 15. SUDS and TIM permits in the Tongass and Chugach NFs active in CY 2007 by permit type.

	Tongass		**Chugach**	
SUDS Permits	Active permits in CY 2007	Percent	Active permits in CY 2007	Percent
Land Occupancy & Recreational Use	1,374	49.6	362	41.2
Outfitter & Guides	623	22.5	278	31.6
Isolated Cabins	393	14.2	151	17.2
ANILCA-Related Use	208	7.5	49	5.6
Research & Educational Use	100	3.6	22	2.5
FLPMA-Related Use	71	2.6	17	1.9
Total	**2,769**	**100**	**879**	**100**
TIM Permits	Active permits in CY 2007	Percent	Active permits in CY 2007	Percent
Free Use Firewood	20	35.7	47	90.4
Free Use Sawlogs	20	35.7	3	5.8
Personal Use Firewood	12	21.4	1	1.9
Commercial Firewood	4	7.2	1	1.9
Total	**56**	**100**	**52**	**100**

(41.2%) were issued for the land occupancy and recreational use category, followed by outfitter and guides permits (31.6%), isolated cabins (17.2%), ANILCA-related use, (5.57%), research and educational use permits (2.5%), and (1.9%) FLPMA permits (Table 15).

In comparison, there were far fewer active TIM permits on both forests—56 on the TNF and 52 on the CNF (Table 15). This difference in the number of permits suggests a higher demand for the uses allowed under SUDS permits. Moreover, TIM data represent a one-time (i.e., annual) use while SUDS permits are issued for ongoing activities such as residence cabin permits and long-term land occupancy permits. Hence, TIM data are more likely to reflect permits only active in 2007. In addition, unlike SUDS permits, all TIM permits were issued to permittees residing within study area communities, indicating more localized use. This result was expected because these permits are for the physical removal of forest products—an activity most suited to on-site processing by local residents.

For TIM permits on both Forests, free use firewood permits were the largest in number—35.7% on the TNF and 90% on the CNF. However, on the TNF, free use sawlog permits were equal in number with free use firewood permits. The personal use firewood permit is the third largest permit category (21.4%), with 7.2% for commercial firewood (Table 15). The percent of permits for commercial firewood reflects the low number of people engaged in the firewood business and does not reflect the amount of wood extracted. Thus, the Forest Service has not developed a mechanism to monitor the amount of firewood collected except for setting a maximum ceiling (e.g., 25 cords per person/yr on the CNF and TNF). Forest Service staff believe that few individuals harvest the maximum amount due to the high costs involved in removing the permitted amount (Miller 2008). On the CNF, the proportion of free use sawlogs permits is only 5.8%. The small number of permits for forest products with no commercial timber harvesting in the CNF indicates that forest use activities tend to be more recreation-oriented than extractive use as compared to the TNF.

TNF Permits Issued to Permittees Residing in Study Area Communities

There was wide variation in the number and types of active 2007 SUDS and TIM permits issued to permittees residing within TNF communities. As a whole, the greatest number of SUDS permits were issued to residents in Juneau (547 permits), Ketchikan (354 permits), Petersburg (221), Sitka (188), Wrangell (181), and Yakutat (134). Fewer permits were issued to Kasaan and Angoon—just 2 permits per community (Figure 8). Based on these data, most SUDS permittees resided in relatively large communities. Communities with residents receiving the most TIM permits included Petersburg (18 permits), Ketchikan (12 permits), Juneau (6 permits), Tenakee Springs (5 permits), and Wrangell (5 permits) (Figure 8). The remaining 10 permits were issued to permittees in eight other communities. Most free use firewood permittees resided in Juneau, Tenakee Springs, Craig, and Sitka. Communities such as Petersburg and Ketchikan, where most of the TIM permittees reside, represent historically wood-processing centers.

In aggregate, Juneau, Ketchikan, and Petersburg are home to the largest number of SUDs and TIM permit holders, indicating a high level of use of the Tongass. This

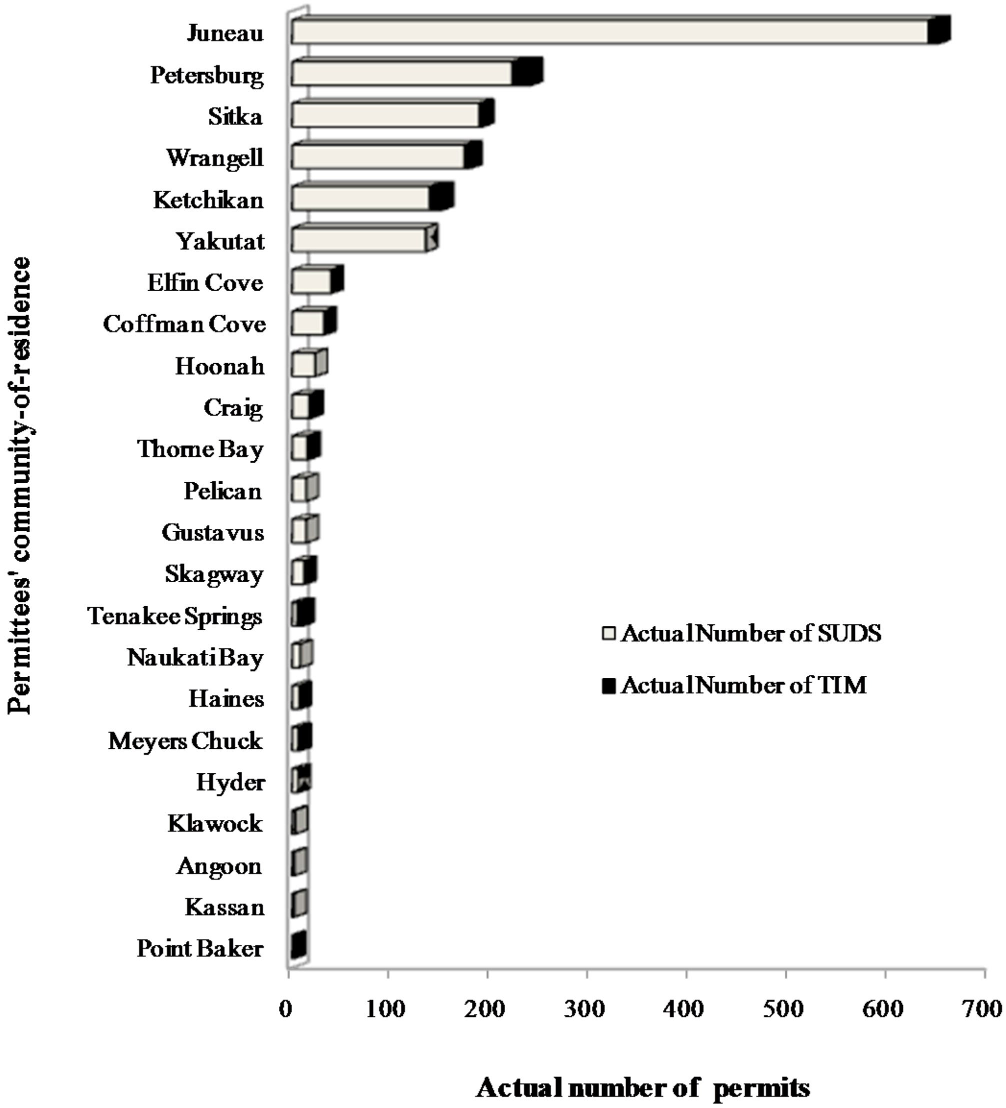

Figure 8. Actual number of SUDS and TIM permits active in 2007 held by permittees residing in TNF communities.

information is important to note because of the large number of permittees who reside in these communities.

As shown in Figure 8, the largest number of SUDS and TIM permits were issued to permittees residing in the region's larger communities. While this provides important information regarding forest use, it masks the relative degree to which local use of public resources is likely to affect nearby communities.

Figure 9 presents the permit numbers presented in Figure 8 adjusted on a per-1,000 households basis. This conversion presents an entirely different representation of the relationship between communities and natural forest use. Accordingly, there were large numbers of SUDS permits per-1,000 households in Elfin Cove, Meyers Chuck, Yakutat, and Coffman Cove compared to the other communities (Figure 9). Other communities also having large numbers of SUDS permits per-1,000 households include Pelican, Naukati Bay, Hyder, and Kasaan (Figure 9).

Likewise, there were large numbers of TIM permits per-1,000 households in Point Baker, Edna Bay, and Tenakee Springs (Figure 9). These communities have small populations—one reason why they had a high number of TIM permits per-1,000 households as compared to the rest of communities in the study area. Other communities that also had a relatively large number of TIM permits per-1,000 households include Meyers Chuck, Petersburg, Thorne Bay, and Craig (Figure 9).

For TIM permits, there were 111 permits per-1,000 households in Meyers Chuck, 85 in Tenakee Springs, 77 in Point Baker, 53 in Edna Bay, and 15 in Petersburg (Figure

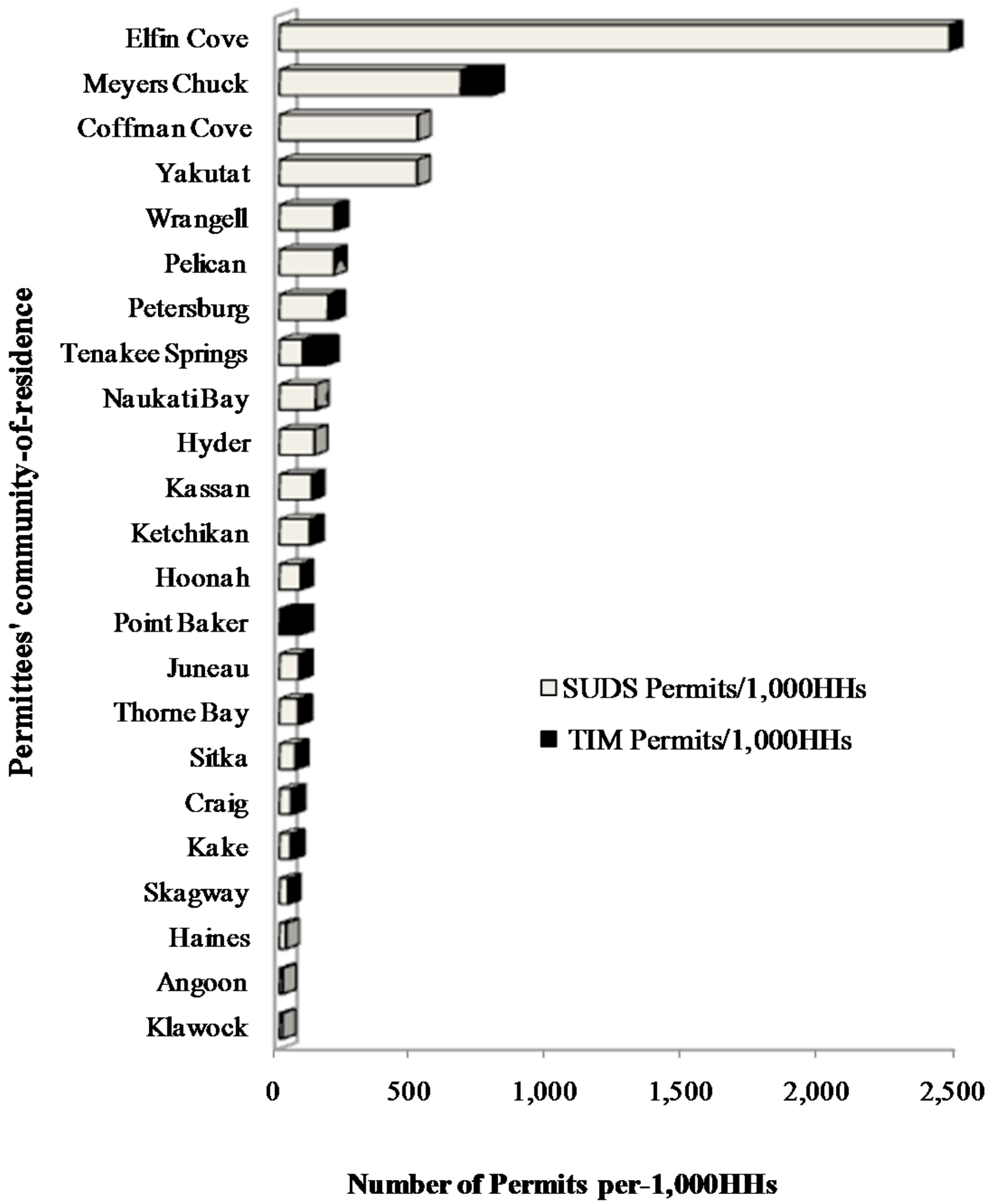

Figure 9. TNF SUDS and TIM permits per-1,000 HHs active in CY 2007.

9). Again, we see a significant difference across communities as compared to the actual number of TIM permits. As with the SUDS permits, smaller communities had more TIM permittees per-1,000 households than larger communities.

Types of Permit Use by TNF Communities Per-1,000 Households

SUDS Permits on the TNF. In southeast Alaska, the rural nature of communities contributes to their dependence on the TNF for both economic and non-economic activities. Even though there are similarities between communities in terms of forest use activities on the Tongass, some communities tend to specialize in certain uses. For example, SUDS data from CY 2007 indicate that, on a per-1,000 households basis, Elfin Cove had by far the most outfitter and guides, isolated cabins, and land occupancy and recreational use permits (Table 16). In comparison, all permits issued to residents in Meyers Chuck were for land occupancy and recreational use. In Coffman Cove there were more land occupancy and recreational use permits, but fewer outfitter and guide permits (Table 16). Kasaan, Yakutat, Hyder, Petersburg, Klawock, and Ketchikan also had high numbers of permits per-1,000 households. In Yakutat and Pelican, however, more ANILCA-related use permits were issued compared to the other communities. Not surprisingly, these communities have a large percentage of Alaska Natives (see Table 7).

Overall, outfitter and guide and land occupancy and recreational use permits were issued to residents across all communities. A few research and education permits were issued in Elfin Cove, Craig, Juneau, and Sitka. FLPMA permits were the least-issued

Table 16. Tongass SUDS permits active in CY 2007 by use type and community-of-residence.

Community	Number of Households	Actual number of land occupancy & recreational uses	Land occupancy & recreational uses/1,000HHs	Actual number of outfitter & guide	Outfitter & guide/1000 HHs	Actual number of isolated cabin	Isolated cabin/1000 HHs	Actual number of ANILCA-related uses	ANILCA Uses/100 0HHs	Actual number of research activities	Research activities/ 1000HHs	Actual number of FLPMA uses	FLPMA/ 1,000HHs
Angoon	184	0	0	2	11	0	0	0	0	0	0	0	0
Coffman Cove	63	31	492	1	16	0	0	0	0	0	0	0	0
Craig	523	15	29	3	6	0	0	0	0	4	8	0	0
Elfin Cove	15	7	467	18	1,200	11	733	0	0	1	67	0	0
Gustavus	199	0	0	9	45	5	25	0	0	0	0	0	0
Haines	752	11	15	4	5	0	0	2	3	0	0	0	0
Hoonah	300	8	27	11	37	4	13	0	0	0	0	0	0
Hyder	47	4	85	2	43	0	0	0	0	0	0	0	0
Juneau	18,770	412	29	95	10	171	18	35	7	29	5	16	1
Kake	246	6	24	4	16	0	0	0	0	0	0	0	0
Kasaan	17	2	118	0	0	0	0	0	0	0	0	0	0
Ketchikan	3,197	230	72	71	22	10	3	22	7	4	1	17	5
Klawock	313	1	3	2	6	0	0	0	0	0	0	0	0
Meyers Chuck	9	6	667	0	0	0	0	0	0	0	0	0	0
Naukati Bay	60	8	133	0	0	0	0	0	0	0	0	0	0
Pelican	70	0	0	4	57	0	0	10	143	0	0	0	0
Petersburg	1,240	101	81	37	30	57	46	20	16	0	0	6	5
Sitka	3,278	76	23	86	26	0	0	0	0	0	0	0	0
Skagway	401	8	20	4	10	0	0	13	4	11	3	2	1
Tenakee Springs	59	0	0	5	85	0	0	0	0	0	0	0	0
Thorne Bay	219	11	50	4	18	0	0	0	0	0	0	0	0
Wrangell	907	22	24	66	73	88	97	4	4	1	1	0	0
Yakutat	265	21	79	50	189	3	11	60	226	0	0	0	0
Total	**31,134**	**980**		**478**		**349**		**166**		**50**		**41**	

permits, perhaps because FLPMA uses are not increasing in demand like recreational use permits. Indeed, land occupancy through FLPMA requires long-term contracts and demands for such uses come from large corporations. Nonetheless, as the SUDS analysis indicates, communities like Ketchikan, Petersburg, Juneau, and Sitka acquired the most FLPMA permits (Table 16). These communities are more urban than the other nearby communities. Figure 10 shows the place-of-origin of outfitter and guide permittees, one of the most commonly issued permitted activities on the Tongass National Forest. These data are displayed on a per-1,000 households basis. As shown in the Figure, communities like Elfin Cove and Yakutat had high numbers of permits per-1,000 household as compared to other communities. Pelican, Tenakee Springs, and Wrangell had relatively moderate numbers of permits per-1,000 households, while the remaining communities had fewer permittees.

Figure 10 shows the place-of-origin of permittees issued land occupancy and recreational use permits—another important use on the Tongass. Once again, these data are displayed on a per-1,000 households basis. Land occupancy and recreational use is a broad category which includes activities such as commercial and noncommercial land uses, and recreational and nonrecreational activities. Land occupancy and recreational uses are aggregated for display due to the small number of data points for most of the individual activities. As a result, it was not possible to display each particular activity on the map.

Another important permitted use on the Tongass is ANILCA-related use. ANILCA-related use is directly related to subsistence use activities such as fishing and

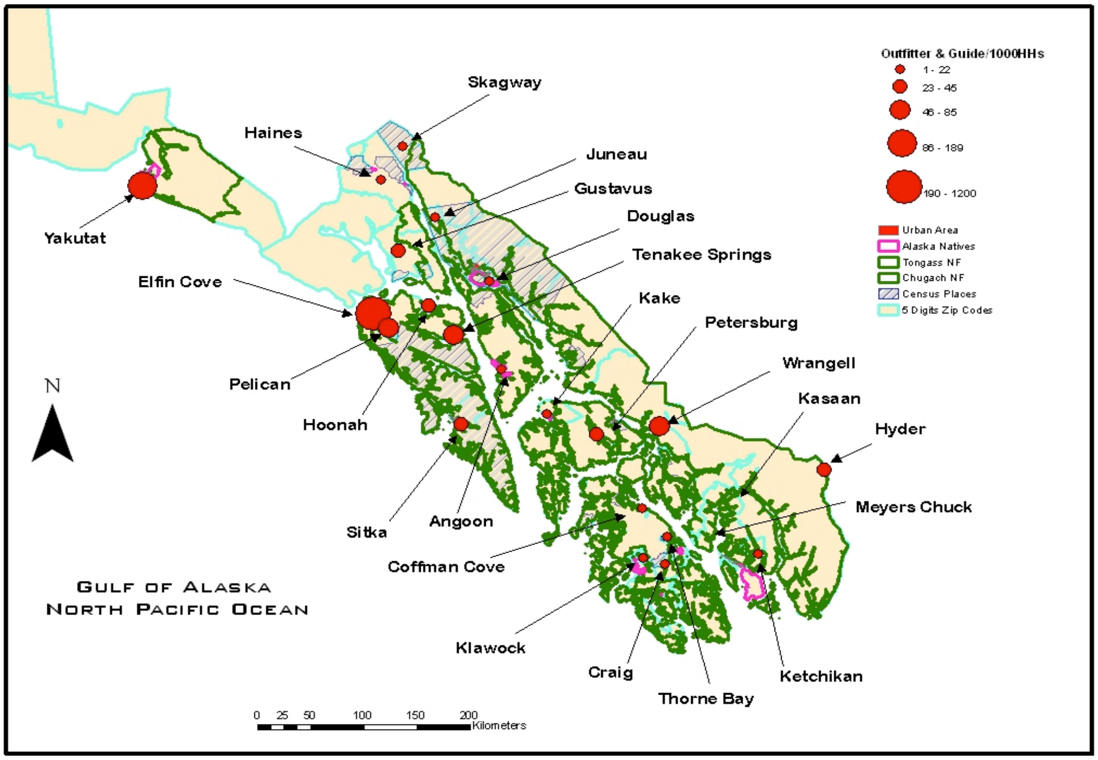

Figure 10. Tongass outfitter and guide permittees' community-of-residence, CY 2007.

hunting and is of special interest to Tongass managers given existing laws and mandates to ensure the continuity of subsistence lifestyles. As shown in Figure 11, Yakutat and Pelican were relatively high-use ANILCA-related communities. Both communities also have a high percent population of Alaska Natives, 47 and 26 percent, respectively. In this regard, these two communities warrant special consideration in subsistence-related forest planning and policy formulation. Other southeast Alaskan communities with high percentages of Native populations but with fewer ANILCA permits include Klawack (58%), Hoonah (69%), Kake (75%), Angoon (86%), and Kassan (49%).

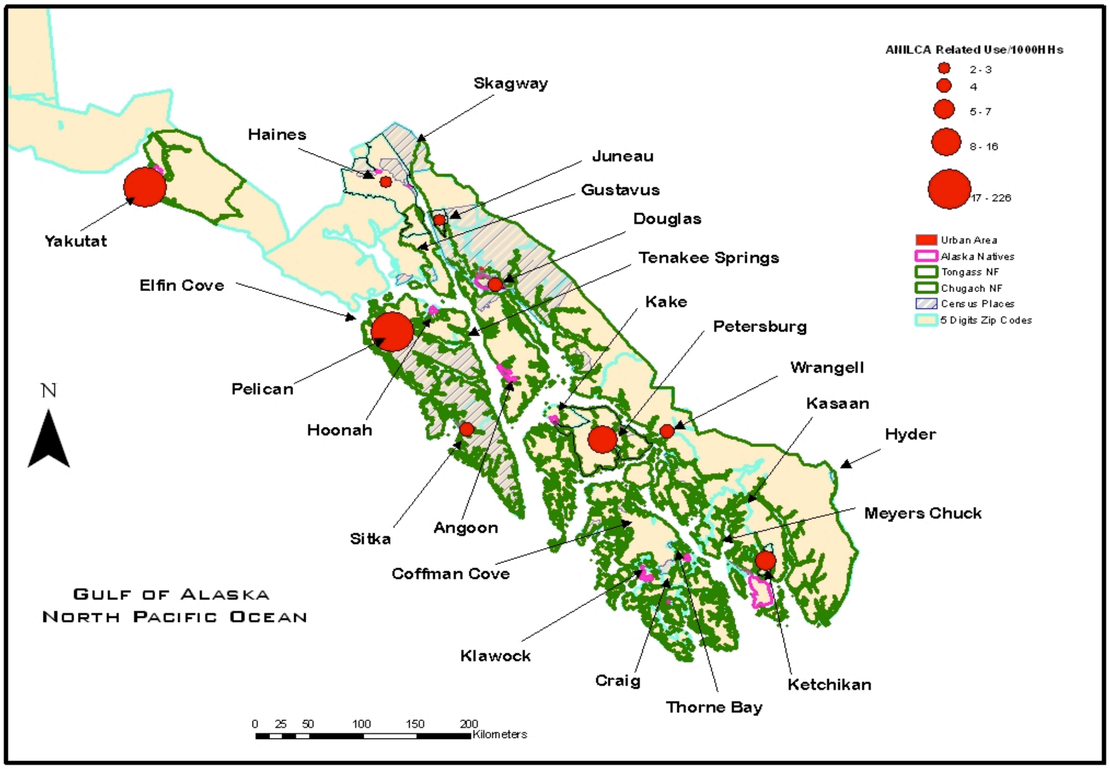

Figure 11. Tongass land occupancy and recreational use permittees by community-of-residence, CY 2007.

TIM Permits on the Tongass. ***National Forest.*** On the TNF, free use firewood permits expressed on a per-1,000 household basis were highest in communities such as Meyers Chuck, Tenakee Springs, Point Baker, Edna Bay, Thorne Bay, and Craig (Figure 12). Similarly, Petersburg had the largest number of free use sawlog permits on a per-1,000 household basis (Figure 12). Ketchikan was the only community that was issued personal use firewood permits, and Wrangell was the only community where commercial use permittees resided (Figure 13).

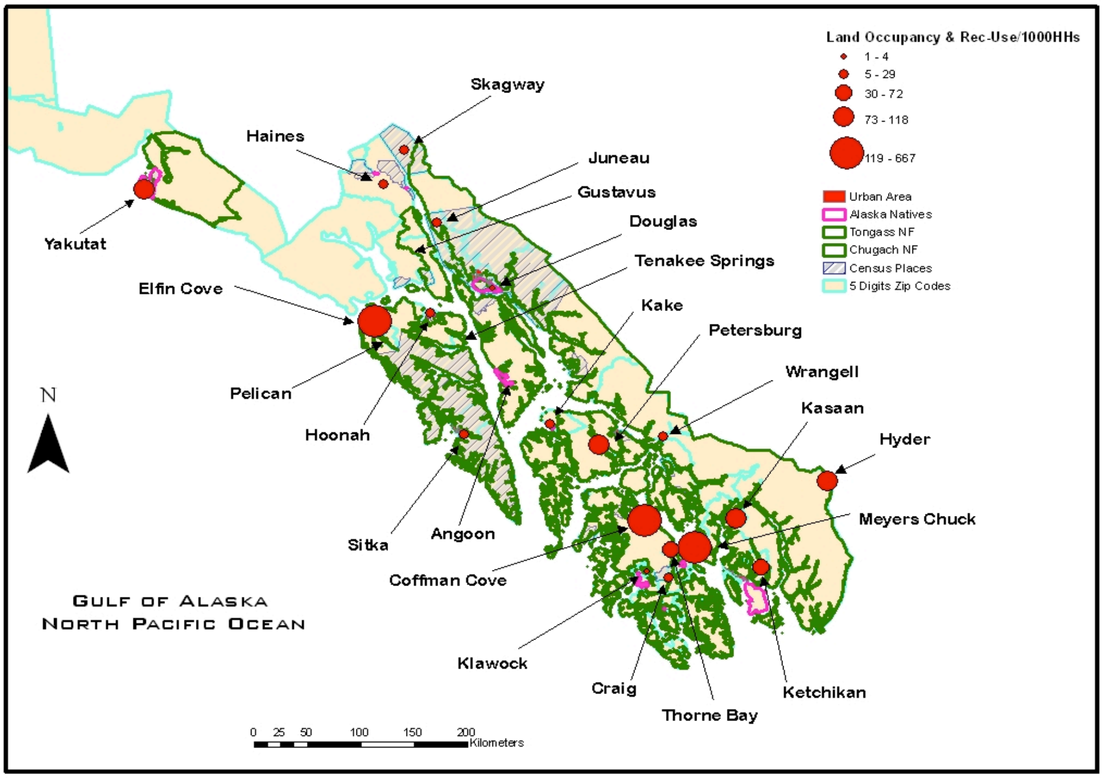

Figure 12. Tongass ANILCA use permittees' community-of-residence, CY 2007.

Wrangell and Ketchikan have a history of extractive forest use. In fact, these towns were the initial home of southeast Alaska's timber sector, where profitable mill operations began in 1956 (Alaska Forest Association 2009; McDowell Group 1998; Smith 1975; Halbrook et al. 2009). Though the pulp mill in Ketchikan permanently closed in 1997, the town continued to support several sawmills even after a shift in TNF management occurred in 1990. Currently, a few sawmills that utilize sawlogs are still open in Ketchikan, Wrangell, and Klawock. For instance, the Ketchikan veneer plant, which started working recently, is a good example that could sustain some of the local sawmills (Alaska Department of Commerce 2009).

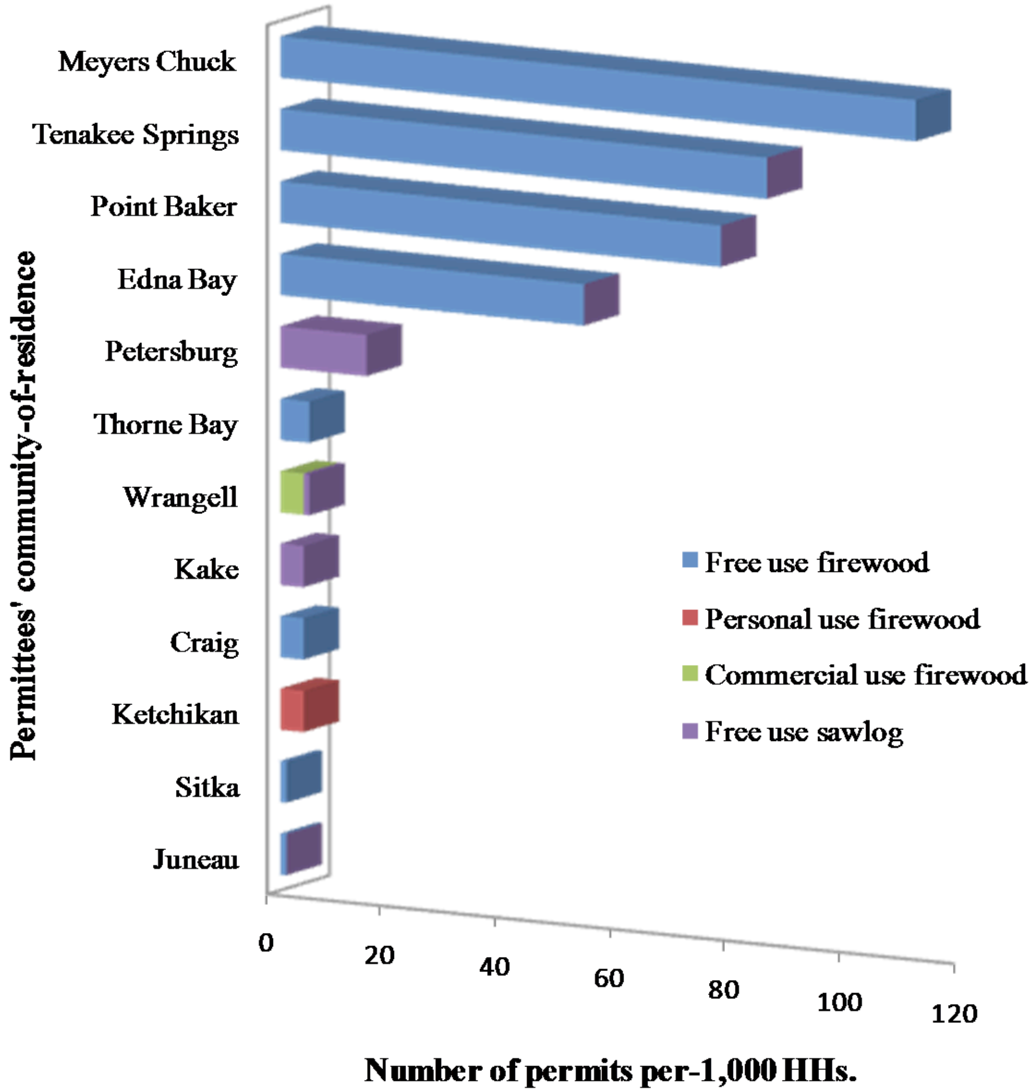

Figure 13. Tongass TIM permits active in CY 2007 by use type and community-of-residence (per-1,000 HHs).

Figure 14 shows community-of-residence for all TIM permittees in the vicinity of the Tongass National Forest. Permittee ratios (displayed by number of permittees per-1,000 households) are highest in Meyers Chuck, Tenakee Springs, Point Baker, and Edna Bay.

On the TNF, the majority of permits were issued for residents to collect free use firewood. Three communities—Meyers Chuck, Tenakee Springs, and Point Baker—had the highest permittee ratio (Figure 15). These communities are remotely located and do not have road access to larger cities, which may be one reason why they depend so heavily upon firewood permits as a heat source. These three communities have a

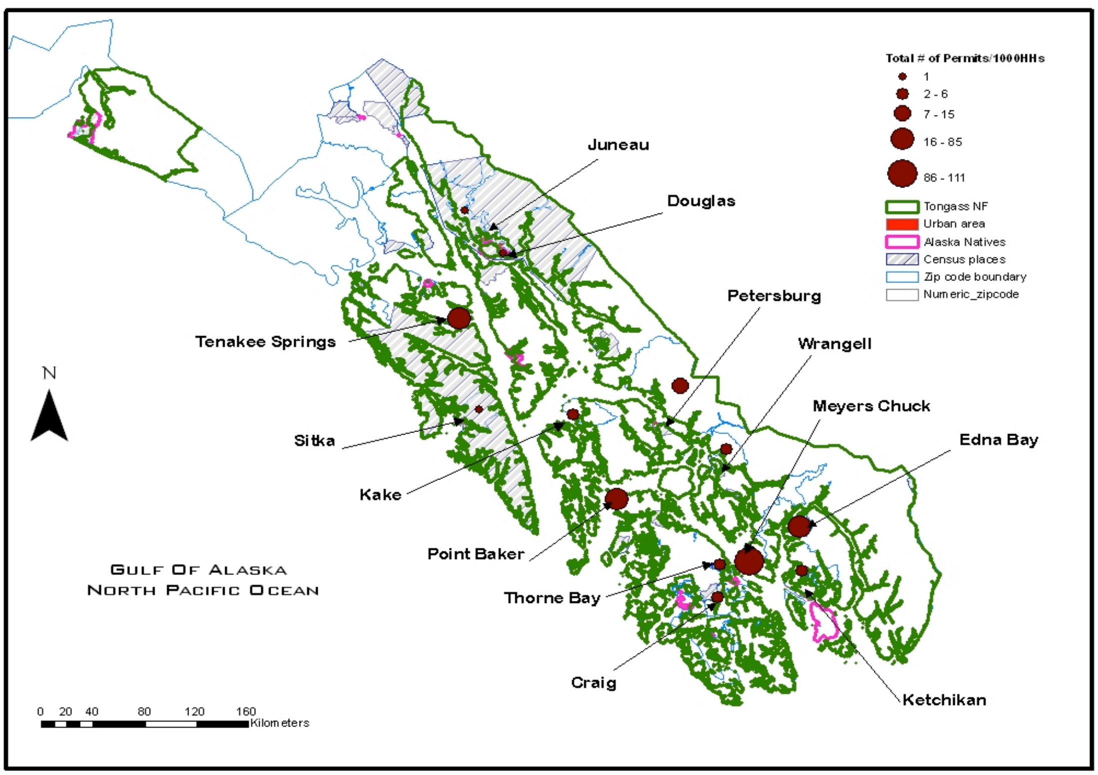

Figure 14. Tongass TIM permittees' community-of-residence, CY 2007.

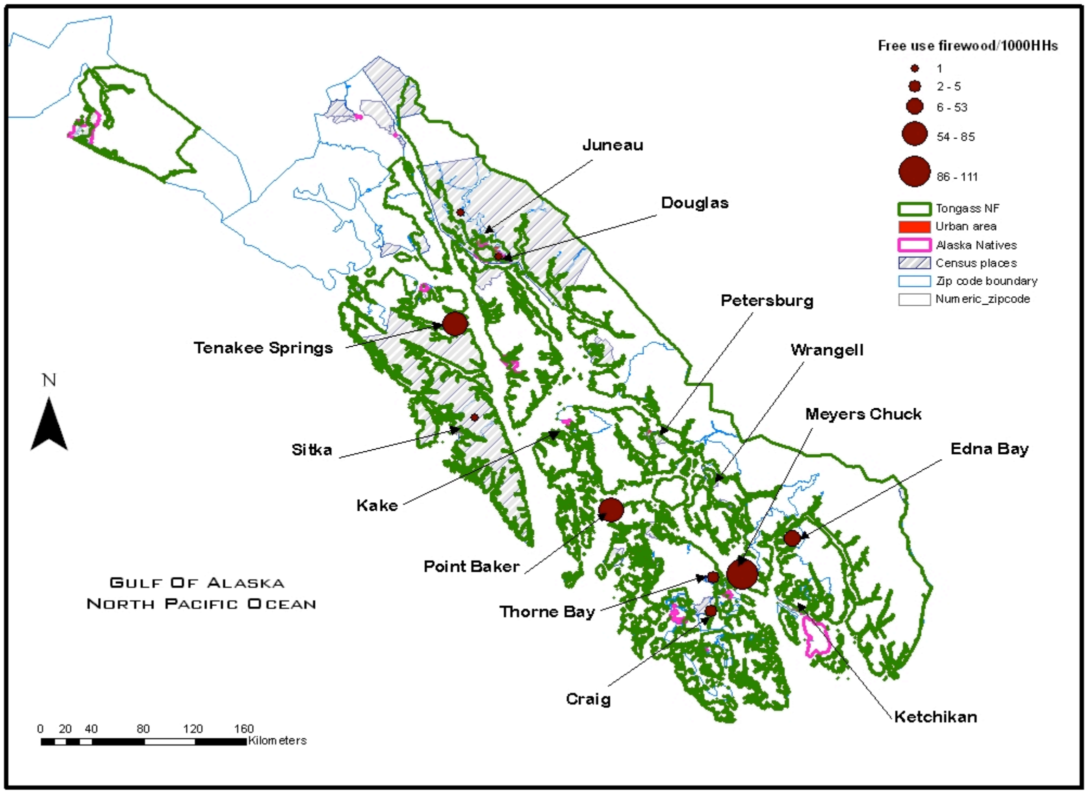

Figure 15. Tongass free use firewood permittees' by community-of-residence, CY 2007.

relatively low percentage of Alaska Natives and low unemployment (zero in all communities except Tenakee Springs, where there was 10%unemployment based on the 2000 U.S. Census).

This is probably an indication of a different situation in socioeconomic characteristics within the three communities, where people may be more likely to follow the rules and regulations that require obtaining a permit for free use firewood from the Forest Service, while residents in other communities may collect resources without a permit. There is in fact awareness among Forest Service staff that in many communities, people do collect firewood without permits (Miller 2008). And also, Alaska Natives are allowed to use other lands such as the Alaska Natives corporation lands, which give exclusive access rights to Alaska Natives, perhaps making non-Natives more dependent on NFS lands.

CNF Permits Issued to Permittees Residing in Study Area Communities

Overall, the largest numbers of special use permits for the CNF were obtained by residents of Anchorage-Girdwood, Cordova, Wasilla, Cooper Landing, and Homer, respectively (Figure 16). All these communities are in close proximity to that national forest, indicating that the majority of SUDS permittees are local. Of the total actual number of TIM permits, most were issued to permittees residing in the Seward and Anchorage-Girdwood communities (Figure 16). All of the TIM permit communities were located in the Kenai Peninsula Borough. This is perhaps an artifact of the data because firewood permits were collected only on the Seward Ranger District. The three Ranger Districts: Glacier Ranger District located in central Chugach, Cordova Ranger District located in eastern Chugach, and Seward Ranger District located in western Chugach, issue permits. Above all, Seward had the largest number of TIM permittees, followed by Anchorage-Girdwood, Moose Pass, and Copper Center. Palmer and Sterling also had sizable numbers of TIM permittees, while there were only a few from Eagle River-Chugiak (Figure 16).

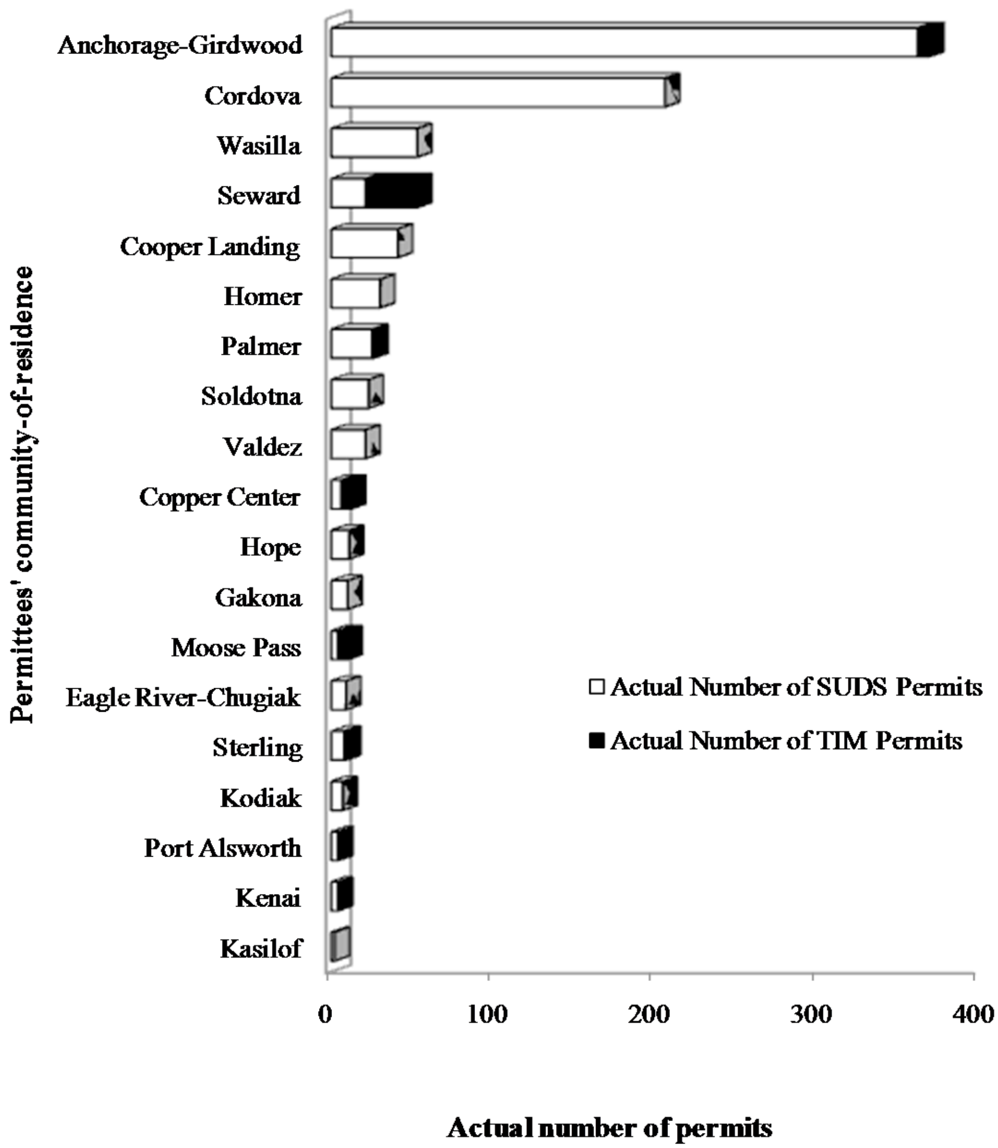

Figure 16. Actual number of SUDS and TIM permits active in CY 2007 held by permittees residing in CNF communities.

When examining both SUDS and TIM permit numbers per-1,000 households, the highest numbers of special use permits were issued to residents of Gakona, Cooper Landing, Cordova, Hope, and Port Alsworth, respectively (Figure 17). Similarly, Moose Pass, Cooper Landing, and Seward had the highest number of TIM permits per-1,000 households. This indicates that small communities, though they have fewer actual numbers of permits (i.e., mainly TIM permits), have relatively more people per-1,000 households that use forest resources compared to places that have larger numbers of permittees and population. This is probably due to the fact that these smaller communities have less access to alternative heat and energy sources.

Assessing TIM use levels per-1,000 households, communities like Moose Pass, Seward, and Cooper Landing tend to request more permits—which also may reflect high firewood use.

Types of Permit Use by CNF Communities Per-1,000 Households

SUDS Permits in the CNF. On the CNF, there was also variation in SUDS use patterns between communities. On a per-1,000 household basis, Cooper Landing has the largest number of outfitter and guide and land occupancy and recreation use permits, while Hope, Gakona, and Port Alsworth also have relatively high numbers of outfitter and guide permits. Moreover, Anchorage-Girdwood, Cordova, and Homer have more than one permit type, indicating more diverse resource use linkages than other communities. However, the proportions of

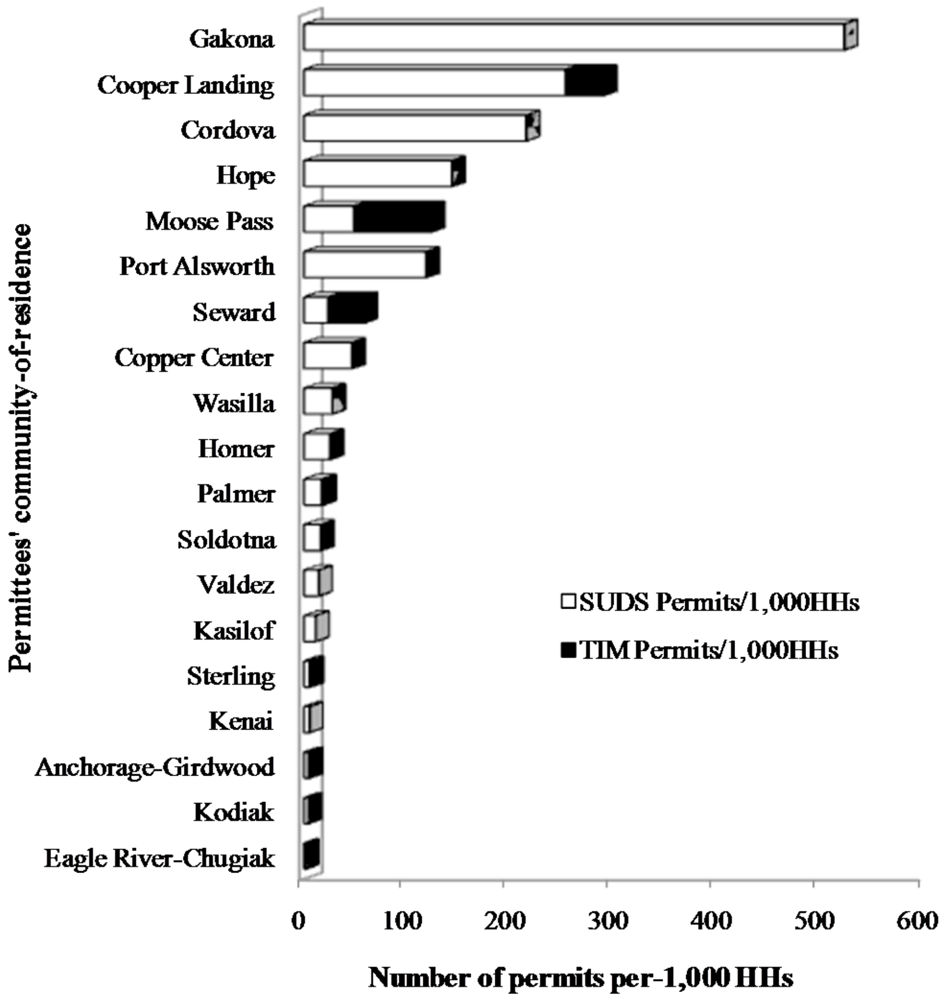

Figure 17. SUDS and TIM permits per-1,000 HHs active in CY 2007 held by permittees residing in CNF communities.

use permits vary from one community to another. For instance, in Cooper Landing there were more outfitter and guide permits per-1,000 households than land occupancy and other recreational use permits. On the other hand, in Anchorage-Girdwood, there were almost an equal proportion of the various SUDS permits expressed on a per-1,000 household basis (Table 17). In Cordova, I found that there were more isolated cabin permits as compared to land occupancy and recreational use and outfitter and guide permits. In Anchorage-Girdwood, Homer, Seward, Soldotna, and Wasilla, there were also few land occupancy and recreational use and outfitter and guide permits expressed on a per-1,000 household basis. Cordova and Homer were the only communities that had research and educational use permits. In the rest of the communities there were fewer numbers and types of permits per-1,000 households (Table 17).

Overall, these findings demonstrate that some communities are differentially linked to the CNF, with many linked by more than one use type. This is an important finding for CNF management because such information can aid policymakers in estimating the extent of communities' use linkages to forest resources for the various types of permitted activities.

A series of maps below shows the residence locations of the holders of the most common SUDS permits from the Chugach National Forest. Figure 17 displays place origins of outfitter and guide permittees in communities surrounding the CNF. As shown on the map, there were large numbers of permits per-1,000 households in Cooper Landing and Hope, followed by Gakona, Port Alsworth, Copper Center, and Moose Pass, respectively.

Figure 17 also shows that the largest numbers of land occupancy and recreational use permits per-1,000 households were in Cooper Landing and Cordova, followed by Seward and Homer. Note that Girdwood is described as part of Anchorage-

Table 17. Chugach SUDS permits active in 2007 by use type and community-of-residence.

Community	Number of Households	Actual number of land occupancy & recreational uses	Land occupancy & recreational uses/1,000HHs	Actual number of outfitter & guide	Outfitter & guide/1000 HHs	Actual number of isolated cabin	Isolated cabin/1000 HHs	Actual number of ANILCA-related uses	ANILCA Uses/1000 HHs	Actual number of research activities	Research activities/ 1000HHs	Actual number of FLPMA uses	FLPMA/ 1,000HHs
Anchorage_Girdwood	94,822	172	2	148	2	21	0	16	0	0	0	5	0
Cooper Landing	162	11	30	30	81	0	0	0	0	0	0	0	0
Copper Center	132	0	0	6	17	0	0	0	0	0	0	0	0
Cordova	958	40	16	30	12	122	50	4	2	9	4	1	0
Eagle River-Chugiak	9,876	1	0	4	0	0	0	4	0	0	0	0	0
Gakona	84	0	0	10	47	0	0	0	0	0	0	0	0
Homer	1,599	11	3	2	1	0	0	4	1	13	3	0	0
Hope	77	0	0	11	80	0	0	0	0	0	0	0	0
Kasilof	180	0	0	2	4	0	0	0	0	0	0	0	0
Kenai	2,622	4	1	0	0	0	0	0	0	0	0	0	0
Kodiak	1,996	0	0	0	0	0	0	0	0	0	0	7	1
Moose Pass	84	0	0	4	19	0	0	0	0	0	0	0	0
Palmer	1,472	0	0	21	5	0	0	4	1	0	0	0	0
Port Alsworth	34	0	0	4	38	0	0	0	0	0	0	0	0
Seward	917	14	5	7	2	0	0	0	0	0	0	0	0
Soldotna	1,465	7	2	16	4	0	0	0	0	0	0	0	0
Sterling	1,676	0	0	8	2	0	0	0	0	0	0	0	0
Valdez	1,494	0	0	21	5	0	0	0	0	0	0	0	0
Wasilla	1,979	10	2	32	6	4	1	7	1	0	0	0	0
Total	**121,629**	**270**		**356**		**147**		**39**		**22**		**13**	

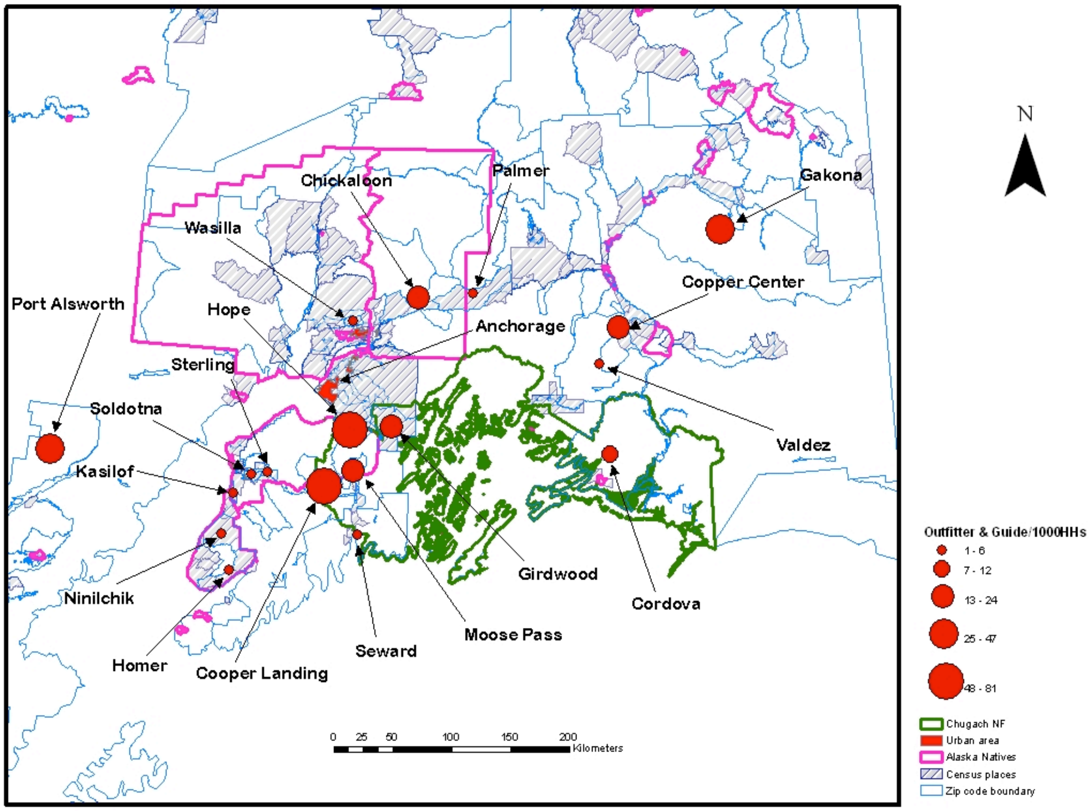

Figure 18. CNF outfitter and guide permittees' community-of-residence, CY 2007.

Girdwood in the permit use summary table (see Table 17). I used the name separately here only for the purpose of visual displaying.

TIM Permits on the CNF. Although there were not many ANILCA use permittees on the CNF, the data indicate that two communities, Girdwood, located within the Anchorage-Girdwood periphery, and Cordova, are the places of origin for the majority of the ANILCA permittees (Figure19).

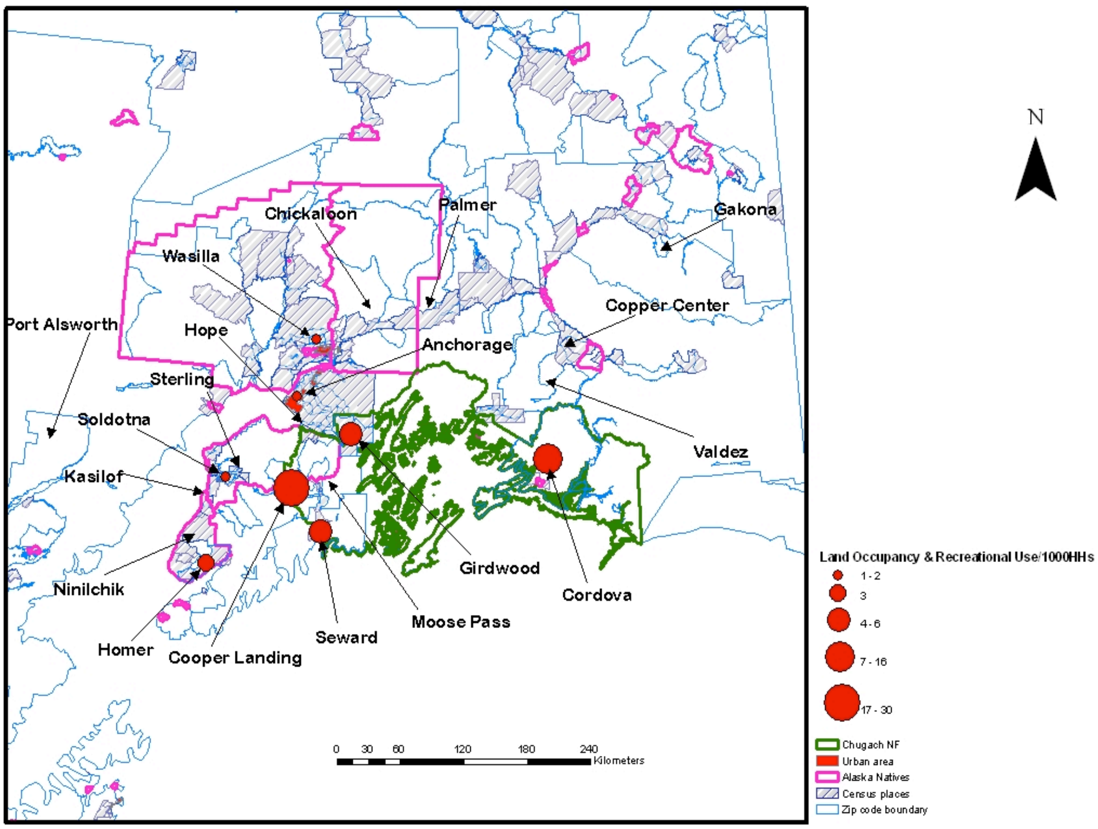

Figure 19. CNF land occupancy and recreational use permittees' community-of-residence, CY 2007.

Overall, there were fewer numbers of TIM permittees on the CNF compared to the TNF. The majority of permittees were from Moose Pass, Cooper Landing, Seward, and Girdwood (Figures 20 and 21). The fewer number of TIM permits on the CNF reconfirms that the CNF is managed primarily for recreation rather than timber harvesting.

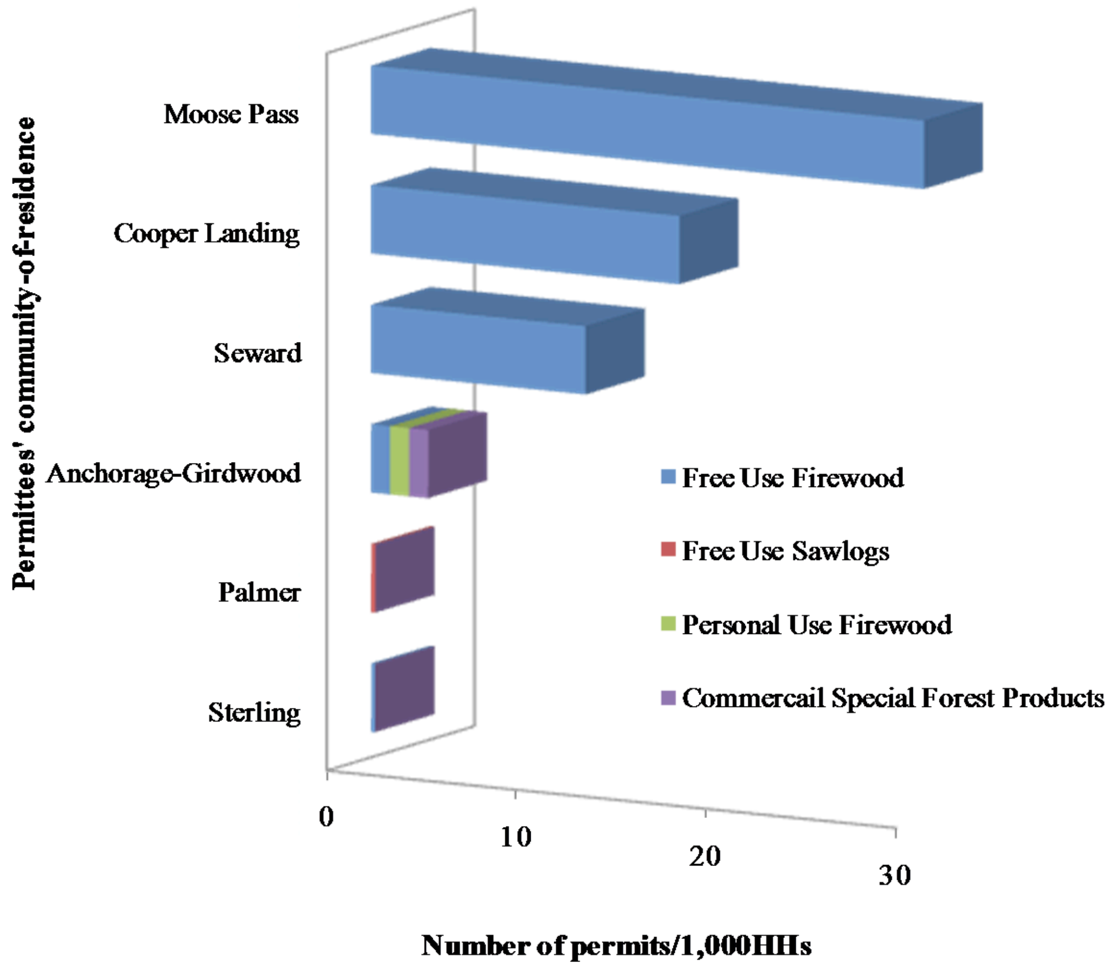

Figure 20. ANILCA use permittees' community-of-residence, CY 2007.

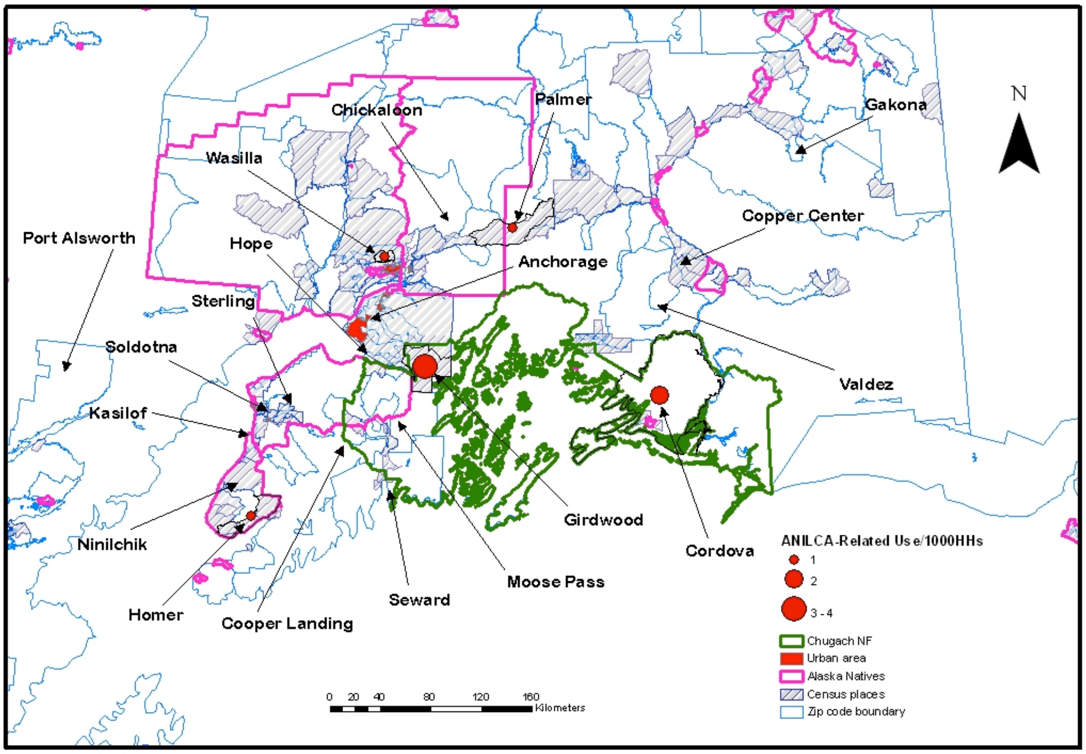

Figure 21. Chugach TIM permits active in CY 2007 by use type and community-of-residence (per-1,000 households).

Figure 22 displays free use firewood permittees' place-of-residence. More than 95% of TIM permittees in the CNF are free use firewood permittees. Large numbers of free use firewood permits per-1,000 households occur in Moose Pass and Cooper Landing communities (Figure 22).

Permit Usage on the Tongass National Forest

This analysis, though a snapshot of time, demonstrates that on the Tongass National Forest, there were relatively low numbers of permittees for timber wood

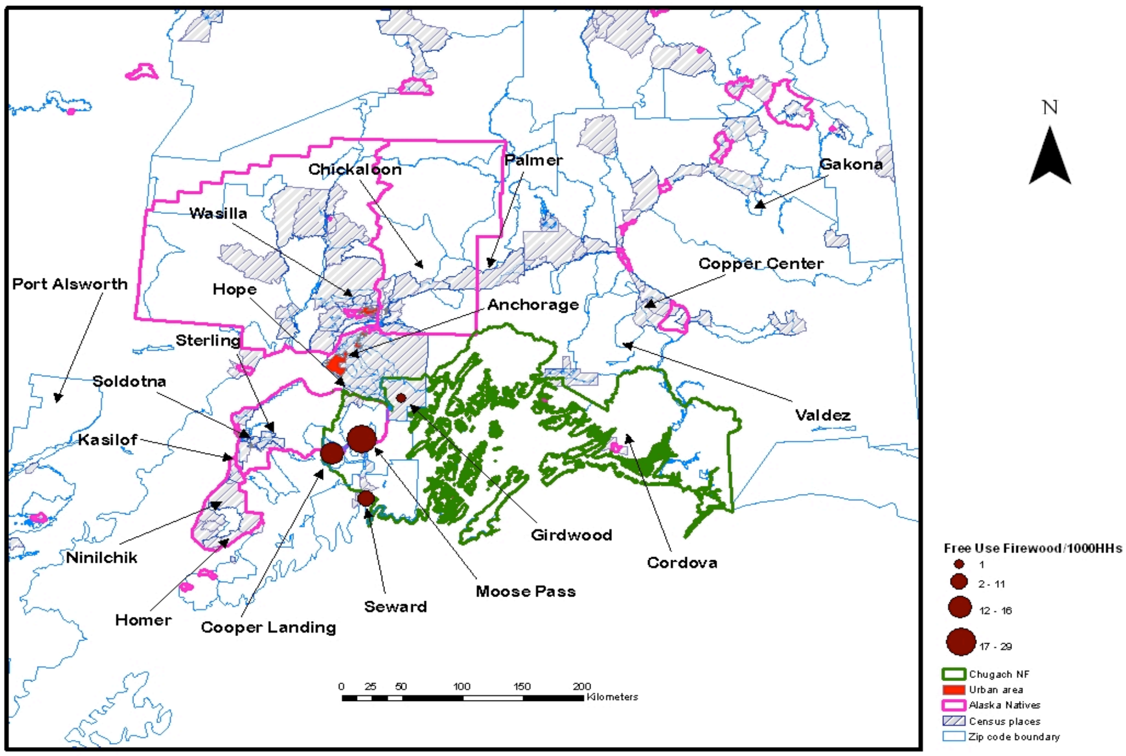

Figure 22. CNF free use firewood permits per-1,000 HHs by community-of-residence, CY 2007.

harvesting. This finding is in agreement with most of the literature and the Tongass plan revision document that reflects the shift of the TNF management approach from timber-oriented to an amenities-based economy. There are a few small sawmills like the ones in Ketchikan, Wrangell, and Klawock that still support local commercial timber harvesting (Alaska Department of Commerce 2009). However, the numbers are small and there were no commercial sawlog permits active in 2007. This was not a surprising result because most sawmills and logging sites in southeast Alaska were closed over the last 15 years due to high production costs and reduced harvest levels as USFS management transitioned from a timber-based to more recreation-oriented focus (Clausen and Schroeder 2004; Crone 2004; Tsournos and Haynes 2004; Braden et al. 2000). In fact, after the adoption of the 1997 TNF management plan, timber sales became a by-product of ecosystem management (USFS 2006). In general, the decrease in TIM permits indicates that the Tongass no longer serves as a primary timber forest.

There were more non-extractive forest uses on the TNF in 2007 than expected. Land occupancy for both commercial and noncommercial use activities is by far the largest permit-based resource use (Table 16). In contrast, there were fewer permittees directly extracting forest products, mainly firewood and sawlogs (Figure 22). More permits were issued to harvest firewood than timber. This is a consistent indicator of the change in Tongass NF management.

The majority of SUDS permittees resided in Juneau, Ketchikan, Petersburg, Sitka, Wrangell, and Yakutat (Figure 8). Juneau and Sitka are relatively larger in population and economic diversity (Table 7). According to the U.S. Census, communities are considered large/urbanized if they have a population of 2,500 or more. Nonetheless, though these two communities had a larger number of SUDS permittees, it does not necessarily indicate the relative importance of those permits to the community as a whole. This is because the standardized number of permits was found to be higher in communities with smaller populations. That is, the ratio of permits per-1,000 households is much higher in many small communities. Using permits per-1,000 households as a metric identified communities such as Elfin Cove, Meyers Chuck, Coffman Cove, and Yakutat as more dependent on the TNF—at least for the particular resources represented by the USFS permit system (Figure 8). These communities also have smaller populations and less-diverse economies (Table 7). Thus, these data can serve as indicators for identifying communities with strong linkages to forest resources.

Most TIM permittees came from Juneau and Ketchikan (Figure 13). Again, these are larger communities where the actual numbers of permits are larger, but may not indicate the relative level of linkages to the forest. Therefore, I used standardized numbers of permits to determine the relative level of use linkages in all communities where permittees originated and ranked them from high to low (Figure 10). Based on this approach, the following four communities are identified as important to be considered by forest management: Meyers Chuck, Tenakee Springs, Point Baker, and Edna Bay (Figure 8). Common characteristics of these communities include: (1) relatively small population sizes; (2) large percentages of Alaska Natives; (3) remote locations; (4) farther from major airport/ferry/float plane service; and (5) compared to Juneau and Ketchikan, they have higher employment in service and natural resource-related sectors. All these socioeconomic attributes positively correlate with strong resource-use linkages.

The small number of TIM permittees in 2007 (n= 56) is probably due to global market competition and high operating costs in Alaska. Since the shift in forest management policy, the 1997 TNF management plan made four main regulatory changes regarding timber harvests: (1) a change enacted in 1999 to remove 100,000 acres from the harvestable timber base, reducing it from 676,000 to 576,000 acres; (2) the allowable harvest rotation age was doubled to 200 years, making it harder to develop a forest products sector based on second-growth timber; (3) allowable road density in the forest was reduced from 1 mile to 0.7 miles per square mile of forested land, compounding access issues already inherent in the forest; (4) average allowable sale quantity (ASQ) was reduced from 267 MMBF to 187 MMBF, limiting the annual production of the forest. These regulatory changes in the forest plan have been mentioned as the main reasons for the large reduction in volume of timber available for harvest. These measures changed forest management from direct (extractive) use to more indirect (amenities based) uses (Clausen and Schroeder 2004). The 2007 year SUDS and TIM permit data may reflect this change in forest management policy on the TNF.

Permit Usage on the Chugach National Forest

The findings for the CNF indicate that there were more permittees for land occupation and recreational uses than timber harvesting or other forest products extractions. Commercial outdoor recreation—particularly outfitter and guide permits—were by far the largest recreational activities. Other recreational and noncommercial activities include cabin and campground permits. These findings for the CNF were expected because management emphasizes recreation more than timber and other forest products uses.

The majority of SUDS permittees resided in communities like Anchorage-Girdwood and Wasilla, a suburb of Anchorage (Figure 17). These communities have relatively large populations and diverse economies. As discussed above, having large numbers of permits alone does not necessarily indicate a strong linkage to the forest. Therefore, using the permits-to-1,000 households ratio, communities such as Gakona, Cooper Landing, Cordova, Hope, Port Alsworth, and Girdwood were identified as communities having strong linkages to the CNF (Figure 16).

There were many actual TIM permittees from Seward, Anchorage-Girdwood, Moose Pass, and Copper Center, respectively (Figure 15). Overall, land occupancy and recreational use and outfitter and guide permits are the largest use categories on the CNF, a similar finding with that of the TNF (Figure 17). Also, on the CNF, actual numbers cannot be used to determine relative importance of use linkages and to compare each community accordingly. Therefore, using a standardized metric (i.e., permits per-1,000 households), the following communities were identified as having the most use linkages: Moose Pass, Seward, Cooper Landing, and Girdwood, respectively (Figure 19). All these communities had more TIM permittees per-1,000 households as compared to the rest of the communities. The majority of these TIM permit holders had permits for free use firewood, an indication of a strong direct resource-use linkage to the CNF. However, there were fewer TIM permittees in the CNF compared to the TNF (Figure 20). Overall, in both forests, free use firewood permits represent more than 90% of the TIM permits. This is a strong indicator of local communities' linkages to both Forests.

Visual Depiction of Permittees' Community-of-Residence

One of the objectives of this study was to visually display community-resource linkages based on SUDS and TIM permit data. Visually displaying use linkages is important for resource managers because it clearly illustrates which communities have ties to the forest, as well as the nature of those ties. In general, maps can be used as a tool for planning to manage resources and to determine potential impacts of policy changes. In this regard, a series of maps that show the different permitted use activities on both forests is presented. However, only the most important use types are presented as a model to demonstrate the use of community maps by visually displaying the location of each community and its relative dependence upon each forest for particular uses.

Permit Data Limitations

The Issue of Scale

Scale is an important factor in defining community resource use linkages and dependency (Beckley 1998; Morse et al. 2009a, b). Scale also determines the type and availability of data. Therefore, identifying the appropriate scale is critical in studying resource-dependent communities. However, in the past, this has not been an easy task for researchers who conducted research on resource dependent communities. In this study, the issue of scale was also a main concern. In order to address this issue, identifying appropriate data sources was critical and formed the core of this study. Examining USFS permit data in order to be able to conduct community-level analysis on forest dependent communities was facilitated by the Forest Service's SUDS and TIM permit data, which is collected by zip code. Zip codes often correlate well with place, with 80% of the information collected by zip code falling within a given place boundary (Kirschner, personal communication, 2008).

However, using zip codes still has some shortcomings, particularly in Alaska. In Alaska, the geographic spatial coverage of some zip codes are sometimes bigger than the size of a borough, an equivalent of a county in the lower 48 states, and in such situations a single zip code can comprise more than one small community, each with very small populations. In other places—usually in urban areas like Juneau and Anchorage-Girdwood—zip code coverage is oftentimes very small, with a larger population in each zip code. In such situations, various zip code boundaries fall within the boundary of a single place or community. This unique attribute of Alaska, having unusual geographic and administrative structures makes place-level analysis somewhat difficult. To overcome such problems, I paid close attention to the relationship between each zip code and community. I used my subjective visual judgment to either include or exclude a zip code in a given place. For instance, if more than 50% of a zip code boundary fell within a boundary of a given place, I considered it as part of that place.

The Ecological Fallacy Issue

The issue of ecological fallacy is another key limiting factor to using zip code permit data with place-level Census data that might lead to biased conclusions about a community. This is because permit information is collected from individuals who came to purchase permits, whereas the demographic and socioeconomic information used in the analysis were collected from place-level Census data. This study acknowledges the limitation of using such an approach and existence of some level of bias in the description of community characteristics. This is due to the reason that proxy (place-level) social data were used—not collected directly from the permit holders.

Data Issues

The permit data used in this analysis is a one-year snapshot of peoples' activities on the TNF and CNF. This may not give the whole picture of community resource linkages, since I have no complete information for previous or more recent years. My results, therefore, represent one full year's (2007) activity only. Even for the 2007 year, there were some unrecorded data points because of permit paperwork shortcomings. I acknowledge that using time series data would have been a better approach had there been access to a complete data set for other years so that I could conduct a trend analysis. However, that was not possible due to missing information and the incompleteness of the data for earlier years.

In general, both SUDS and TIM permit data are incomplete, particularly with regard to information about peoples' activities on the forests (see Appendix D). From my interviews with Forest Service employees, I learned that there may be some local residents who use forest resources without acquiring permits. This in turn can affect forest management activities as such unrecorded activities are not considered in forest planning. It seems like both the Tongass and Chugach National Forests lack adequate resources to monitor and control undocumented forest users. Hence, my analysis misses information on the activities of such user groups, which by necessity must temper my conclusions and recommendations.

Furthermore, for some permittees, information like place-of-origin was not recorded correctly. Permittees with incorrect addresses were excluded from the analysis. In other cases, some SUDS permit holders may reside out of the state of Alaska although they have local in-state business addresses. In those situations, my analysis might have overestimated community-use linkages because those permittees may not represent local communities.

Generally, the TIM and SUDS databases have limitations for USFS-wide application. There is variation between regions in terms of the use of SUDS and TIM. Even though every region receives the same directive from the USFS's Washington Office, each region operates differently, a weakness of the data entering and management process. Fully utilizing the potential of SUDS and TIM requires a fairly high level of skill and training—a challenge for many Ranger Districts. For example, when it comes to forest products such as timber and firewood, the unit of measure can vary for some species of trees, making law enforcement difficult. With less monitoring, residents can use resources without acquiring a permit. This is particularly germane for special forest products such as mushrooms, burls, barks, cones, etcetera, given their ease of harvest, especially when compared to the skills and equipment needed to harvest timber. This type of harvest is less noticeable than timber and firewood harvesting. Moreover, biological data has not been collected to determine appropriate and sustainable levels of harvest of special forest products. A product plan, an annual document, is used to determine harvest volumes for timber products and areas where permit holders can harvest, but lack of adequate staff limits monitoring activities (Miller 2008).

Overall, many of the shortcomings of permit data originate from the lack of adequate staff at the Ranger District level. Employee turnover is high, and hence, new staffers are always learning. Differences in reporting systems also cause problems due to the lack of standardized systems. There are organizational problems with both databases. A study by Oschell and Nickerson (2008) reported similar problems in their need assessment study on outfitter and guide permits for Region One.

Finally, the incompleteness of permit data has large implications for this study. However, effort has been made to narrow the gap between the data and the actual ground situation through data validation processes (e.g., interviews and literature references), but it may still not be adequate since it did not include primary data as part of the analysis. As a result, the conclusions and recommendation made might not be strong enough in justifying the use of permit data for studying community resource use linkages, at least at its current status. However, this does not mean that the potential is not there. In fact, the contribution of this study at the end of the day is its ability of showing the potential uses of both the SUDS and TIM data so that the USFS can give renewed attention to data for effective forest management (see Chapter VII for detailed recommendations).

CHAPTER VI

MEASURING COMMUNITY RESOURCE USE, DEPENDENCY, AND VULNERABILITY IN SOUTHEAST AND SOUTHCENTRAL ALASKA

This chapter discusses the findings from the analyses conducted to estimate community resource use, dependency, and vulnerability surrounding the Tongass and Chugach National Forests. Detailed description of community permit usage on both forests, and the links between community permit usage, dependency, and vulnerability, is demonstrated using tables and figures.

Background

Measuring communities' resource use level, economic dependency, and vulnerability to forest policy changes is fundamental for the development of comprehensive forest management approaches and for helping communities adapt to change. Past literature on resource dependent communities noted that changes in forest policies affected the economic well-being of many rural communities dependent on forest resources—both in the U.S. and Canada (Ross 1999; Harris et al. 2000; Russell and Harris 2001; Berck et al. 2003; Leake et al. 2006; Charnley et al. 2008).

For the last two decades in southeast and southcentral Alaska, there has been increasing environmental awareness and support from the environmental movement to protect the old-growth forest ecosystems on federally-managed lands. These concerns have been key factors in the decline of timber harvesting in both regions, and have been exacerbated by declining demand for Alaska timber in global markets, high operations costs within the state, and the removal of federal subsidies (Warren 2009; Allen et al. 1998). The result has been a major paradigm shift—a change in forest management policies from resource extraction to a more amenity-based form of management. This policy shift has affected many resource-based communities, especially those dependent upon wood processors such as sawmills, most of which have ceased operation.

As discussed in Chapter III, a majority of rural communities in southeast and southcentral Alaska are small and isolated. Due to this fact, many are dependent upon natural resources (e.g., forests, water, fisheries, hunting and mining) for their subsistence and overall socioeconomic well-being. However, despite their dependence on forest resources, most rural communities and other residents do not control or own nearby forests. Various public sector interests, including federal agencies (e.g., the U.S. Forest Service, the U.S. National Park Service, and the U.S. Fish and Wildlife), and the state and Alaska Native Corporations, largely own and manage these lands and their resources (see Chapter III for detail).

In our study area, the largest public land parcels, the Tongass and Chugach National Forests (TNF and CNF), respectively, are administered by the USFS. By law, the USFS requires permits for many of the uses and activities on National Forests. This demonstrates that the National Forests are not free access lands despite being publicly owned. Hence, it is important to understand how resource use is regulated, who uses the lands and resources most, and what types and amount of resources are used by the residents of rural communities. These questions were addressed in Chapter V.

In this chapter, the USFS's permit data and socioeconomic information from the 2000 U.S. Census are used to go beyond communities' resource use characteristics to identify those communities highly dependent on forest resources, and also potentially vulnerable to current and future forest policy changes, as well as competition from nonlocal users. In doing so, I first examine the socioeconomic characteristics of communities bordering the Tongass and Chugach National Forests to determine their dependency on forest resources using a standard measure of dependency, recognizing that the definition of forest dependency in the social science literature varies greatly (see Chapter II for a review of relevant literature).

For the purpose of this study, forest dependency is defined based on a community's employment in jobs related to forest resources (Elo and Beale 1985; Stedman et al. 2007; Drielsma 1984). Unfortunately, in the Census data all natural resources-related jobs are aggregated (e.g., forestry, fishing, hunting, mining, and farming), making it impossible to discern employment data for forestry-related sectors only. As a result, an expanded conceptual definition of resource dependency was adopted based on the percentage of total communities' employment in natural resources-related sectors. As a break-point, a minimum threshold of 20% was set for each community's employment that must come from forest-related sectors for a community to be classified as "forest dependent." The 20% threshold was used based on a review of the literature (see Elo and Beale 1985). The analysis also uses forest permit data to test and validate its potential for measuring resource dependency. Communities identified by permit data were compared to communities identified by the Census-based method described above (i.e., percent employment in natural resources) (Stedman et al. 2007; Jackson et al. 2004; Mazza 2004; Nord 1994).

To measure a community's potential vulnerability to forest policy changes, socio-demographic and economic data are used (see Chapter IV for a description of variables). Vulnerability is defined by focusing on the concept of community capacity. The link between the concept of community capacity and vulnerability has been widely studied in the literature. Measuring community capacity generally refers to the examination of both economic and non-economic attributes of a community that affect its resiliency when facing adverse impacts that may affect the socioeconomic well-being of a community. For a conceptual definition of the term vulnerability and its contextual application in the analysis, see Chapter II.

Measuring resource dependency and vulnerability at the community level is difficult compared to regional, national, and global-level analyses. This is because many rural communities—particularly in rural Alaska—are less integrated into broader political and administrative structures than urban communities. As a result, disaggregated socioeconomic data are not available at the community level and, as a result, a lack of data is a major limiting factor in conducting community-level analyses.

As a result, most community-related studies use proxy data or primary data collected by researchers. For instance, if one looks at past and current social science literature on vulnerability, a majority of studies focus on the national or global-level impacts of climate change (see Adger et al. 2004; Kelly and Adger 2000; Ribot 1996; Downing 1991). Only a few studies (e.g., Charnley et al. 2008; Parkins and MacKendrick

2007; Russell and Harris 2001; Harris et al. 2000; Kusel 2001; Beckley et al. 2002) examined forest dependency and vulnerability at the community level. The main reason for this is the lack of measurable data for community-level analysis.

This study focuses on the potential impacts of forest policy changes on rural communities in Alaska and evaluates their potential resilience capacity. A list of key variables was identified by reviewing the literature and evaluating place-level data sets that are readily quantified (see Tables 11 and 12 in Chapter IV). These key variables were then used in the analysis for developing indices to identify resource-dependent communities potentially vulnerable to forest policy changes.

Tongass and Chugach Area Community Forest Resource Use and Dependency

This section discusses community resource use and dependency on the Tongass and Chugach National Forests using information from a detailed analysis of communities' socioeconomic characteristics. There is little consensus in the literature about the best way to develop measures of community dependency (which is discussed in this section) and/or vulnerability—(discussed in subsequent sections). In this study, two approaches—a typology and ranking approach—were used, and the results were compared. The community typology and community ranking approaches discussed in Chapter 4 are used here to determine each community's permit usage and degree of dependency on employment in the natural resource-related sectors.

Since the purpose of this study is developing a new approach, it was felt that using two different approaches and comparing the results would help to estimate the robustness of the methodology and to provide different ways for planners and managers to consider permit data. The community ranking approach, however, is used for validation of the typology analysis—a primary analytical approach of this study. The two methods generally produced similar results, although some communities were ranked differently (see specific differences in Appendix D and Appendix E). As a result, a more detailed discussion focuses on the typology approach than the ranking approach.

Moreover, before adopting the typology and ranking approaches, the Spearman's Rank Order Correlation, described in Chapter IV, was run to determine association between the Tongass' 22 communities' permit use level and the key socioeconomic variables identified as explanatory variables based on the literature review (see Appendix D). A similar analysis was also executed to determine association between the Chugach's 16 communities' permit use level and the same socioeconomic variables (see Appendix E).

Tongass Area Community Forest Resource Use and Economic Dependency

Measuring forest resource use was achieved by using U.S. Forest Service's permit data. The term "resource use" in this context refers to not only market-based economic uses, but also the ways rural Alaskans rely on natural resources, including forest resources, for sustaining livelihoods with non-market benefits and goods. In non-market based resource use and dependency, subsistence uses of forest resources (e.g., wildlife, fishing, nontimber products, firewood, etc.), and recreational or non-extractive uses of the forest prevail and are generally located outside established markets.

In contrast, measuring economic dependency is achieved by using key socioeconomic indicators (e.g., employment and income) from place-level U.S. Census data. However, as discussed in Chapter IV, income data were not readily available, and hence, only a community's employment reliance on the natural resource-related jobs is used. As a result, I used the term "employment dependency" throughout the text to denote "economic dependency." Other types of dependency (e.g., sociocultural dependency) are not covered here due to a lack of data. However, this study recognizes the importance of this aspect of natural resources dependency, especially in Alaska, where natural resources contribute to traditional community culture, values, and identity. Therefore, within these contexts, the relationship between the key socioeconomic variables and degree of resource use was examined using Spearman's Rank Order Correlation analysis. The same definitions and approaches were also applied to Chugach area communities.

The top portion of Table 18 shows Spearman's Rank Order Correlation analyses for the Tongass area. There is a relatively strong and negative relationship between community permit usage and population size, although this was not statistically significant (r_s = -0.340, p = 0.1210) (Table 18). Similar findings were identified for population below poverty line, (r_s = -0.221, p = 0.3210), and community employment diversity index (r_s = -0.309, p = 0.1620).

Table 18. TNF Spearman's Rank Order Correlation between dependent variables (communities' permit use and employment dependency) and selected socioeconomic variables.

Spearman's rho Correlations

		Population (index)	Median income (index)	Alaska Natives (index)	Population below poverty (index)	Population age 25 & above hold high school diploma (index)	Community employment diversity (index)
Permits per-1,000HH	Correlation Coefficient	-0.340	0.018	-0.081	-0.221	-0.093	-0.309
	Sig. (2-tailed)	0.1210	0.9380	0.7210	0.3220	0.6800	0.1620
Employment dependency in natural resource-related sectors (%)	Correlation Coefficient	-0.155	-0.350	0.015	-0.144	-0.259	-0.120
	Sig. (2-tailed)	0.4920	0.1100	0.9470	0.5220	0.2440	0.5950
	N	22	22	22	22	22	22

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Other variables negatively correlated with permit usage, but with relatively weak relationships, include Alaska Natives population (r_s = -0.081, p = 0.7210), and education level (r_s = -0.093, p = 0.6800) (Table 18). Median household income is the only variable positively correlated with Tongass area communities' permit use, but it was a very weak relationship (r_s = 0.018, p = 0.9380) (Table 18).

The bottom half of Table 18 presents relationships between TNF communities' employment dependence and key socioeconomic variables. There was a positive correlation between employment dependency on the natural resource-related sectors and Alaska Natives population, the only variable positively correlated, although this too was not statistically significant (r_s = 0.015, p = 0.9470). All other socioeconomic variables were negatively correlated with employment dependence including community population size (r_s = -0.155, p = 0.4920), median household income (r_s = -0.350, p = 0.1100), population below poverty line (r_s = -0.144, p = 0.5220), education level (r_s = -0.259, p = 0.2440), and community employment diversity (r_s = -0.120, p = 0.5950) (Table 18). All of these were not statistically significant, but the negative correlation between employment dependence in natural resources sectors and median household income is relatively strong.

In general, the Spearman's Rank Order Correlations produced weak associations between most of the socioeconomic variables and communities' employment dependency on natural resources-related sectors. This is due to low sample size, as there were several strong correlations within 0.31to 0.35 range. Nonetheless, the results from the Spearman's rank order correlation analysis could be useful for better understanding of the existing nature of permit data by showing its strengths and weaknesses. More explanation is given on this under conclusion and recommendations.

Tongass Area Community Resource Use Ranking and Typology

Table 19 summarizes the Tongass area community resource use levels. Communities were first ranked based on their resource use level using the ranking approach, a continuous data method using no cutoff points. The ranked communities were then assigned into three main categories (i.e., “high,” “medium,” or “low”) to create each community’s general resource use levels. Communities’ use level ranking and typology were produced from the analysis that used USFS permit data reported in Chapter 4. As a result, the last column of Table 19 presents each community’s rank based on their permit use level from highest use to lowest permit use per-1,000 households. Accordingly, Elfin Cove, Yakutat, and Pelican are the three communities ranked top from highest to lowest, respectively. Three other communities: Wrangell, Tenakee Springs, and Meyers Chuck were placed as the second highest ranking group. The remaining communities were ranked low. As a result, from the very bottom list of the last column, we find Klawock, Haines, Craig, and Skagway, respectively, had the lowest permit use levels (Table 19).

In the typology approach (second to the last column in Table 19), we find the same communities, i.e., Elfin Cove, Yakutat, and Pelican, as “high,” and Wrangell, Tenakee Springs, and Meyers Chuck as “medium” level permits users, where both groups placed top in the list.

Table 19. TNF community permit usage summary based on the typology and ranking approaches.

Community	Population	HHs use of firewood for home heating (%)	Number of permits issued	Number of HHs	Permits per-1,000HH	Community rank based on permit use	Community permit use typology
Elfin Cove	37	16.7	29	15	1933.3	22	High
Yakutat	683	3.4	113	265	426.4	21	High
Pelican	253	2.8	14	70	200.0	20	High
Wrangell	2,305	6.0	173	907	190.7	19	Medium
Tenakee Springs	85	27.1	10	59	169.5	18	Medium
Meyers Chuck	21	100.0	1	9	111.1	17	Medium
Petersburg	3,258	4.3	96	1,240	77.4	16	Low
Point Baker	35	72.2	1	13	76.9	15	Low
Gustavus	426	21.5	14	199	70.4	14	Low
Hoonah	892	9.7	18	300	60.0	13	Low
Ketchikan	7,922	1.9	146	3,197	45.7	12	Low
Hyder	98	52.1	2	47	42.6	11	Low
Sitka	8,835	1.6	111	3,278	33.9	10	Low
Juneau	36,011	1.5	342	13,770	24.8	9	Low
Thorne Bay	576	47.8	5	219	22.8	8	Low
Kake	715	5.3	5	246	20.3	7	Low
Coffman Cove	208	18.5	1	63	15.9	6	Low
Angoon	573	15.4	2	184	10.9	5	Low
Skagway	870	10.9	4	401	10.0	4	Low
Craig	1,424	10.3	5	523	9.6	3	Low
Haines	1,794	11.2	6	752	8.0	2	Low
Klawock	846	10.7	2	313	6.4	1	Low

Overall, if we look at the distribution of Tongass communities across the three typology categories ("high," "medium," or "low"), the majority of them fell within the "low" permit use category (last column in Table 19). Craig, Haines, and Klawock are located at the very bottom of the list, indicating the lowest number of permits per-1,000 households (Table 19).

Comparing the ranking of communities using the two approaches, communities like Petersburg, Ketchikan, Sitka, and Juneau were ranked (16), (12), (10), and (9), respectively, in the ranking approach (see last column of Table 19) and had relatively high permit usage. In the typology approach, however, because of the cutoff points used, all of them fell within the "low" permit use category (last column of Table 19).

Note that communities that had a high or medium level of permit use per-1,000 households had generally small populations (Table 19). However, this does not necessarily lead to the conclusion that most permit users resided in small communities. Indeed, if we look at the actual number of permits issued, there are more permit holders in the larger communities. The reasons why larger communities had small number of permits per-1,000 households is that permits were standardized by the total number of households. As a result, those communities with large population sizes have smaller permit-to-population ratios. A community's population size was thus a big factor in determining permit use levels. For example, in the Tongass area, after adjusting the number of permits to a per-1,000 household level, the larger communities such as Petersburg, Ketchikan, Sitka, and Juneau had relatively “low” permit use per-1,000 households (Table 19).

Other important information on communities’ characteristics shown in Table 19 is communities’ firewood use on a per-household level (described as a percent). Firewood collection is one of the major forest use activities on the Tongass (Miller 2008) and is thus an important activity that can be used to link community resource use back to Tongass forests. Data on communities’ firewood use level were collected from the Alaska community profile to compare with number of permits issued by the Tongass National Forest. As shown in Table 19, while most Tongass communities tend to use little firewood for home heating, Point Baker and Meyers Chuck had the highest use index.

Tongass Area Community Employment Dependence Ranking and Typology

For communities in the Tongass area, employment dependencies on the natural resources-related sectors are shown in Table 20. The second to the last column in Table 20 shows communities ranking by employment dependence on natural resources sectors. The ranking approach simply ranked communities from highest-to-lowest based on percent of communities’ employment. The highest-ranked community was assigned the value of 22, while the lowest-ranked was assigned with the value of 1 (see Chapter IV for detail). Coffman Cove, Point Baker, Yakutat, Elfin Cove, and Pelican are the five communities ranking the highest, and Meyers Chuck, Hyder, Skagway, Gustavus, and

Table 20. TNF community employment dependence on natural resource-related sectors category based on the ranking and typology approaches (2000 U.S. Census) (ranked by employment percent in natural resources).

Community	2000 Population	Total number of HHs	Employment in natural resource-related sectors	Employment in service-related sectors	Total employment	Employment diversity (index)	Community employment diversity (index)	Community employment dependence on natural resource-related sectors	Community employment dependence on natural resource-related sectors
			(percent)				typology	rank	typology
Coffman Cove	208	63	50	6	111	1.6	High	22	High
Point Baker	35	13	40	34	100	1.3	Medium	21	High
Yakutat	683	265	31	24	440	1.8	High	20	Medium
Elfin Cove	36	15	30	20	10	1.0	Medium	19	Medium
Pelican	253	70	26	20	81	1.6	High	18	Medium
Craig	1,424	523	24	27	719	1.9	High	17	Medium
Hoonah	892	300	24	28	317	1.8	High	16	Medium
Petersburg	3,258	1,240	20	26	1,518	2.0	High	15	Medium
Thorne Bay	576	219	20	26	269	1.9	High	14	Medium
Wrangell	2,305	907	16	28	1,079	2.0	High	13	Low
Kake	715	246	14	30	248	1.9	High	12	Low
Klawock	846	313	13	22	372	2.0	High	11	Low
Tenakee Springs	85	59	11	14	44	2.0	High	10	Low
Sitka	8,835	3,278	9	41	4,352	1.9	High	9	Low
Haines	1,794	752	6	30	772	2.1	High	8	Low
Angoon	573	184	5	53	188	1.6	High	7	Low
Juneau	36,011	13,770	5	27	16,537	2.0	High	6	Low
Ketchikan	7,922	3,197	5	29	3,888	2.1	High	5	Low
Gustavus	425	199	4	45	190	1.7	High	4	Low
Skagway	870	401	0	27	475	1.9	High	1	Low
Hyder	98	47	0	33	24	1.2	Medium	3	Low
Meyers Chuck	21	9	0	0	3	0.0	Low	2	Low

Ketchikan are the bottom ranking communities (Table 20). The rest of the communities were distributed in between.

In the typology approach (see last column of Table 20), using the cutoff points adopted, two communities—Coffman Cove and Point Baker—are categorized as “high” employment dependency. In these communities, the share of employment in the natural resources-related sectors was 50 and 40 percent, respectively. In Coffman Cove, logging support services historically provided the majority of employment. Currently, this is no longer the case in the area because of the decline of the timber sectors. However, there are still some logging support services surviving in the area (Alaska Department of Commerce, Community and Development 2009). Most of the employment resides in tourism-related activities, where a large a number of people in the community operate bed and breakfasts or rent cabins to visitors engaged in hunting or fishing—activities directly related to the natural resources of southeast Alaska (Alaska Department of Commerce, Community and Development 2009). Similarly for Point Baker, the economy is directly or indirectly linked to natural resources. For instance, in 2009, half of the population in the community held commercial fishing permits, while the remaining had permits for subsistence and recreational uses (Alaska Department of Commerce, Community and Development 2009). Subsistence and recreational food sources include deer, salmon, halibut, shrimp, and crab (Alaska Department of Commerce, Community and Development 2009).

The majority of communities in the “medium” category also depend upon employment in commercial fishing and service sector-related tourism (Table 20). For instance, in Elfin Cove, commercial fishing, sport fishing, charter services, and summer lodges and local retail business provide employment, making the economy highly seasonal. Likewise, in Yakutat, Pelican, Craig, Hoonah, Petersburg, and Thorne Bay, commercial fishing and tourism-related activities play a major role, although logging supports small sawmill operations (Alaska Department of Commerce, Community and Development 2009).

Based on the Alaska Department of Commerce, Community and Development (2009) report, employment characteristics of the bottom seven communities within the "low" category (see last column of Table 20) indicate that in Ketchikan, Angoon, and Gustavus, employment dependency is mainly linked to either commercial fishing or tourism-related activities. In these communities, though the contribution of the Tongass National Forest is minimal, other public lands (e.g., the Glacier Bay National Park in Gustavus) play a significant role in supporting employment. For instance, in Gustavus, 50% of working locals are employed by the National Park Service. In Juneau—the capital of Alaska—state, local, and federal agencies provide nearly 45% of community employment. Tourism is also a significant contributor to the private economy during the summer, creating nearly 2,000 jobs and generating $130 million in income (Alaska Department of Commerce, Community and Development 2009). Examples of local attractions include Mendenhall Glacier, Juneau icefield air tours, Tracy Arm Fjord Glacier, the Alaska State Museum, and the Mount Roberts Tramway.

Bottom-ranked Meyers Chuck, Hyder, and Skagway show no employment in the natural resource-related sectors (see the fourth column in Table 20). In Skagway and

Hyder, however, employment in tourism-related sectors is dominant, where the tourism-based economy is directly linked to local attractions such as the Klondike Gold Rush Historical Park and White Pass and Yukon Railroad (Alaska Department of Commerce, Community and Development 2009). However, these tourism-related businesses are largely owned by nonlocals. For instance, in 1999, based on a study of economic impacts conducted by the City of Skagway, 51% of the owners of visitor-related businesses were not year-round residents.

Hyder's economy is also heavily reliant on tourism. Four of the five largest employers are tourist-related, and visitor services are shared with Stewart, British Columbia. A bottled water business employs local residents. Few residents held commercial fishing permits (Alaska Department of Commerce, Community and Development 2009). Recreational fishing and hunting provide food for some families. Deer, salmon, shrimp, and crab are harvested resources. In Meyers Chuck**,** fishing provides the basis of the local economy. For instance, in 2009, half of the town's residents held commercial fishing permits, while many depended on subsistence activities to supplement the relatively few cash opportunities created by wage employment. Deer and fish provide the majority of meat in the local diet (Alaska Department of Commerce, Community and Development 2009).

Comparing the ranking and typology approaches in measuring dependency, no differences were observed between the two (Table 20). As discussed earlier, the basic distinction between the two approaches is the use of cutoff points in the typology approach to create categories so that information can be summarized qualitatively for forest management purposes.

Chugach Area Community Forest Resource Use and Employment Dependency

For communities in the Chugach area, the Spearman's Rank Order Correlation analysis shows a strong and negative correlation between community permit use and population size, which was statistically significant (r_s = -0.720, p = 0.0017), population below poverty line (r_s = -0.367, p = 0.1624), community employment diversity index (r_s = -0.453, p = 0.0779), and median household income (r_s = -0.216, p = 0.4210) were all negatively correlated with permit use but were not statistically significant (Table 21). On the other hand, there was a positive correlation between Chugach area communities' permit usage and Alaska Native population (r_s = 0.108, p = 0.6919) and education level, although neither was statistically significant (r_s = 0.119, p = 0.6597) (Table 21).

The negative relationship between community population size and permit usage indicates that as community population increases, the number of permits per-1,000 households decreases. However, as described earlier, this does not necessarily mean that fewer permits are issued in large communities.

Likewise, the negative correlation between median household income and communities' permit usage indicates more concentration of permit holders in communities with low median household income. This suggests that as median income increases, residents tend to acquire fewer permits. There is, however, variation between the permits types considered purchased.

Table 21. CNF Spearman's Rank Order Correlation between dependent variables (communities' permit use and employment dependency) and selected socioeconomic variables.

Spearman's rho Correlations								
		Population (index)	Median income (index)	Alaska Natives (index)	Pop. below poverty (index)	Pop. age 25 & above hold high school diploma (index)	Community employment diversity (index)
Permits per-1,000HH	Correlation Coefficient	(-)0.720**	-0.216	0.108	-0.367	0.119	-0.453
	Sig. (2-tailed)	0.0017	0.4210	0.6919	0.1624	0.6597	0.0779
	N	16	16	16	16	16	16
Employment dependency in natural resource-related sectors (%)	Correlation Coefficient	-0.046	0.634**	-0.171	-0.014	-0.065	0.065
	Sig. (2-tailed)	0.8659	0.0083	0.5278	0.9587	0.8102	0.8104
	N	16	16	16	16	16	16

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Overall assessment of the different permit types shows that more permits were purchased for recreational uses as compared to timber permits. This has influenced the correlation analysis. The other reason is that some extractive resource uses such as subsistence uses are not reflected in Forest Service permit data and, hence, the correlation analysis may not reflect the actual situation for some communities.

Similarly, though it is hard to generalize because of the small sample size, there are moderately high negative correlations between indices of community permit usage and community employment diversity index and population below poverty line—although none of these were statistically significant (Table 21). The correlation between permit holders and high income may be due to the dominance of recreational use activities as most high income communities acquired permits for recreation-related activities in the Chugach area. The presence of many outfitter and guide permit holders in larger communities such as Anchorage-Girdwood is an indication of high demand for recreational use activities.

The bottom half of Table 21 presents a correlation analysis between Chugach area communities' dependency on the natural resource-related sectors and selected socioeconomic variables. Accordingly, there was a negative but not statistically significant relationship between communities' dependence on employment in the natural resource-related sectors and community population size (r_s = -0.046, p = 0.8659), percent Alaska Natives, (r_s = -0.171, p = 0.5278), population below poverty line (r_s = -0.014, p = 0.9590), and education level (r_s = -0.065, p = 0.8102) (Table 21). All of these correlations are weak.

In contrast, there was a significant positive correlation between a communities' dependence on employment in the natural resource-related sectors and median household income (r_s = 0.634, p = 0.0083) (Table 21). There was a weak but positive correlation between community employment dependency in the natural resource-related sectors and community employment diversity index, although this was not statistically significant (r_s = 0.065, p = 0.8104) (Table 21).

In summary, the results of the Rank Order Correlation analysis are limited by the small sample size and few data points considered for most of the variables (e.g., median household income and Alaska Native population). Nonetheless, the results from the analysis deliver important information about community resource dependency.

Chugach Area Community Resource Use Ranking and Typology

The ranking and typology results for the Chugach-area communities' permit use are shown in Table 22. As discussed earlier, the only difference between the two approaches is the "high," "medium," or "low" categories developed for the typology approach based on the cut point methods discussed in Chapter IV. As a result, the typology approach (see last column of Table 22) identified Cooper Landing as the only community that fell into the "high" permit use category. Five other communities fell into the "medium" use level: Cordova, Hope, Gakona, Moose Pass, and Port Alsworth. The remaining communities fell into the "low" permit use category (see last column of Table 22). Like the "high" use communities in the Tongass area, Cooper Landing, the community in the "high" permit use category, also had a small

Table 22. CNF community permit usage summary based on the typology and ranking approaches.

Community	Population	HHs use of firewood for home heating (%)	Number of permits issued	Number of HHs	Permits per-1,000HH	Community rank based on permit use	Community permit use typology
Cooper Landing	369	19.8	36	162	222.2	16	High
Cordova	2,454	3.1	157	958	163.9	15	Medium
Hope	137	55.6	11	77	142.9	14	Medium
Gakona	215	18.3	10	84	119.0	13	Medium
Moose Pass	184	10.7	10	84	119.0	12	Medium
Port Alsworth	104	17.0	4	34	117.6	11	Medium
Copper Center	362	12.2	6	132	45.5	10	Low
Seward	2,830	1.6	39	917	42.5	9	Low
Wasilla	5,469	0.3	43	1,979	21.7	8	Low
Palmer	4,533	0.3	26	1,472	17.7	7	Low
Valdez	4,036	1.1	21	1494	14.1	6	Low
Kasilof	471	14.6	2	180	11.1	5	Low
Soldotna	3,759	0.0	16	1,465	10.9	4	Low
Sterling	4,702	5.1	9	1,676	5.4	3	Low
Homer	3,946	3.9	6	1,599	3.8	2	Low
Anchorage-Girdwood	260,283	0.3	66	95,643	0.7	1	Low

population. Interestingly, Cordova is the only relatively large community that fell into the "medium" use level (population, 2,454).

In the Chugach area, data on household use of firewood for home heating were examined in order to compare the level of extractive resource use with the number of permits issued. Although the relationship was not statistically tested, there were more households that used firewood for home heating, while at the same time had more permits per-1,000HHs. These include Cooper Landing, Hope, Gakona, Moose Pass, Port Alsworth, and Copper Center (Table 22). The exception is Kasilof, which fell within the "low" permit use category but had a relatively high percentage of households that used firewood. The rest of the communities that had a high percentage of households that used firewood fell within the "medium" or "high" permit use categories (Table 22). This reflects important community resource use linkages to the Chugach National Forest. However, how many firewood use permits were actually used for home heating needs to be verified in each community.

This study describes the relationship between the USFS permit data and Census-derived household firewood use based on secondary data only, a noted limitation of the approach. As a remedy, an effort was made to support the findings of the analyses by adding information from interviews with USFS staff. Information from the interviews was helpful in understanding the relationship between household firewood use and permit data, which although not statistically significant, is an important use activity.

According to Gene Miller, the USFS TIM data manager in Region 10 (Alaska), there was more firewood use by neighboring communities on both forests than reflected by TIM permits. Residents may obtain wood from private land, neighbors, commercial sellers, or other public lands not managed by the USFS. All of these explain why household firewood use might have a weak relationship with permit activities, but similar studies also found that firewood use was an important activity of communities around other National Forest lands (e.g., Charnley et al. 2006; Sullivan 1997).

Chugach Area Community Employment Dependency Ranking and Typology

Table 23 presents a ranking of Chugach-area communities based on employment dependency in natural resource-related sectors using the ranking and typology approaches. As discussed earlier, there are no measurement differences between the ranking and typology approaches except that in the latter method, cutoff points are used to group communities qualitatively. For instance, Moose Pass, Port Alsworth, and Cordova, respectively, are the three top-ranking communities, while Hope, Cooper Landing, and Copper Center, respectively, are ranked as least dependent in the two approaches (Table 23). The rest of the communities are located between these upper and lower ranking communities. In the typology approach, however, the distribution of communities distinctly varied as they were grouped into ‘high,” “medium,” or “low.” As in the previous sections, the discussion here also focuses mainly on the typology approach.

Moose Pass has the highest employment dependence on natural resource-related sectors (39%), largely due to employment within the State Division of Forestry. In addition, there were some residents who held commercial fishing permits (Alaska

Table 23. CNF community employment dependence on natural resource-related sectors category based on the ranking and typology approaches (U.S. Census Bureau 2000), (ranked by employ.yment percent in natural resources).

Community	2000 Population	Total number of HHs	**Employment in natural resource-related sectors**	**Employment in service-related sectors**	Total employment	Employment diversity (index)	Community employment diversity (index)	Community employment dependence on natural resource-related sectors	Community emplomyent dependence on natural resource-related sectors
			(percent)				typology	rank	typology
Moose Pass	206	84	39	7	97	1.8	High	16	High
Port Alsworth	104	34	17	14	29	1.8	High	15	Medium
Cordova	2,454	958	14	23	1,154	2.1	High	14	Low
Kasilof	471	180	12	28	181	2.1	High	13	Low
Sterling	4,705	1,676	11	26	1,926	1.9	High	12	Low
Soldotna	3,759	1,465	8	36	1,687	2.0	High	11	Low
Homer	3,946	1,599	7	38	1,761	2.0	High	10	Low
Seward	2,830	917	5	38	998	1.8	High	9	Low
Wasilla	5,469	1,979	4	29	2,443	2.1	High	8	Low
Palmer	4,533	1,472	4	36	1,818	1.9	High	7	Low
Valdez	4,036	1,494	3	24	2,043	2.2	High	6	Low
Anchorage-Girdwood	260,283	95,643	3	29	125,735	2.1	High	5	Low
Gakona	215	84	0	35	63	2.0	High	1	Low
Copper Center	362	132	0	37	90	1.9	High	2	Low
Cooper Landing	369	162	0	26	159	1.7	Medium	3	Low
Hope	137	77	0	15	39	0.9	Low	4	Low

Department of Commerce 2010) (Table 23). Next on the list is Port Alsworth, with 19% employment in natural resource-related sectors. This community, located far from the Chugach, receives a "medium" designation due to the presence of many outfitter and guides and lodges that offer services for summer recreational visitors (Table 23). Other than that, few residents held commercial fishing permits directly or indirectly linked to the Chugach forest.

Other important communities that can be mentioned here include Cordova, Kasilof, and Sterling. In these communities, even though they fell into the "low" dependency category, they had a relatively large percentage of employment in natural resource-related jobs (Table 23).

In Cordova, the Forest Service and the commercial fishing and processing industries (e.g., Trident Seafoods, Inc.) are major employers in the natural resource sector. There is diversified economic activity in Cordova as indicated by a high employment diversity index (Table 23). As a result, there are also other employers that support a large number of residents (e.g., Cordova School District, Cordova Hospital, and the Department of Transportation). However, it is not known how many local residents work for these employers.

Kasilof is another distantly located community, but many of its residents who depend on employment in the natural resource sectors work for commercial and sport fishing, timber, and tourism-related industries, and may or may not be linked to the Chugach National Forest (Table 23). Like Cordova, Kasilof also has a relatively diverse economy, i.e., with employment diversity index score 2.1. Other employers in the community include oil and gas processing, retail businesses, and government (Alaska Department of Commerce, Community and Development 2009; Alaska Department of Labor and Workforce Development 2001).

Sterling residents depend upon employment related to sport fishing and commercial fishing, timber, and tourism-related services for recreational enthusiasts. Here again, the economy is relatively diverse, with other employing sectors including oil and gas, retail, and government (Alaska Department of Commerce, Community and Development 2009; Alaska Department of Labor and Workforce Development 2001).

Communities ranked at the bottom of Table 23 such as Cooper Landing, Copper Center, Gakona, and Hope had no employment in natural resource-related sectors. For example, in Hope, school and local retail business provided the only employment (Alaska Department of Labor and Workforce Development 2001). There is also a report that describes limited mining activities and a small community sawmill. These activities are relatively benign, however, when it comes to employment dependency on the natural resource sectors.

In Cooper Landing, 2000 U.S. Census data show no employment in natural resource-related sectors. A recent report by the Alaska Department of Labor and Workforce (2001), however, reveals that tourism and services provide the majority of employment. Also, a few residents held commercial fishing permits. This largely conforms with the 2000 Census data used here, i.e., 26% for service sector employment (Table 23).

In Copper Center, the tourism-related industry (37%) is a major economic engine (Table 23). For example, the National Park Service's Wrangell-St. Elias Visitor Center, completed in 2002, the Copper River Princess Wilderness Lodge, also completed in 2002, and the river parks and boat charter services are good indicators of the growing recreational service sector (Alaska Department of Labor and Workforce Development 2001). In addition, many Alaska Natives depend upon subsistence hunting, fishing, trapping, and gathering.

In Gakona, local businesses directly and indirectly related to natural resources and seasonal tourist travels provide most job opportunities (Alaska Department of Commerce 2010). Local businesses include motels, restaurants, bars, sawmills, and a host of recreational operations such as dog-sledding, fishing and hunting guides, rafting operations, and outfitters (Alaska Department of Labor and Workforce Development 2001; Alaska Department of Commerce, Community and Development 2009). Here again we observe the growth of tourism-based service industries linked to the Chugach and other public lands such as Kenai Fjords National Park, Kenai National Wildlife Refuge, Chugach State Park, Denali State Park, and Kachemark State Park.

Mean Comparison of employment Dependency on Natural Resource-Related Sectors Between the Tongass and Chugach NFs

Information on communities' employment patterns is highly relevant in identifying communities dependent on particular economic sectors. This information can then be linked to permit use as a method of measuring communities' dependency.

In a given community, a dominant sector could be either natural resources or non-natural resources-related. The focus of this portion of the analysis is mainly on those communities where the natural resources-related economic activities are dominant compared to other sectors. The assumption here is that such communities may be the most likely to be affected by changes in forest management policies that limit access to resources on the Tongass and Chugach NFs.

Based on this reasoning, I ran t-tests to compare the TNF and CNF in terms of communities' employment dependence on natural resource-related sectors. The analysis shows that there was a statistically significant difference between the two Forests (Table 24), with more employment in natural resource-related sectors in the TNF area as compared to the CNF. However, there was no statistically significant difference between the communities associated with the two forests in terms of employment in recreation-related service sectors that could be directly or indirectly related to forest lands and their resources. This could be an indication of the growing trend toward amenity-based forest use on the Tongass, which historically was characterized as a

Table 24. Mean difference between Tongass and Chugach communities' employment dependency on natural resource and service sectors.

Forest Area Communities	Natural resource-related sectors (%)	Service-related sectors (%)	Employment diversity index
CNF	7.08	24.47	1.679
TNF	16.045	26.82	1.701
Significance	p=0.02*	p=0.54	p=0.91

more resource extraction-based economy. Similarly, there is no statistically significant difference between the two Forests in terms of employment diversity (Table 24). This runs counter to the widespread belief that employment in Chugach communities is more diverse as compared to the Tongass.

Tongass and Chugach Area Community Vulnerability Ranking and Typology

The ranking and typology approaches described in Chapter IV are applied here to measure vulnerability in Tongass and Chugach area communities. Similar to the dependency measure discussed in the earlier section of this chapter, the two approaches generally produced similar results. However, there was some variation between the two approaches in communities' ranking (see details in Appendices D and E). Moreover, in this section, the detailed discussion of results mainly focuses on the output from the typology approach. The ranking approach is used for validation purposes.

Tongass Area Community Vulnerability Ranking

Table 25 lists Tongass area communities ranked by their vulnerability index scores. The last column of the table displays each community's rank from highest to lowest. Since 22 communities were identified from the permit data and included in the analysis, the ranking approach assigned a value of "22" for the community with the highest average vulnerability index score (i.e., Angoon), and "1" for the community with the lowest average vulnerability score (i.e., Juneau).

If we look at the order of communities listed in Table 25, the top five communities ranked from highest to lowest include Angoon, Hoonah, Kake, Elfin Cove, and Kalwock, respectively. Likewise, five other communities were ranked at the very bottom:Ketchikan, Sitka, Petersburg, Skagway, and Juneau, respectively (Table 25).

In the ranking approach, communities were also ranked based on the weighted index value of each explanatory variable. For instance, if we consider Angoon—the community ranked as most vulnerable—its composite vulnerability index score is 19.2 (second to the last column in Table 25). This same community, however, has high values for explanatory variables used in the analysis. Accordingly, Angoon has ranked high in the following socioeconomic variables that comprised its vulnerability risk: median household income (21), Alaska Natives (22), population below poverty line (21), education level (19), and community employment diversity index (18). The higher rank indicates a community's higher vulnerability. Similarly, Hoonah, the second-ranked community, also has high values in its socioeconomic variables used in the analysis. These include Alaska Natives (20), population below poverty line (20), education level (18), and median household income (16) (Table 25).

Tongass Area Community Vulnerability Typology

Table 25 presented results for the TNF communities from the ranking approach. Table 26 summarizes final results from the analysis of the typology approach. These analyses estimate each community's potential vulnerability to forest management and policy changes. The key variables used in the analysis to determine community

Table 25. TNF community vulnerability rank based on the ranking approach (listed from highest-to-lowest vulnerability).

Variables association	(-)	(-)	(+)	(+)	(-)	(-)	*	
Community	Ranked index of population weight scoring	Ranked index of median income weight scoring	Ranked index of Alaska Natives weight scoring	Ranked index of population below poverty weight scoring	Ranked index of population age 25 & above hold high school diploma weight scoring	Ranked index of community employment diversity weight scoring	Average sum of community vulnerability index based on the ranking	Community vulenrability rank
Angoon	14	21	22	21	19	18	19.2	22
Hoonah	8	16	20	20	18	13	15.8	21
Kake	11	15	21	19	17	11	15.7	20
Elfin Cove	20	19	1	7	22	21	15.0	19
Klawock	10	17	19	18	16	6	14.3	18
Hyder	18	2	3	22	20	20	14.2	17
Yakutat	12	8	18	16	14	14	13.7	16
Pelican	16	7	17	3	21	16	13.3	15
Point Baker	21	22	9	5	1	19	12.8	14
Gustavus	15	18	8	17	2	15	12.5	13
Tenakee Springs	19	20	4	15	5	7	11.7	12
Coffman Cove	17	12	7	4	9	17	11.0	11
Wrangell	5	13	15	13	13	4	10.5	10
Meyers Chuck	22	1	10	1	6	22	10.3	9
Craig	7	11	2	14	15	9	9.7	8
Thorne Bay	13	10	5	10	10	8	9.3	7
Haines	6	14	13	12	8	1	9.0	6
Ketchikan	3	9	14	9	11	2	8.0	5
Sitka	2	4	16	11	3	10	7.7	4
Petersburg	4	6	11	6	12	5	7.3	3
Skagway	9	5	6	2	4	12	6.3	2
Juneau	1	3	12	8	7	3	5.7	1

* Community vulnerability index was calculated by summing and averaging all the independent variables' weighted ranks

vulnerability are displayed in Table 25. The last columns of the two tables displayed communities' vulnerability indices ranked from highest-to-lowest (see Table 12 in Chapter 4, and Appendices D and F for details).

In the TNF area, the typology approach identified seven communities as "highly" vulnerable: Angoon, Hyder, Hoonah, Kake, Klawock, Elfin Cove, and Point Baker (Table 26). Similarly, seven other communities were identified in the "medium" vulnerability category, including Gustavus, Pelican, Yakutat, Tenakee Springs, Haines, Coffman Cove, and Meyers Chuck. The remaining eight communities fell within the "low" vulnerability category, which include Craig, Wrangell, Sitka, Thorne Bay, Ketchikan, Petersburg, Skagway, and Juneau (Table 26).

Based on the typology criteria developed, communities in the "high" vulnerability category generally share similar characteristics such as "low" population, "low" median household income (except Hyder—the only community that had "high" median household income), "high" index of Alaska Natives, "low" index of population below poverty line, and "medium" index of education level (population age 25 and above holding a high school diploma). In terms of the employment diversity index, an equal distribution of both "high" and "low" categories is observed across the vulnerability ratings (Table 26).

Communities with a "low" employment diversity index that fell within the "high" vulnerability category include Hyder, Elfin Cove, and Point Baker (Table 26). On the other hand, communities that had a "high" employment diversity index and "high"

Table 26. TNF community vulnerability typology (communities ranked from highest to lowest vulnerability).

Variables association	(-)	(-)	(+)	(+)	(-)	(-)		
Community	Population typology	Median income typology	Alaska Natives typology	Population below poverty typology	Population age 25 & above hold highschool diploma typology	Community employment diversity typology	Average sum of community vulnerability index	Community vulnerability typology
Angoon	low	low	high	medium	medium	medium	2.50	High
Hyder	low	high	low	high	medium	low	2.17	High
Hoonah	low	low	high	low	medium	high	2.17	High
Kake	low	low	high	low	medium	high	2.17	High
Klawock	low	low	high	low	medium	high	2.17	High
Elfin Cove	low	low	low	low	low	low	2.17	High
Point Baker	low	low	low	low	high	low	2.00	High
Gustavus	low	low	low	low	high	medium	1.83	Medium
Pelican	low	medium	low	low	medium	medium	1.83	Medium
Yakutat	low	medium	medium	low	high	high	1.67	Medium
Tenakee Springs	low	low	low	low	high	high	1.67	Medium
Haines	low	low	low	low	high	high	1.67	Medium
Coffman Cove	low	medium	low	low	high	medium	1.67	Medium
Meyers Chuck	low	high	low	low	high	low	1.67	Medium
Craig	low	medium	low	low	high	high	1.50	Low
Wrangell	low	medium	low	low	high	high	1.50	Low
Sitka	low	medium	low	low	high	high	1.50	Low
Thorne Bay	low	medium	low	low	high	high	1.50	Low
Ketchikan	low	medium	low	low	high	high	1.50	Low
Petersburg	low	medium	low	low	high	high	1.50	Low
Skagway	low	medium	low	low	high	high	1.50	Low
Juneau	high	high	low	low	high	high	1.00	Low

vulnerability score include Hoonah, Kake, and Klawock. In these communities, even though employment was diversified, jobs tended to be seasonal and low-paying. As a result, these communities received a “high” vulnerability index value (see Appendix D).

From a land and resource management perspective, all seven Tongass communities that fell within the “high” vulnerability category are most sensitive and may need special attention from Tongass managers. These implications are discussed in detail later by comparing with the two other measures:permit use and dependency.

The key difference between the ranking approach (Table 25) and the typology approach (Table 26) is the method used to determine a communities’ risk of being vulnerable or not (see Chapter 4 for details) and the way the results are presented. In Table 26, the typology approach describes community vulnerability qualitatively as high, medium, or low, whereas the ranking approach uses the actual numeric values from the explanatory variables to calculate the composite vulnerability indices.

Comparison of TNF Vulnerable Communities Identified by the Typology and Ranking Approaches

In order to help readers understand why the typology approach developed in this study is useful for forest planners, I compared it with the ranking approach. The typology approach is simply a summarized way of presenting data, while the ranking approach is more detailed and transparent. Unfortunately, those characteristics may also make the ranking approach more difficult to use for management or planning purposes.

Overall, by presenting both the typology and the ranking approaches, it was possible to identify methodological inconsistencies or problems that may emerge by using one approach over the other.

Table 27 compares the two approaches for Tongass-area communities. Using the ranking approach, communities were first ranked from 1 to 22 based on their vulnerability index; then, ranked communities were compared with communities identified as high, medium, and low by the typology approach. For the ranking approach, the value "22" represents the most vulnerable community, while "1" represents the least vulnerable community. The ranking is applied in a similar fashion for both methods, then the absolute difference between the two rankings was calculated to examine how close they are in classifying the same communities (Table 27). See also Appendix D and E for a detailed analysis of community vulnerability showing the variables used.

As shown in Table 27, there are few differences in the two approaches. Only four communities show large inconsistencies between the typology and ranking approaches: Hyder with rank difference of 4, Haines with rank difference of 5, and Yakutat and Wrangell with rank differences of 3 (Table 27). If we examine communities in the "high" vulnerability category, the typology and ranking approaches placed Angoon and Klawock on same rank as indicated by rank difference value of (0) (Table 27). Even for the other communities within the high vulnerability category, the rank difference between the two approaches is minor. For instance, Elfin Cove and Point Baker had a rank difference of 2, while Hoonah and Kake had a rank difference of 1. Hyder is the only exception within this category that had a rank difference of (4). For the rest of the communities, the range

Table 27. Comparison of vulnerable communities identified by the typology and ranking approaches (TNF).

	Typology approach			Ranking approach		
Community	Community vulnerability index	Community vulnerability typology	Community vulnerability rank based on typology approach	Community vulnerability based on ranking approach	Community vulnerability rank based on ranking approach	Rank difference between ranking and typology approaches
Angoon	2.5	High	22	19.2	22	0
Elfin Cove	2.2	High	17	15.0	19	2
Hoonah	2.2	High	20	15.8	21	1
Hyder	2.2	High	21	14.2	17	4
Kake	2.2	High	19	15.7	20	1
Klawock	2.2	High	18	14.3	18	0
Point Baker	2.0	High	16	12.8	14	2
Gustavus	1.8	Medium	15	12.5	13	2
Pelican	1.8	Medium	14	13.3	15	1
Coffman Cove	1.7	Medium	10	11.0	11	1
Haines	1.7	Medium	11	9.0	6	5
Meyers Chuck	1.7	Medium	9	10.3	9	0
Tenakee Springs	1.7	Medium	12	11.7	12	0
Yakutat	1.7	Medium	13	13.7	16	3
Craig	1.5	Low	8	9.7	8	0
Ketchikan	1.5	Low	4	8.0	5	1
Petersburg	1.5	Low	3	7.3	3	0
Sitka	1.5	Low	6	7.7	4	2
Skagway	1.5	Low	2	6.3	2	0
Thorne Bay	1.5	Low	5	9.3	7	2
Wrangell	1.5	Low	7	10.5	10	3
Juneau	1.0	Low	1	5.7	1	0

of rank difference between the two approaches is between (1) and (2), validating the typology approach's consistency in determining community vulnerability (Table 27).

The small difference between the ranking and typology approaches is an indication of similarity in community rankings. Likewise, the three larger differences between the two approaches are relatively modest variations in community ranking. Since there are such small differences between the two approaches for the Tongass area communities, the typology approach, which this study considers as a more user-friendly method, has the greatest potential for community vulnerability assessments.

Chugach Area Community Vulnerability Ranking

Tables 28 and 29 present community vulnerability results for the CNF based on the ranking and typology approaches, respectively. In the Chugach-area, the permit data identified 16 communities that use forest resources on the CNF and/or nearby public lands. In the vulnerability analysis, these 16 communities were included to identify those at risk of being impacted by potential Forest Service policy changes.

In the Chugach area, the ranking approach identified communities Copper Center, Hope, Palmer, Seward, Port Alsworth, Kasilof, and Gakona (Table 28). As expected, these communities generally ranked high in most of the socioeconomic variables that contribute to high vulnerability risk (Table 28).

Communities at the bottom of the ranking approach include Cordova, Moose Pass, Sterling, Anchorage-Girdwood, and Valdez (Table 28). These communities

Table 28. CNF community vulnerability rank based on ranking approach (listed from highest to lowest vulnerability).

Variables association	(-)	(-)	(+)	(+)	(-)	(-)	*	
Community	Ranked index of population weight scoring	Ranked index of median income weight scoring	Ranked index of Alaska Natives weight scoring	Ranked index of population below poverty weight scoring	Ranked index of population age 25 & above hold high school diploma weight scoring	Community employment diversity index weight scoring	Average sum of community vulnerability index based on the ranking	Community vulenrability rank
Copper Center	12	15	16	14	15	11	13.8	16
Hope	15	16	4	12	11	16	12.3	15
Palmer	4	9	11	13	16	9	10.3	14
Seward	8	10	14	11	4	12	9.8	12
Port Alsworth	16	3	15	4	8	13	9.8	11
Kasilof	10	11	6	16	9	5	9.5	13
Gakona	13	14	13	2	2	6	8.3	10
Soldotna	7	6	7	6	13	8	7.8	7
Cooper Landing	11	13	3	3	1	15	7.7	5
Wasilla	2	7	8	10	14	4	7.5	8
Homer	6	12	5	9	5	7	7.3	6
Cordova	9	5	12	8	7	2	7.2	9
Moose Pass	14	1	1	1	12	14	7.2	2
Sterling	3	8	2	15	3	10	6.8	4
Anchorage-Girdwood	1	4	9	7	10	3	5.7	3
Valdez	5	2	10	5	6	1	4.8	1

* Community vulnerability index was calculated by summing and averaging all the independent variables' weighted ranks

Table 29. CNF Community vulnerability typology (communities ranked from highest to lowest vulnerability).

Variables association	(-)	(-)	(+)	(+)	(-)	(-)		
Community	Population typology	Median income typology	Alaska Natives typology	Population below poverty typology	Population age 25 & above hold highschool diploma typology	Community employment diversity typology	Average sum of community vulnerability index	Community vulnerability typology
Copper Center	low	low	high	medium	low	high	2.50	High
Hope	low	low	low	low	medium	low	2.17	High
Kasilof	low	medium	low	medium	medium	high	1.83	Medium
Palmer	low	medium	low	low	low	high	1.83	Medium
Wasilla	low	medium	low	low	low	high	1.83	Medium
Soldotna	low	medium	low	low	low	high	1.83	Medium
Port Alsworth	low	medium	medium	low	medium	high	1.83	Medium
Cooper Landing	low	low	low	low	high	medium	1.83	Medium
Sterling	low	medium	low	medium	high	high	1.67	Medium
Seward	low	medium	medium	low	high	high	1.67	Medium
Homer	low	low	low	low	high	high	1.67	Medium
Cordova	low	medium	low	low	medium	high	1.67	Medium
Gakona	low	low	low	low	high	high	1.67	Medium
Valdez	low	high	low	low	medium	high	1.50	Low
Moose Pass	low	high	low	low	medium	high	1.50	Low
Anchorage-Girdwood	high	medium	low	low	medium	high	1.33	Low

generally had lower index scores for socioeconomic variables positively associated with high vulnerability and had higher index scores for variables negatively associated with high vulnerability (Table 28). These combined characteristics contributed to the lower vulnerability index score than the above communities.

As with Tongass-area communities, the ranking approach identified larger communities as least vulnerable. Examples of large communities are Anchorage-Girdwood, Valdez, and Cordova (Table 28). These communities share common socioeconomic characteristics in terms of employment diversity, education level, median household income, etcetera. These variables indicated low vulnerability, thus contributing to the potential resiliency of such communities—a key element into withstanding adverse impacts resulting from changes in forest policy.

Chugach Area Community
Vulnerability Typology

The typology approach identified two communities in the "high" vulnerability category: Copper Center and Hope (Table 29). In the "medium" vulnerability category, 11communities were identified, including Kasilof, Palmer, Wasilla, Soldotna, Port Alsworth, Cooper Landing, Sterling, Seward, Homer, Cordova, and Gakona (Table 29). The remaining three communities, Valdez, Moose Pass, and Anchorage-Girdwood, fell within the "low" vulnerability category (Table 29).

As with TNF communities, this typology is consistent with study metrics because most of the communities in the "low" vulnerability category had large population sizes and "high" employment diversity indices. In contrast, the two communities in the "high" vulnerability category—Copper Center and Hope—had “low” population and “low” median household income, but they did differ in some socioeconomic variables. For example, Copper Center had a “high” percentage of Alaska Natives, while Hope had a “low” percentage. Likewise, while Copper Center had “high” employment diversity index, Hope had a “low” diversity index (Table 29).

Also, Copper Center had a “high” percent of Alaska Natives while Hope had a “low” percent. Likewise, while Copper Center fell within “medium” and “low” for its population below poverty line and education attainment, respectively, while Hope fell within the “low” and “medium” categories, respectively.

As with Tongass-area communities, most Chugach communities within the “medium” vulnerability category tended to have a “high” employment diversity index, which reduced the likelihood of a community being categorized in the “high” vulnerability category. The only exception is Copper Landing, which had a “medium” employment diversity index (Table 29). Nonetheless, these communities generally had “low” index scores for their population size, median household income, and education attainment, which are all negatively associated with a “high” vulnerability index. These same communities, on the other hand, had “high” index scores for variables like percent of Alaska Natives and percent of population below poverty line (Table 29).

Communities within the “low” vulnerability category generally had a “high” employment diversity index, a negative factor in calculating the “high” vulnerability category. These communities also had similar characteristics with regard to other explanatory variables used in the analysis to determine vulnerability (Table 29).

Anchorage-Girdwood is the only exception; it had a “high” population size but fell within the “medium” category for its median household income (Table 29).

Comparison of CNF Vulnerable Communities Identified by the Typology and Ranking Approaches

In Chugach-area communities, the differences between the ranking and typology approaches in identifying communities were larger than those found on the Tongass, although the substantive implications of those differences are still relatively minor. In the Chugach area, the two approaches ranked four communities—Copper Center, Hope, Homer, and Moose Pass—similarly (Table 30). Copper Center and Hope were ranked top by both methods. Valdez and Anchorage-Girdwood were ranked lowest by the two approaches, indicating their “low” vulnerability. These two communities had a rank difference of 2. Other communities with small (i.e., a difference of 1) ranking differences include Kasilof, Palmer, and Port Alsworth (Table 30).

The seven remaining communities differed in their ranking by larger margins: Cooper Landing, Soldotna, Wasilla, Cordova, and Sterling had a rank difference of 4, Gakona a rank difference of 6, and Seward a rank difference of 5. If we examine why such differences arise, we find that Cooper Landing was ranked (9) in the typology approach but (5) in the ranking approach. Likewise, Soldotna ranked high (11) in the typology approach but (7) in the ranking approach. On the other hand, Wasilla was ranked (12) in the typology approach but (8) in the ranking approach. Gakona had the largest variation (6) in ranking because it was ranked (4) in the typology approach but

Table 30. Comparison of vulnerable communities identified by the typology and ranking approaches (CNF).

	Typology approach			Ranking approach		
Community	Community vulnerability index	Community vulnerability typology	Community vulnerability rank based on typology approach	Community vulnerability based on ranking approach	Community vulnerability rank based on ranking approach	Rank difference between ranking and typology approaches
Copper Center	2.5	High	16	13.8	16	0
Hope	2.2	High	15	12.3	15	0
Cooper Landing	1.8	Medium	9	7.7	5	4
Kasilof	1.8	Medium	14	9.5	13	1
Palmer	1.8	Medium	13	10.3	14	1
Port Alsworth	1.8	Medium	10	9.8	11	1
Soldotna	1.8	Medium	11	7.8	7	4
Wasilla	1.8	Medium	12	7.5	8	4
Cordova	1.7	Medium	5	7.2	9	4
Gakona	1.7	Medium	4	8.3	10	6
Homer	1.7	Medium	6	7.3	6	0
Seward	1.7	Medium	7	9.8	12	5
Sterling	1.7	Medium	8	6.8	4	4
Moose Pass	1.5	Low	2	7.2	2	0
Valdez	1.5	Low	3	4.8	1	2
Anchorage-Girdwood	1.3	Low	1	5.7	3	2

(10) in the ranking approach. Next to Gakona was Seward, with a ranking difference of (5). Seward was ranked (7) in the typology approach but (12) in the ranking approach (Table 30).

The key socioeconomic factors that contributed to the rank differences between the two approaches are population size, population below poverty line, percent Alaska Natives, median household income, and employment diversity index (see Appendix D and Appendix E). The range of values for these variables was large and affected the ranking—particularly in the typology approach because of the cutoff points used.

However, the practical implications of the categorization for these communities would have changed very little: Gakona and possibly Seward may have been categorized higher but still within the “medium” vulnerability category. Sterling is the only community that would have changed typology category: it would have been ranked a “low” vulnerable community rather than a “medium” vulnerability community.

Overall, the difference in ranking of communities between the two approaches is somewhat expected given the small sample size and variation in values between data points. Variation between the two approaches also increased due to the use of cutoff points in the typology approach during computation of the composite vulnerability index (see Chapter IV and Appendix D). In the ranking approach, variable index values were simply ranked from the highest to lowest, and scores were assigned depending on each variable’s direction of association in determining vulnerability (see Appendix E). In the typology approach, after cutoff points were applied to develop the “high,” “medium,” and “low” categories, scores were assigned depending on the direction of association each variable had with the vulnerability index.

Comparisons of the three Measures Permit Use, Employment Depndency, and Vulnerability

In the Tongass area, communities within the “high” vulnerability category tended to rank low on permit use per-1,000 households, “medium” to “high” on the employment diversity index, and “low” on percent of employment dependency in natural resource-related sectors (Table 31). Two of the “high” vulnerable communities, Elfin Cove and Point Baker, however, had distinct characteristics in their permit usage and employment dependency. Elfin Cove, for example, had “high” permit use level, “medium” level employment diversity, and “medium” level employment dependency in natural resource-related sectors. The “high” permit use level in this community is a clear distinction from the other communities (Table 31). Similarly, Point Baker had “high” employment dependency in the natural resource-related sectors, which is also a distinct characteristic that made this community differ from the other communities within the “high’ vulnerability category (Table 31).

Likewise, the majority of communities within the “medium” vulnerability category had a “high” employment diversity index but varied in their characteristics across permit use and employment dependency measures (Table 31). For example, Pelican and Yakutat were the only communities in this category that had “high” permit use. On the other hand, Coffman Cove was the only community that had “high” employment dependency in natural resource-related sectors. Meyers Chuck was the only community that had a “low” employment diversity index, while the rest of the communities in the same vulnerability category had “high” employment diversity index values (Table 31). Such varied characteristics of communities require community specific impact mitigation approaches.

In the Chugach area, the majority of the communities fell within the “medium” level vulnerability category, and only two communities—Copper Center and Hope—fell within the “high” vulnerability category (Table 32). While Copper Center had “low” permit use level, Hope rated a “medium.” Likewise, while Copper Center had a “high” employment diversity index, Hope had a “low” employment diversity index, the main

Table 31. Comparison between measures of TNF communities' permit use, employment dependency, and vulnerability (ranked by community vulnerability).

		Permit use dependency		**Dependency on employment in natural resource-related sectors**				**Vulnerability measure**	
Community	Population	Permits per-1,000HH	Community permit use typology	Employment diversity index	Community employment diversity index typology	Employment in natural resource-related sectors (%)	Community dependency on employment in natural resource-related sectors (typology)	Average sum of community vulnerability index	Community vulnerability (typology)
Angoon	573	10.87	Low	1.57	High	5	Low	2.50	High
Elfin Cove	37	1933.33	High	1.03	Medium	30	Medium	2.17	High
Hoonah	892	60.00	Low	1.84	High	24	Medium	2.17	High
Hyder	98	42.55	Low	1.23	Medium	0	Low	2.17	High
Kake	715	20.33	Low	1.86	High	14	Low	2.17	High
Klawock	846	6.39	Low	1.98	High	13	Low	2.17	High
Point Baker	35	76.92	Low	1.26	Medium	40	High	2.00	High
Gustavus	426	70.35	Low	1.75	High	4	Low	1.83	Medium
Pelican	253	200.00	High	1.63	High	26	Medium	1.83	Medium
Coffman Cove	208	15.87	Low	1.60	High	50	High	1.67	Medium
Haines	1,794	7.98	Low	2.08	High	6	Low	1.67	Medium
Meyers Chuck	21	111.11	Medium	0.00	Low	0	Low	1.67	Medium
Tenakee Springs	85	169.49	Medium	1.97	High	11	Low	1.67	Medium
Yakutat	683	426.42	High	1.81	High	31	Medium	1.67	Medium
Craig	1,424	9.56	Low	1.93	High	24	Medium	1.50	Low
Ketchikan	7,922	45.67	Low	2.08	High	5	Low	1.50	Low
Petersburg	3,258	77.42	Low	2.03	High	20	Medium	1.50	Low
Sitka	8,835	33.86	Low	1.90	High	9	Low	1.50	Low
Skagway	870	9.98	Low	1.86	High	0	Low	1.50	Low
Thorne Bay	576	22.83	Low	1.94	High	20	Medium	1.50	Low
Wrangell	2,305	190.74	Medium	2.04	High	16	Low	1.50	Low
Juneau	36,011	24.84	Low	2.04	High	5	Low	1.00	Low

distinction between the two communities (Table 32). Comparatively, Hope would appear to be more vulnerable than Copper Center because of its “low” employment diversity index and “medium” permit use level. On the other hand, Copper Center had “low” permit use level and “high” employment diversity index (Table 32).

Communities within the “medium” vulnerability category generally had “low” permit use levels, “high” employment diversity indexes, and “low” employment dependency in natural resource-related sectors (Table 32). Cooper Landing had a “high” level of permit use, and thus would likely be sensitive to policies affecting resource access. Three communities—Port Alsworth, Cordova, and Gakona—differed from the rest of the “medium” vulnerability communities in terms of permit use and employment dependency (Table 32).

For instance, Port Alsworth is the only community that had “medium” level employment dependency in the natural resource-related sectors, while all other communities had “low” levels of dependency. Port Alsworth also had a “medium” permit use level, along with Cordova and Gakona (Table 32).

Visualization of TNF and CNF Community Forest Resource Use, Dependency, and Vulnerability

Mapping community forest resource use, dependency, and vulnerability provides a spatially explicit understanding of where communities are located and their likely sensitivity, as described in this study, of potential changes in forest policies. Such visualizations have a general appeal to decision makers because they help place

Table 32. Comparison between measures of CNF communities' permit use, employment dependency, and vulnerability (ranked by community vulnerability).

		Permit use dependency		**Dependency on employment in natural resource-related sectors**				**Vulnerability measure**	
Community	Population	Permits per-1,000HH	Community permit use typology	Employment diversity index	Community employment diversity index typology	Employment in natural resource-related sectors (%)	Community dependency on employment in natural resource-related sectors (typology)	Average sum of community vulnerability index	Community vulnerability (typology)
Copper Center	362	45.45	Low	1.91	High	0	Low	2.50	High
Hope	137	142.86	Medium	0.94	Low	0	Low	2.17	High
Cooper Landing	369	222.22	High	1.69	High	0	Low	1.83	Medium
Kasilof	471	11.11	Low	2.08	High	12	Low	1.83	Medium
Palmer	4,533	17.66	Low	1.93	High	4	Low	1.83	Medium
Port Alsworth	104	117.65	Medium	1.80	High	17	Medium	1.83	Medium
Soldotna	3,759	10.92	Low	1.96	High	8	Low	1.83	Medium
Wasilla	5,469	21.73	Low	2.09	High	4	Low	1.83	Medium
Cordova	2,454	163.88	Medium	2.11	High	14	Low	1.67	Medium
Gakona	215	119.05	Medium	1.99	High	0	Low	1.67	Medium
Homer	3,946	3.75	Low	1.96	High	7	Low	1.67	Medium
Seward	2,830	42.53	Low	1.82	High	5	Low	1.67	Medium
Sterling	4,702	5.37	Low	1.91	High	11	Low	1.67	Medium
Moose Pass	184	119.05	Medium	1.78	High	39	High	1.50	Low
Valdez	4,036	14.06	Low	2.16	High	3	Low	1.50	Low
Anchorage-Girdwood	260,283	0.69	Low	2.11	High	3	Low	1.33	Low

information in its appropriate spatial context, thus facilitating data interpretation and internalization (Preston et al. 2008; Sheppard 2005; Tufte 1990). Visualization also contributes to a greater feeling of urgency than would otherwise arise in response to more generic statements about the consequences of potential forest policy changes.

Figures 23 and 24, respectively, display the spatial distribution of Tongass and Chugach community vulnerability typologies (maps showing Tongass and Chugach area community permit use and employment dependency are included in Appendices F and G). In addition to understanding of the socioeconomic characteristics of each vulnerable community, Figures 23 and 24 also help forest managers make decisions and minimize potential impacts on nearby communities.

By visually studying the three types of maps, i.e., permit use, dependency (see Appendices F and G), and vulnerability maps (Figures 23 and 24), public land managers can determine which communities are most likely to be sensitive to USFS policies. For instance, according to this study assessment criteria, communities within the “high” and “medium” vulnerability categories that also fall into the “high” and “medium” permit use categories warrant special attention when making decisions that may affect permitted uses. As a result, in the TNF, six communities—Elfin Cove, Pelican, Meyers Chuck, Tenakee Springs, Yakutat, and Wrangell—are the most critical communities that merit close attention by the USFS. On the CNF, Hope, Cooper Landing, Port Alsworth, Cordova, Gakona, and Moose Pass are similarly positioned (Figures 23 and 24, Appendices F and G).

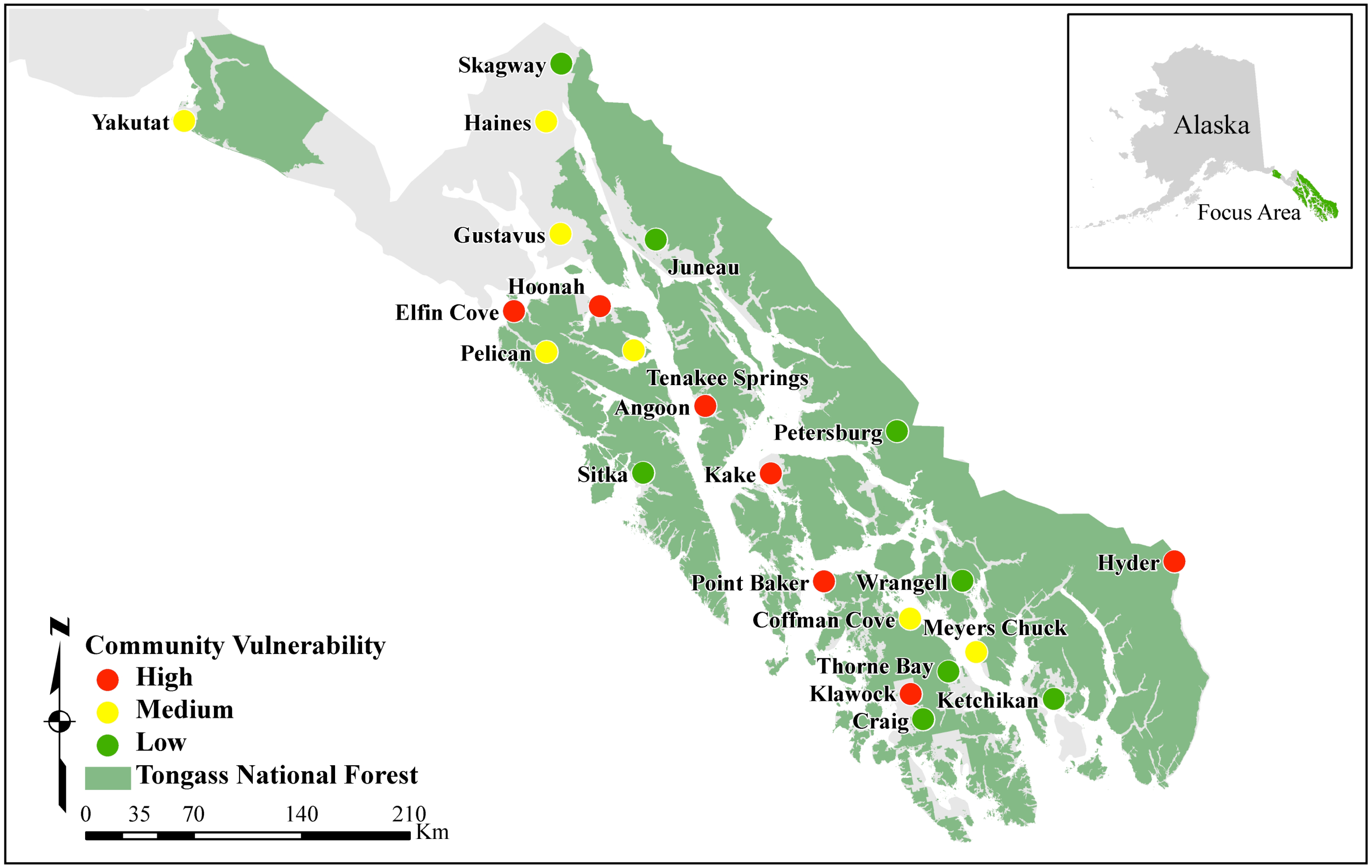

Figure 23. Spatial display of TNF communities' vulnerability typology.

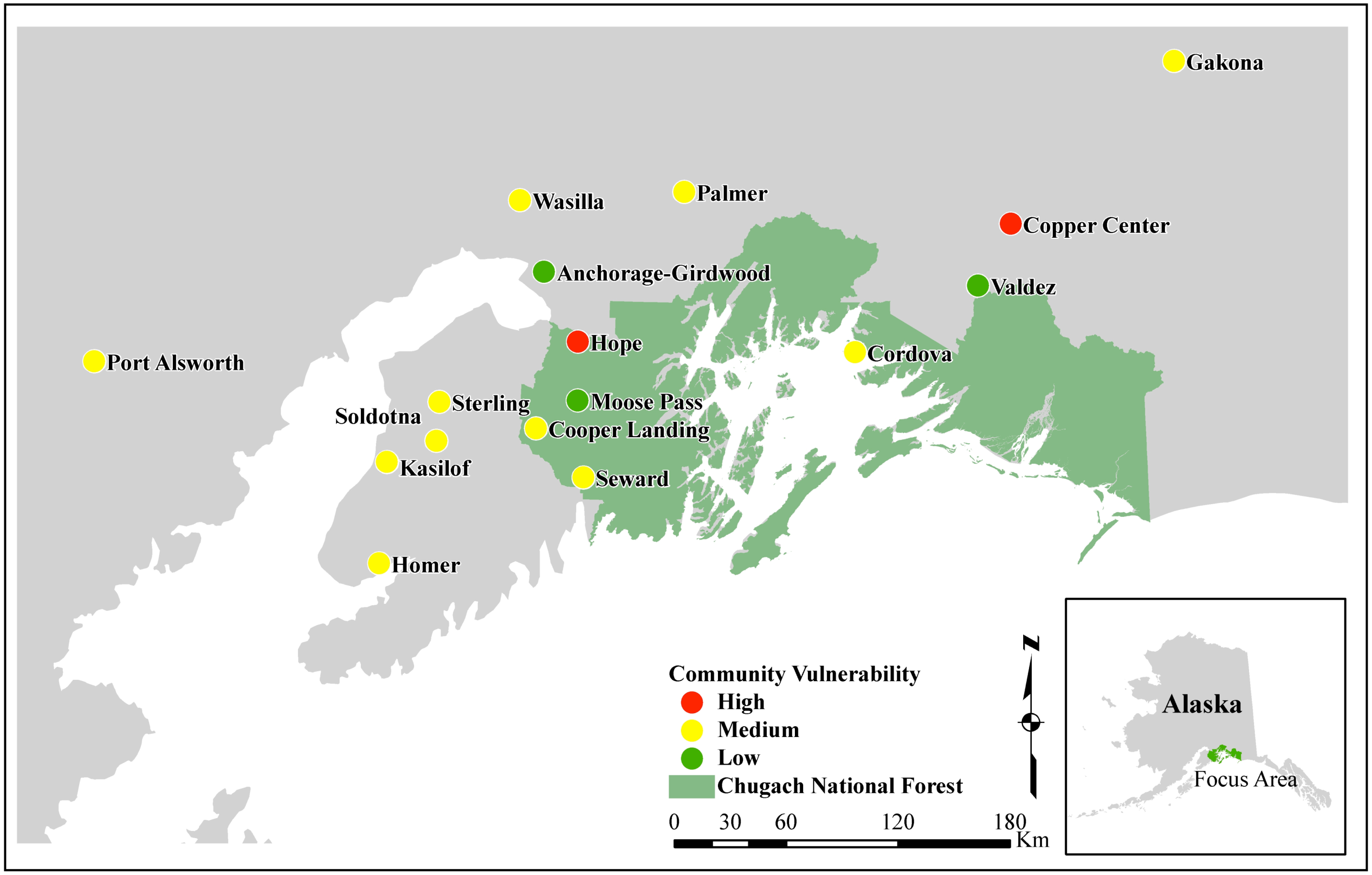

Figure 24. Spatial display of CNF communities' vulnerability typology.

Discussion

This Chapter presents summary metrics to assess southcentral and southeast Alaska communities' potential risk of being vulnerable to impacts that may occur as result of forest policy changes. As discussed in Chapters II and V, communities' access to forest lands and their resources is an important component of vulnerability. Since the majority of Tongass and Chugach area communities use and depend upon forest resources, this study focuses mainly on communities located within and surrounding these two Forests. As a result, all of the communities studied are located within close proximity to the TNF and CNF, although some communities are relatively far from the Forest's boundaries (e.g., Gakona in the case of the CNF).

These more- distant communities were included to demonstrate linkages to the two forest lands as identified by USFS permit, thus adopting an "inside-out" approach as described by Endter-Wada and Blahna (*forthcoming*). That is, rather than identifying community characteristics (e.g., natural resource dependency and/or vulnerability) first and then assuming that some linkage(s) to a National Forest exists, the approach starts with identifying the groups' or communities' resource-use or other activities on the forest to determine the relevant unit of analysis.

Permitees from non-Alaskan communities that acquired USFS permits for various activities were not included in the analysis. This was done to simplify the analysis and to reflect the likelihood that such distances reduced the economic reliance on forest resources of nonresident permittees as compared to those residing in or near the periphery of the two Forests. Moreover, in the past, there has been little study about direct community impacts due to data limitations. Filling this information gap was necessary to help the Forest Service achieve its management objectives to ensure the continuous and sustainable supply of goods and services to local Alaskan communities and beyond.

Community vulnerability was measured from a variety of different perspectives, i.e., I not only assessed community capacity but also efforts were made to link these communities to Forest lands by measuring their use-levels by examining permit data for both material and nonmaterial (e.g., recreational) use activities (see Chapter V for more detail). Likewise, the degree of dependency in natural resource sectors for employment was also considered to identify those communities in high risk categories. The 2000 U.S. Census data have been used to determine communities' natural resources use dependency, which was discussed in detail earlier in this chapter.

This study acknowledges the challenges embodied in assuming that the activities recorded in the permit data are an accurate reflection of local people's use dependence on National Forest lands. Indeed, it is difficult to fully understand and measure communities' resource use level on USFS and other public lands. For instance, in the Tongass area there are other publicly owned lands that may support local community needs for resources. These include Haines State Forest Resource Management Area, Glacier Bay National Park, Misty Fjords National Monument, Admiralty Island National Monument, Mendenhall Wetlands State Game Refuge, and Glacier Bay National Preserve, just to mention a few.

Similarly, in the Chugach area, there are also public lands managed by other state and federal agencies that may also support local use of natural resources. Examples include Kenai National Wildlife Refuge, Kenai Fjords National Park, Trading Bay State Game Refuge, Wrangell-Saint Elias National Park, and Wrangell-Saint Elias National Preserve. The Forest Service may have little control over the activities that take place on these other public lands, making aggregate resource use and demands difficult to estimate. Since it was beyond the objectives of this study to assess situations on other public lands, the vulnerability assessment may have exaggerated some communities' potential vulnerability. Had there been information from the other public lands, communities' within the "high" vulnerability category might have been categorized in different categories. This, however, may need further investigation of communities' activities on other public lands, which could be a good research idea that can be conducted in the future.

The dispersed nature of resource use and resource ownership/control suggests that policies should be considered to coordinate local community use across various jurisdictions. Indeed, one possible recommendation for the US Forest Service would be to collaborate with other public land management agencies to exchange information regarding peoples' activities on public lands. For instance, there could be one central database system to store data on peoples' activities on all types of public lands that could easily be accessed by employees of all agencies; this is the very idea behind the USFS' INFRA database, but applied more broadly across federal and state agencies. Such a system would further help to describe and understand peoples' linkages to public lands—a useful step in developing land management plans that explicitly consider local use, dependence, and vulnerability.

Our vulnerability assessment of Tongass and Chugach area communities shows that many communities lack the necessary capacity to overcome changes that may affect their use of forest lands and resources. In many of these communities, the socioeconomic indicators examined here reveal their precarious situations. This is reflected in “low” ratings for various socioeconomic measures (e.g., “low” income and population sizes, “high” percent of population below poverty line, “high” percent of Alaska Natives, etc.).

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

Community-level analyses requires the identification of various types of useful data like the Forest Service's permit data to supplement standard socioeconomic data such as that provided by the U.S. Census and other state- and county-level sources. This study evaluated the potential use of USFS SUDS and TIM permit data, which are used to monitor and control permitted activities on National Forest System lands. We also developed a methodology that uses these data and proxy (i.e., place-level) socioeconomic data for community-level social assessment. The quality of the permit data were examined by studying the accuracy and completeness of information recorded in the SUDS and TIM databases. Evaluation of the USFS's permit data indicates that permit data quality is limited by a variety of factors, including data entry errors, data backlogs, lack of trained staff, staff turnover, and the lack of a standardized data entry system.

Despite these limitations, the findings reveal that both the SUDS and TIM contain valuable information that can be used to estimate communities' use of forest resources, including amount, type, and frequency of uses. As demonstrated here, information on community resource use can be combined with widely available socioeconomic data in order to estimate and characterize community resource dependency and vulnerability. The use of permit data in social assessment is useful for forest land management and policy formulation because it is readily available and has information about the direct linkages between people and public lands not found in standard socioeconomic data (e.g., type and number of use permits, period of use, place of use, permittees' place-of-residence, etcetera). Such information can also be used for community impact assessment, a unit of analysis oftentimes overlooked due to data limitations. This is critical because understanding the way people use forest resources for both economic and non-economic purposes (e.g., cultural uses) is increasingly seen as an important aspect in community impact assessment. As a result, it is also appropriate for developing forest management plans and polices (Charnley et al. 2008).

The analyses also found that, in the Tongass and Chugach areas, there were more active special land and recreational use permits in 2007 than timber and other forest products permits on both Forests. There were large numbers of permits for outfitters and guides, isolated cabins, and other special land use permits on both Forests. This in turn supports the finding of this study that there were few differences between the TNF and CNF in terms of resource use and other land use activities, except that there were more permits on the TNF than the CNF. Variations in numbers were observed between the different types of SUDS permits on both Forests, indicating use differences between Forests. Also, in both the Tongass and Chugach areas, small communities with fewer numbers of employment sectors tended to have more permit use per-1,000 households as compared to the larger communities with more diverse economies.

Comparing communities in terms of employment dependence on natural resource-related sectors on both Forests, the analysis indicated that there is a statistically significant difference between the Tongass and Chugach area communities. There was more employment dependence on natural resource-related sectors in the Tongass area as compared to the Chugach. However, no differences were observed regarding communities' economic diversity between the two Forests.

In terms of community vulnerability, the analyses resulting from the ranking and typology approaches revealed that small communities in or adjacent to the two Forests, and those communities with relatively more permits per-1,000HHs than larger communities, tended to be more vulnerable to forest policy changes or other types of threats to their well-being. Comparatively, more communities in the TNF area were found to be vulnerable than communities in the CNF area. This is partly driven by the fact that many more small communities exist in and around the TNF as compared to the CNF. In addition, small communities in the Tongass area are more isolated—a factor that limits access to other opportunities to wage employment. This finding is relevant and can guide the Forest Service planning process. As the analyses indicate, forest-specific plans may be needed to help small and vulnerable communities adapt to changes affecting their livelihood and social well-being.

Another contribution of this study is its methodological approach. Using U.S. Census data and USFS permit data, it was possible to demonstrate the importance of analyzing multiple data sources for social assessment, forest management planning, and policy development. The use of permit data in this context is novel. In the past, a few studies have used permit data to study use linkages and, when they did, they described activities on NFS lands—not linkages back to local communities (see, e.g., Charnley et al. 2008). None studied use linkages or measures of community dependence and vulnerability. In this study, the typology approach developed is useful for managers as it summarizes important information qualitatively so that planners and policymakers can easily apply such information for forest planning and management purposes.

In Alaska, it has been difficult to capture rural communities' lifestyles using standard methods of social assessment. The use of permit data in this regard offers improved insight and fills the information gap surrounding small and isolated rural communities. It was noted that permit data quality impart some limitations due to missing data. This is the main reason why this study used only a single year's snapshot (i.e., 2007 represents the first complete year of accurate data). Despite this limitation, permit data obviously have the potential to inform decision makers about community resource use, dependence, and vulnerability. As a result, forest managers should give more attention to ensuring quality data collection and maintenance. For example, if permit data are properly documented and maintained, it should capture important aspects of forest dependence, including the non-economic or cultural aspects of forest dependency where traditional approaches fall short. As the analyses in this study indicate, the standard measures of resource dependency are limited to market-related activities because they emphasize number of jobs or income generated, thus failing to capture the non-market economy and cultural uses of resources, which is an important aspect of rural Alaskan life. In some communities, cultural linkages to forest resources are more important than traditional economic activities. Indeed, people can have a strong sense of place attachment that cannot be readily measured using standard economic metrics. If permit data are standardized and analyzed to capture such important information, it could assist policymakers in developing comprehensive land management policies. Another important quality of permit data is its on-site use record, reflecting people's actual use linkages and activities on public lands.

Next, the maps derived from permit data reveal locations of different neighboring communities located inside or surrounding the Tongass and Chugach National Forests. As discussed earlier, these maps offer forest managers a visual understanding of how forest policy may affect local communities. The maps also depict use linkages from the "inside-out" instead of the reverse. Such a depiction demonstrates that publicly owned forest lands make important contributions to communities in various ways.

On the other hand, managing forests from the perspective of "outside-in" may overlook the unique relationship some communities have with forests. The "inside-out" approach, since it is a community focus approach, the findings show limitations of the "outside-in" approach, which is a more generalized approach. Hence, this study could be used as a case to sell the idea of using alternative data sources such as the Forest Service's permit data for the purposes of communities focus studies, i.e., linkages from "inside-out."

In order to realize the full potential of the USFS permit data for community level analysis, more work needs to be done. Particularly, as the SUDS permit shows more special land uses on both Forests, it is important to give more emphasis to improve the standard and quality of the data. Indeed, comparing the two data sets, the SUDS data set is less organized. The TIM data set is relatively simple and can be used with little improvement. Hence, the Forest Service should consider assigning more staff and resources at the Ranger District level, a place where permits are issued and permittees' information is collected. It is essential to establish a system to standardize data collection methods for all forests, and staff need to be better trained to enter, retrieve, and maintain permit data.

The USFS could use permit data to help create greater awareness about the importance of social data among its staff, especially those involved in permit-related activities. For example, information on part-time or year-round Alaska residents is critical to identify how many are local and nonlocal. Based on the evaluation of SUDS data, some permittees were not local (year-round residents), but used Alaska zip codes. The majority of these permittess in both the Tongass and Chugach areas held special use permits (e.g., outfitter and guide, or other service-related permits). These nonlocal permittees resided in states such as New Jersey, Washington, California, and other parts of the U.S., yet were registered as “local” on their permit application form, using local zip codes or post office addresses in Alaska. Such information about a permittees’ place of residence limits this study’s conclusions that permittees are local residents. Recognizing such problems, one major recommendation of this study is that information be correctly recorded and maintained. The permitting system needs to clearly show whether a permit is acquired by an individual or by a group of people, and whether their place-of-residence is local or nonlocal. Correct information about permittees can help public land managers know whether residents in a community are forest users—useful information for developing appropriate land management policies.

Finally, this study was conducted using secondary data and interviews of USFS employees. Future researchers, however, need to collect primary data using either a mail/phone survey questionnaire or conducting face-to-face interviews to randomly selected community members from areas surrounding the Tongass and Chugach National Forests. Data from such surveys, together with permittee data, can produce good results and offers better understanding about public lands use and conditions. Conducting primary data collection is important for validation of the USFS's permits data potential for community-level analysis.

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APPENDICES

Appendix A. Interview Questionnaires.

Discussion Questions Used During Interviews of Forest Service Employees.

Objectives

- To get clarification on the Special Use Database System (SUDS) and Forest and Timber Products Information System (TIM).
- To identify other types of information that can be used to map the residences or communities of forest users, volunteers, or partners.

Target Interviewees

Forest Service employees working on forest permits database system at various levels including Regional office, Supervisor's offices, and Forest Ranger Districts.

Purpose of the Interviews

My name is Mekbeb Tessema, a graduate student at Utah State University. I am working on a project that tries to understand the types of community and forest resource use linkages in southeast and southcentral Alaska, focusing on the Tongass and the Chugach National Forests. I have been given permission to access the SUDS and TIM databases and have spent some time exploring information contained there. The purpose of the project is to better understand the ways that permit data are gathered and recorded, to understand the strengths and weaknesses of the current permitting systems, and to identify how the permit data might be made more useful to local and regional USFS staff as they make decisions and plan their activities.

I have developed some questions that may help me to get more insight on the permitting process before I make any recommendation on the improvement of the database systems. Detailed information will help to develop a better permits system for the Forest Service.

Questions for Special Use Database System (SUDS)

Regional Forest staff that work on permits

First, I want to ask you some questions about your position in the Forest Service.

1. Can you describe your position and what you do in your job?
2. What role do you play in the collection or analysis of permit data in the SUDS?

I am particularly interested in details about how permit information is collected in this forest.

3 What kinds of activities require permits in this forest?

4 What types of permits are included in the Special Use Permit database?

5 What are the Federal Land Policy and Management Act (FLPMA) permitted activities?

6 In my research I have noticed that a number of permits are given out as "ANILCA" uses; can you explain what kinds of activities might generate an ANILCA special use permit?

7 What are some of the major uses of this forest that do not require permits from the USFS?

8 How have the uses of special use permits changed in the last 5 to 10 years on this forest?

9 When did SUDS start being used as database system?

10 What are the purposes of issuing special use permits?

11 Are all special use permits sold entered in the SUDS database system?

12 What office is responsible for entering information from local permits into the SUDS database? Who maintains the database?

13 Are there set roles for people who issue permits and enter data and manage permits for the forests or are these variable?

14 Is there an official or unofficial codebook (or a list of code descriptions) for the SUDS data? If yes, who keep it?

15 Are the code descriptions/codebook the same for all forests? Who determines the codes?

16 Are all of the permits issued by local ranger districts entered in the SUDS database?

17 How do you use the permits in your office? Have you analyzed the permit information to help guide forest district programming or work? Is it possible that the permit database is not complete in some years?

18 Given your experience with the permit system, what are some of the biggest limitations in how permits are implemented now? What (if any) changes would you like to recommend in how permits are issued?

19 How do you think the permit database system can be improved?

20 Are there other sources of data that I may need to consider for the purpose of my study? Who would you recommend I talk to?

Supervisor's Office

First, I want to ask you some questions about your position in the Forest Service.

21 Can you describe your position and what you do in your job?

22 What role do you play in the collection or analysis of permit data in the SUDS?

I am particularly interested in details about how permit information is collected in this forest.

23 What kinds of activities require permits in this national forest?

24 What are the purposes of issuing permits?

25 Are there any important uses of the forest that are not captured by permits? What are they?

26 Is there any recording on the monitoring of fishing and hunting? How do I know these activities are monitored on the forest lands?

27 How do I know if fishing and hunting licenses are linked to outfitter and guide permits?

28 Are there specific areas that outfitter and guide activities are permitted?

29 Do you think the information is mapped?

30 How do you use the permits in your office? Have you analyzed the permit information to help guide forest district programming or work?

31 Given your experience with the permit system, what are some of the biggest limitations in collecting, storing, and using the data and, in general, how permits are implemented now? What (if any) changes you would like to recommend in how permits are issued?

32 How do you think the permit database system can be improved?

33 Are there other sources of data that I may need to consider for the purpose of my study? Who would you recommend I talk to?

Ranger District Office

First, I want to ask you some questions about your position in the Forest Service.

34 Can you describe your position and what you do in your job?

35 What role do you play in the collection or analysis of permit data in the SUDS?

I am particularly interested in details about how permit information is collected in this forest.

36 How do you use the permits in your office?

37 Have you analyzed the permit information to help guide forest district programming or work?

38 What trends in permits have you noted in the last 5 to 10 years?

39 In my analysis, I have noted that the number of permits jumps around a lot from year to year. Why do you think this happens?

40 Is it possible that the permit database is not complete in some years?

41 What is the difference between issued date and effective date?

42 What are the typical activities of outfitter and guide permit holders?

43 Is there any recording on the monitoring of fishing and hunting? How do I know these activities are monitored on the forest lands?

44 How do I know if fishing and hunting licenses are linked to outfitter and guide permits?

45 Are there specific areas that outfitter and guide activities are permitted? Do you think the information is mapped?

46 As I've analyzed the Special Use Data, I have noted that often the city of the permittee does not match their zip code. Can you help me understand why the data are recorded in this way?

47 In your experience, are most permit holders local or non-local? How would you describe the differences between local and non-local permit holders?

48 What information are collected when issuing permits? Do you keep permit forms? If yes,

49 Where and how is the information recorded and kept? Who has access?

50 How are the different permits values calculated?

51 Given your experience with the permit system, what are some of the biggest limitations in collecting, storing, and using the data and, in general, how permits are implemented now? What (if any) changes you would like to recommend in how permits are issued?

52 How do you think the permit database system can be improved?

53 Are there other sources of data that I may need to consider for the purpose of my study? Who would you recommend I talk to?

Question for Timber Information Manager (TIM)

Regional Forest staff that work on permits

First, I want to ask you some questions about your position in the Forest Service.

54 Can you describe your position and what you do in your job? Can you draw the organization chart of your office and show me where your position is?

55 What role do you play in the collection or analysis of permit data in the Timber Information Manager (TIM) permit system?

I am particularly interested in details about how permit information is collected in this forest.

56 What kinds of activities require permits in this forest?

57 What types of permits are included in the Timber Information Manager (TIM) permit system?

58 In my research I have noticed that a number of permits are given out as “ANILCA” uses; can you explain what kinds of activities might generate an

ANILCA special use permit?

59 What are the Federal Land Policy and Management Act (FLPMA) permitted activities?

60 Are subsistence uses recorded or monitored differently? Are permit requirements different for Alaskan Natives?

61 Are there any kinds of forest product and timber permits issued by the USFS that are not included in the TIM database?

62 What are some of the major uses of forest that do not require permits from the USFS?

63 What are the purposes of issuing permits?

64 When did TIM start being used as database systems? Is it complete?

65 What office is responsible for entering information from local permits into the TIM database? Who maintains the database?

66 How have the uses of forest product and timber permits changed in the last 5 to 10 years on this forest?

67 Are there set roles for people who issue permits and enter data and manage permits for the forests or are these variable?

68 Is there an official or unofficial codebook (or a list of code descriptions) for TIM data? If yes, who keep it?

69 Are the code descriptions/codebook the same for all forests? Who determines the codes?

70 Are the code descriptions the same for all forests? Who determines the codes?

71 Are all of the permits issued by local ranger districts entered in the TIM database?

72 How do you use the permits in your office? Have you analyzed the permit information to help guide forest district programming or work? Is it possible that the permit database is not complete in some years?

73 Given your experience with the permit system, what are some of the biggest limitations in collecting, storing, and using the data and, in general, how permits

are implemented now? What (if any) changes would you like to recommend in how permits are issued?

74 How do you think the permit database system can be improved?

75 Are there other sources of data that I may need to consider for the purpose of my study? Who would you recommend I talk to?

Supervisor's Office

First, I want to ask you some questions about your position in the Forest Service.

76 Can you describe your position and what you do in your job?

77 What role do you play in the collection or analysis of permit data in the TIM?

I am particularly interested in details about how permit information is collected in this forest.

78 What kinds of activities require permits in this national forest?

79 What are the purposes of issuing permits?

80 Are there any important uses of the forest that are not captured by permits? What are they?

81 How do you use the permits in your office? Have you analyzed the permit information to help guide forest district programming or work?

82 What is the difference between free use and personal use permits?

83 Are there specific areas assigned for TIM permitted activities? Do you think this information is mapped?

84 Given your experience with the permit system, what are some of the biggest limitations in collecting, storing, and using the data and, in general, how permits are implemented now? What (if any) changes you would like to recommend in how permits are issued?

85 How do you think the permit database system can be improved?

86 Are there other sources of data that I may need to consider for the purpose of my study? Who would you recommend I talk to?

Ranger District Office

First, I want to ask you some questions about your position in the Forest Service.

87 Can you describe your position and what you do in your job? Can you draw the organization chart of your office and show me where your position is?

88 What role do you play in the collection or analysis of permit data in the TIM?

I am particularly interested in details about how permit information is collected in this forest.

89 How do you use the permits in your office?

90 Have you analyzed the permit information to help guide forest district programming or work?

91 What trends in permits have you noted in the last 5 to 10 years?

92 In my analysis, I have noted that the number of permits jumps around a lot from year to year. Why do you think this happens?

93 Is it possible that the permit database is not complete in some years?

94 What is the difference between issued date and effective date?

95 What are the typical activities of forest product and timber permit holders?

96 What is the difference between free use and personal use permits?

97 Are there specific areas assigned for TIM permitted activities? Do you think this information is mapped?

98 In your experience, are most permit holders local or non-local? How would you describe the differences between local and non-local permit holders?

99 What information is collected when issuing permits? Do you keep permit forms? If yes,

100 Where and how is the information recorded and kept? Who has access?

101 How are the different permits values calculated?

102 Given your experience with the permit system, what are some of the biggest limitations in collecting, storing, and using the data and, in general, how permits are implemented now? What (if any) changes you would like to recommend in how permits are issued?

103 How do you think the permit database system can be improved?

104 Are there other sources of data that I may need to consider for the purpose of my study? Who would you recommend I talk to?

List of Forest Service Employees Interviewed.

Face-to-face discussion with Forest Service employees on the Tongass and Chugach National Forests that perform work related to the TIM and SUDS permit systems. These include:—

National Forest	Contact	Position	Phone #	E-mail
Tongass NF	Bill Trembaly	Recreation Program Manager, Supervisors Office, Petersburg	907-723-7598	btremblay@fs.fed.us
	Marc Scholten	Work on recreation cabin and campground permits, Juneau RD	907-789-624	mscholten@fs.fed.us
Chugach NF	Courtney James	SUDS expert, Supervisors Office, Anchorage		cjames@fs.fed.us
	Courtney Brown	SUDS expert working on Outfitters and Guides, Seward RD	907-224-4117	cebrown@fs.fed.us
	Chandra Heaton	Natural resource specialist, Glacier RD	907-754-2325	cheaton@fs.fed.us
	Teresa Paquest	SUDS expert, Glacier RD.	907-783-2094	tpaquest@fs.fed.us
	Brian Bergman	Forester working on TIM data at the Kenai Work Center	760-376-3781	brianbergman@fs.fed.us
	Karen O'Leary	SUDS expert, Seward RD.	907-224-3374	kaoleary@fs.fed.us
Region 10	Janis Burns	SUDS expert, Regional Office, Juneau	907-586-7871	
	Susan Alexander	Regional Economist, Juneau	907-586-8809	salexander@fs.fed.us
	Gene Miller	TIM Data Manager, Regional Office, Juneau	907-586-7881	gmiller03@fs.fed.us

Appendix B. List of Collapsed Employment Sectors Used to Calculate Community's Employment Diversity Index.

Original list employing sectors	New categories for collapsed employing sectors
Agricutlure, forestry, fishing and hunting, and mining;	Natural resource-related sectors
Art entertainment, recreation, and accomodation and food services	
Construction	Construction and manufacturing
Manufacturing	
Transportation and warehousing, and utitlities	Transportation, warehousing and utilities
Wholesale trade	Wholesale trade
Retail trade	Retail trade
Finance, insurance, real estate and rental and leasing	Finance and related industries
Professional, scientific, management, administrative and waste managemetn services	Professional and science related
Education, health and social services	All service-related industries
Other services (except public administration)	Non-public administration services
Public administration	Public administration services

Appendix C. Procedure Followed to Run Spearman's Rank Order Correlation Coefficients Statistical Analysis

Calculating correlation coefficients attach(data1)

Matrix.data1=as.matrix(cbind(Perm_1000HOUSEHOLD,Popn+HOUSEHOLD_no,NatResJobs,MedianIncome,
Alaska_Natives,Poverty,Highschool.grad,Firewood_heating,RetailTrade,Trans_Util,

Allservices))cor.data1Rank=round(cor(Matrix.data1,method='kendal'),3)

cor.data1Cov=cor(Matrix.data1,method='pearson')

write.csv(cor.data1Rank, file='c:\\MekR/RankCorrelation')

write.csv(cor.data1Cov, file='c:\\MekR/PearsonCorrelation')

detach(data1)

Appendix D. Detail Analysis of Community Vulnerability Using Typology Approach.

TNF

Variables association	(-)				(-)			
Community	Population	Population index	Population index typology	Population (typology) weight scoring	Median income	Median income index	Median income index typology	Median income (typology) weight scoring
Angoon	573	0.0153	low	3	29,861	0.0512	low	3
Hyder	98	0.0021	low	3	62,034	0.9356	high	1
Hoonah	892	0.0242	low	3	39,028	0.3032	low	3
Kake	715	0.0193	low	3	39,643	0.3201	low	3
Klawock	846	0.0229	low	3	35,000	0.1924	low	3
Elfin Cove	37	0.0004	low	3	33,750	0.1581	low	3
Point Baker	35	0.0004	low	3	28,000	0.0000	low	3
Gustavus	426	0.0113	low	3	34,766	0.1860	low	3
Pelican	253	0.0064	low	3	48,750	0.5704	medium	2
Yakutat	683	0.0184	low	3	46,786	0.5165	medium	2
Tenakee Springs	85	0.0018	low	3	33,125	0.1409	low	3
Haines	1,794	0.0493	low	3	39,926	0.3279	low	3
Coffman Cove	208	0.0052	low	3	43,750	0.4330	medium	2
Meyers Chuck	21	0.0000	low	3	64,375	1.0000	high	1
Craig	1,424	0.0390	low	3	45,298	0.4755	medium	2
Wrangell	2,305	0.0635	low	3	43,250	0.4192	medium	2
Sitka	8,835	0.2449	low	3	51,901	0.6571	medium	2
Thorne Bay	576	0.0154	low	3	45,625	0.4845	medium	2
Ketchikan	7,922	0.2195	low	3	45,802	0.4894	medium	2
Petersburg	3,258	0.0899	low	3	49,028	0.5781	medium	2
Skagway	870	0.0236	low	3	49,375	0.5876	medium	2
Juneau	36,011	1.0000	high	1	62,034	0.9356	high	1

TNF (Cont…)

(+)				(+)				(-)			
Alaska Natives (%)	Alaska Natives index	Alaska Natives index typology	Alaska Natives (typology) weight scoring	Population below poverty (%)	Population below poverty index	Population below poverty index typology	Population below poverty (typology) weight scoring	Population age 25 & above hold highschool diploma (%)	Population age 25 & above hold highschool diploma index	Population age 25 & above hold highschool diploma index typology	Population age 25 & above hold highschool diploma (typology) weight scoring
80.9	1.0000	high	3	27.9	0.5974	medium	2	45.55	0.5817	medium	2
4.1	0.0507	low	1	46.7	1.0000	high	3	42.86	0.5470	medium	2
69.4	0.8578	high	3	16.6	0.3555	low	1	46.86	0.5986	medium	2
74.6	0.9221	high	3	14.6	0.3126	low	1	50.63	0.6472	medium	2
58.1	0.7182	high	3	14.2	0.3041	low	1	50.83	0.6497	medium	2
0.0	0.0000	low	1	5.6	0.1199	low	1	0.43	0.0000	low	2
8.9	0.1100	low	1	4.9	0.1049	low	1	78	1.0000	high	1
8.2	0.1014	low	1	14.0	0.2998	low	1	68.94	0.8832	high	1
25.8	0.3189	low	1	4.7	0.1006	low	1	39.92	0.5091	medium	2
46.8	0.5785	medium	2	13.5	0.2891	low	1	54.32	0.6947	high	1
4.8	0.0593	low	1	11.8	0.2527	low	1	62.35	0.7982	high	1
18.5	0.2287	low	1	7.9	0.1692	low	1	60.03	0.7683	high	1
6.0	0.0742	low	1	4.9	0.1049	low	1	59.13	0.7567	high	1
9.5	0.1174	low	1	0.0	0.0000	low	1	61.90	0.7924	high	1
3.9	0.0482	low	1	9.8	0.2099	low	1	52.81	0.6753	high	1
23.8	0.2942	low	1	9.0	0.1927	low	1	55.27	0.7070	high	1
24.7	0.3053	low	1	7.8	0.1670	low	1	67.13	0.8599	high	1
4.8	0.0593	low	1	7.8	0.1670	low	1	58.68	0.7509	high	1
22.7	0.2806	low	1	7.6	0.1627	low	1	56.58	0.7239	high	1
12	0.1483	low	1	5.0	0.1071	low	1	55.99	0.7163	high	1
5.1	0.0630	low	1	3.7	0.0792	low	1	67.10	0.8595	high	1
16.6	0.2052	low	1	6.0	0.1285	low	1	60.37	0.7727	high	1

TNF (Cont…)

(-)					
Community employment diversity index	Community employment diversity index typology	Community employment diversity (typology) weight scoring	Average sum of community vulnerability index	Community vulnerability typology	Community
1.57	medium	2	2.50	High	Angoon
1.23	low	3	2.17	High	Hyder
1.84	high	1	2.17	High	Hoonah
1.86	high	1	2.17	High	Kake
1.98	high	1	2.17	High	Klawock
1.03	low	3	2.17	High	Elfin Cove
1.26	low	3	2.00	High	Point Baker
1.75	medium	2	1.83	Medium	Gustavus
1.63	medium	2	1.83	Medium	Pelican
1.81	high	1	1.67	Medium	Yakutat
1.97	high	1	1.67	Medium	Tenakee Springs
2.08	high	1	1.67	Medium	Haines
1.60	medium	2	1.67	Medium	Coffman Cove
0.00	low	3	1.67	Medium	Meyers Chuck
1.93	high	1	1.50	Low	Craig
2.04	high	1	1.50	Low	Wrangell
1.90	high	1	1.50	Low	Sitka
1.94	high	1	1.50	Low	Thorne Bay
2.08	high	1	1.50	Low	Ketchikan
2.03	high	1	1.50	Low	Petersburg
1.86	high	1	1.50	Low	Skagway
2.04	high	1	1.00	Low	Juneau

CNF

Variables association	(-)				(-)			
Community	Population	Population index	Population index typology	Population (typology) weight scoring	Median income	Median income index	Median income index typology	Median income (typology) weight scoring
Copper Center	362	0.0010	low	3	32,188	0.1588	low	3
Hope	137	0.0001	low	3	21,786	0.0000	low	3
Kasilof	471	0.0014	low	3	43,929	0.3380	medium	2
Palmer	4,533	0.0170	low	3	45,571	0.3631	medium	2
Wasilla	5,469	0.0206	low	3	48,226	0.4036	medium	2
Soldotna	3,759	0.0140	low	3	48,420	0.4066	medium	2
Port Alsworth	104	0.0000	low	3	58,750	0.5643	medium	2
Cooper Landing	369	0.0010	low	3	34,844	0.1993	low	3
Sterling	4,702	0.0177	low	3	47,700	0.3956	medium	2
Seward	2,830	0.0105	low	3	44,306	0.3438	medium	2
Homer	3,946	0.0148	low	3	42,821	0.3211	low	3
Cordova	2,454	0.0090	low	3	50,114	0.4325	medium	2
Gakona	215	0.0004	low	3	33,750	0.1826	low	3
Valdez	4,036	0.0151	low	3	66,532	0.6831	high	1
Moose Pass	184	0.0003	low	3	87,291	1.0000	high	1
Anchorage-Girdwood	260,283	1.0000	high	1	55,546	0.5154	medium	2

CNF (Cont…)

(+)				(+)			
Alaska Natives (%)	Alaska Natives index	Alaska Natives index typology	Alaska Natives (typology) weight scoring	Population below poverty (%)	Population below poverty index	Population below poverty index typology	Population below poverty (typology) weight scoring
50.6	1.0000	high	3	18.8	0.5251	medium	2
5.8	0.1146	low	1	11.7	0.3268	low	1
6.2	0.1225	low	1	35.8	1.0000	medium	2
12.5	0.2470	low	1	12.7	0.3547	low	1
9.1	0.1798	low	1	9.6	0.2682	low	1
6.9	0.1364	low	1	6.6	0.1844	low	1
22.1	0.4368	medium	2	6.0	0.1676	low	1
4.9	0.0968	low	1	2.2	0.0615	low	1
4.4	0.0870	low	1	23.8	0.6648	medium	2
20.9	0.4130	medium	2	10.6	0.2961	low	1
6.2	0.1225	low	1	9.3	0.2598	low	1
15	0.2964	low	1	7.5	0.2095	low	1
17.7	0.3498	low	1	0.0	0.0000	low	1
10.2	0.2016	low	1	6.1	0.1704	low	1
0.0	0.0000	low	1	0.0	0.0000	low	1
10.0	0.1976	low	1	7.3	0.2039	low	1

CNF (Cont…)

(-)			
Population age 25 & above hold highschool diploma (%)	Population age 25 & above hold highschool diploma index	Population age 25 & above hold highschool diploma index typology	Population age 25 & above hold highschool diploma (typology) weight scoring
48.9	0.0643	low	3
54.2	0.3743	medium	2
55.5	0.4503	medium	2
47.8	0.0000	low	3
49.9	0.1228	low	3
52.9	0.2982	low	3
55.8	0.4678	medium	2
64.9	1.0000	high	1
60.4	0.7368	high	1
59.9	0.7076	high	1
59.9	0.7076	high	1
56.9	0.5322	medium	2
61.8	0.8187	high	1
57.3	0.5556	medium	2
53.7	0.3450	medium	2
55.5	0.4503	medium	2

CNF (Cont…)

(-)					
Community employment diversity index	Community employment diversity index typology	Community employment diversity (typology) weight scoring	Average sum of community vulnerability index	Community vulnerability (typology)	Community
1.91	high	1	2.50	High	Copper Center
0.94	low	3	2.17	High	Hope
2.08	high	1	1.83	Medium	Kasilof
1.93	high	1	1.83	Medium	Palmer
2.09	high	1	1.83	Medium	Wasilla
1.96	high	1	1.83	Medium	Soldotna
1.80	high	1	1.83	Medium	Port Alsworth
1.69	medium	2	1.83	Medium	Cooper Landing
1.91	high	1	1.67	Medium	Sterling
1.82	high	1	1.67	Medium	Seward
1.96	high	1	1.67	Medium	Homer
2.11	high	1	1.67	Medium	Cordova
1.99	high	1	1.67	Medium	Gakona
2.16	high	1	1.50	Low	Valdez
1.78	high	1	1.50	Low	Moose Pass
2.11	high	1	1.33	Low	Anchorage-Girdwood

Appendix E. Detail Analysis of Community Vulnerability Using Ranking Approach.

TNF

Variables association	(-)				(-)			
Community	Population	Population Index	Population Index ranked from highest to lowest	Ranked index of population weight scoring	Median Income	Median Income Index	Median Income Index ranked from highest from lowest	Ranked index of median income weight scoring
Angoon	573	0.0153	9	14	29,861	0.0512	2	21
Hoonah	892	0.0242	15	8	39,028	0.3032	7	16
Kake	715	0.0193	12	11	39,643	0.3201	8	15
Elfin Cove	37	0.0004	3	20	33,750	0.1581	4	19
Klawock	846	0.0229	13	10	35,000	0.1924	6	17
Hyder	98	0.0021	5	18	62,034	0.9356	21	2
Yakutat	683	0.0184	11	12	46,786	0.5165	15	8
Pelican	253	0.0064	7	16	48,750	0.5704	16	7
Point Baker	35	0.0004	2	21	28,000	0.0000	1	22
Gustavus	426	0.0113	8	15	34,766	0.1860	5	18
Tenakee Springs	85	0.0018	4	19	33,125	0.1409	3	20
Coffman Cove	208	0.0052	6	17	43,750	0.4330	11	12
Wrangell	2,305	0.0635	18	5	43,250	0.4192	10	13
Meyers Chuck	21	0.0000	1	22	64,375	1.0000	22	1
Craig	1,424	0.0390	16	7	45,298	0.4755	12	11
Thorne Bay	576	0.0154	10	13	45,625	0.4845	13	10
Haines	1,794	0.0493	17	6	39,926	0.3279	9	14
Ketchikan	7,922	0.2195	20	3	45,802	0.4894	14	9
Sitka	8,835	0.2449	21	2	51,901	0.6571	19	4
Petersburg	3,258	0.0899	19	4	49,028	0.5781	17	6
Skagway	870	0.0236	14	9	49,375	0.5876	18	5
Juneau	36,011	1.0000	22	1	62,034	0.9356	20	3

TNF (Cont…)

(+)				(+)			
Alaska Natives (%)	Alaska Natives Index	Alaska Natives Index ranked from highest tp lowest	Ranked index of Alaska Natives weight scoring	Popn. Below Poverty (%)	Popn. Below Poverty Index	Population Below Poverty Index ranked from highest to lowest	Ranked index of population below poverty weight scoring
80.9	1.0000	22	22	27.9	0.5974	21	21
69.4	0.8578	20	20	16.6	0.3555	20	20
74.6	0.9221	21	21	14.6	0.3126	19	19
0.0	0.0000	1	1	5.6	0.1199	7	7
58.1	0.7182	19	19	14.2	0.3041	18	18
4.1	0.0507	3	3	46.7	1.0000	22	22
46.8	0.5785	18	18	13.5	0.2891	16	16
25.8	0.3189	17	17	4.7	0.1006	3	3
8.9	0.1100	9	9	4.9	0.1049	5	5
8.2	0.1014	8	8	14.0	0.2998	17	17
4.8	0.0593	4	4	11.8	0.2527	15	15
6.0	0.0742	7	7	4.9	0.1049	4	4
23.8	0.2942	15	15	9.0	0.1927	13	13
9.5	0.1174	10	10	0	0.0000	1	1
3.9	0.0482	2	2	9.8	0.2099	14	14
4.8	0.0593	5	5	7.8	0.1670	10	10
18.5	0.2287	13	13	7.9	0.1692	12	12
22.7	0.2806	14	14	7.6	0.1627	9	9
24.7	0.3053	16	16	7.8	0.1670	11	11
12	0.1483	11	11	5.0	0.1071	6	6
5.1	0.0630	6	6	3.7	0.0792	2	2
16.6	0.2052	12	12	6.0	0.1285	8	8

TNF (Cont…)

(-)			
Popn. Age 25 & Above Hold Highschool Diploma (%)	Popn. Age 25 & Above Hold Highschool Diploma Index	Population Age 25 & Above Hold Highschool Diploma Index rnaked from highest to lowest	Ranked index of population age 25 & above hold highschool diploma weight scoring
45.55	0.5817	4	19
46.86	0.5986	5	18
50.63	0.6472	6	17
0.43	0.0000	1	22
50.83	0.6497	7	16
42.86	0.5470	3	20
54.32	0.6947	9	14
39.92	0.5091	2	21
78	1.0000	22	1
68.94	0.8832	21	2
62.35	0.7982	18	5
59.13	0.7567	14	9
55.27	0.7070	10	13
61.90	0.7924	17	6
52.81	0.6753	8	15
58.68	0.7509	13	10
60.03	0.7683	15	8
56.58	0.7239	12	11
67.13	0.8599	20	3
55.99	0.7163	11	12
67.10	0.8595	19	4
60.37	0.7727	16	7

TNF (Cont…)

(-)					
Community employment diversity index	Community employment diversity index ranked from highest to lowest	Ranked index of community employment diversity weight scoring	Average sum of community vulnerability index based on the ranking	Community	Community vulenrability rank
1.57	5	18	19.17	Angoon	22
1.84	10	13	15.83	Hoonah	21
1.86	12	11	15.67	Kake	20
1.03	2	21	15.00	Elfin Cove	19
1.98	17	6	14.33	Klawock	18
1.23	3	20	14.17	Hyder	17
1.81	9	14	13.67	Yakutat	16
1.63	7	16	13.33	Pelican	15
1.26	4	19	12.83	Point Baker	14
1.75	8	15	12.50	Gustavus	13
1.97	16	7	11.67	Tenakee Springs	12
1.60	6	17	11.00	Coffman Cove	11
2.04	19	4	10.50	Wrangell	10
0.00	1	22	10.33	Meyers Chuck	9
1.93	14	9	9.67	Craig	8
1.94	15	8	9.33	Thorne Bay	7
2.08	22	1	9.00	Haines	6
2.08	21	2	8.00	Ketchikan	5
1.90	13	10	7.67	Sitka	4
2.03	18	5	7.33	Petersburg	3
1.86	11	12	6.33	Skagway	2
2.04	20	3	5.67	Juneau	1

CNF

Variables association	(-)				(-)			
Community	Population	Population Index	Population Index Ranking	Ranked index of population weight scoring	Median Income	Median Income Index	Median Income Index Ranking	Ranked index of median income weight scoring
Copper Center	362	0.0010	5	12	32,188	0.1588	2	15
Hope	137	0.0001	2	15	21,786	0.0000	1	16
Palmer	4,533	0.0170	13	4	45,571	0.3631	8	9
Seward	2,830	0.0105	9	8	44,306	0.3438	7	10
Port Alsworth	104	0.0000	1	16	58,750	0.5643	14	3
Kasilof	471	0.0014	7	10	43,929	0.3380	6	11
Gakona	215	0.0004	4	13	33,750	0.1826	3	14
Soldotna	3,759	0.0140	10	7	48,420	0.4066	11	6
Cooper Landing	369	0.0010	6	11	34,844	0.1993	4	13
Wasilla	5,469	0.0206	15	2	48,226	0.4036	10	7
Homer	3,946	0.0148	11	6	42,821	0.3211	5	12
Cordova	2,454	0.0090	8	9	50,114	0.4325	12	5
Moose Pass	184	0.0003	3	14	87,291	1.0000	16	1
Sterling	4,702	0.0177	14	3	47,700	0.3956	9	8
Anchorage-Girdwood	260,283	1.0000	16	1	55,546	0.5154	13	4
Valdez	4,036	0.0151	12	5	66,532	0.6831	15	2

CNF (Cont…)

(+)				(+)			
Alaska Natives (%)	Alaska Natives Index	Alaska Natives Index Ranking	Ranked index of Alaska Natives weight scoring	Popn. Below Poverty (%)	Popn. Below Poverty Index	Popn. Below Poverty Index Ranking	Ranked index of population below poverty weight scoring
50.6	1.0000	16	16	18.8	0.5251	14	14
5.8	0.1146	4	4	11.7	0.3268	12	12
12.5	0.2470	11	11	12.7	0.3547	13	13
20.9	0.4130	14	14	10.6	0.2961	11	11
22.1	0.4368	15	15	6.0	0.1676	4	4
6.2	0.1225	6	6	35.8	1.0000	16	16
17.7	0.3498	13	13	0.0	0.0000	2	2
6.9	0.1364	7	7	6.6	0.1844	6	6
4.9	0.0968	3	3	2.2	0.0615	3	3
9.1	0.1798	8	8	9.6	0.2682	10	10
6.2	0.1225	5	5	9.3	0.2598	9	9
15	0.2964	12	12	7.5	0.2095	8	8
0.0	0.0000	1	1	0.0	0.0000	1	1
4.4	0.0870	2	2	23.8	0.6648	15	15
10.0	0.1976	9	9	7.3	0.2039	7	7
10.2	0.2016	10	10	6.1	0.1704	5	5

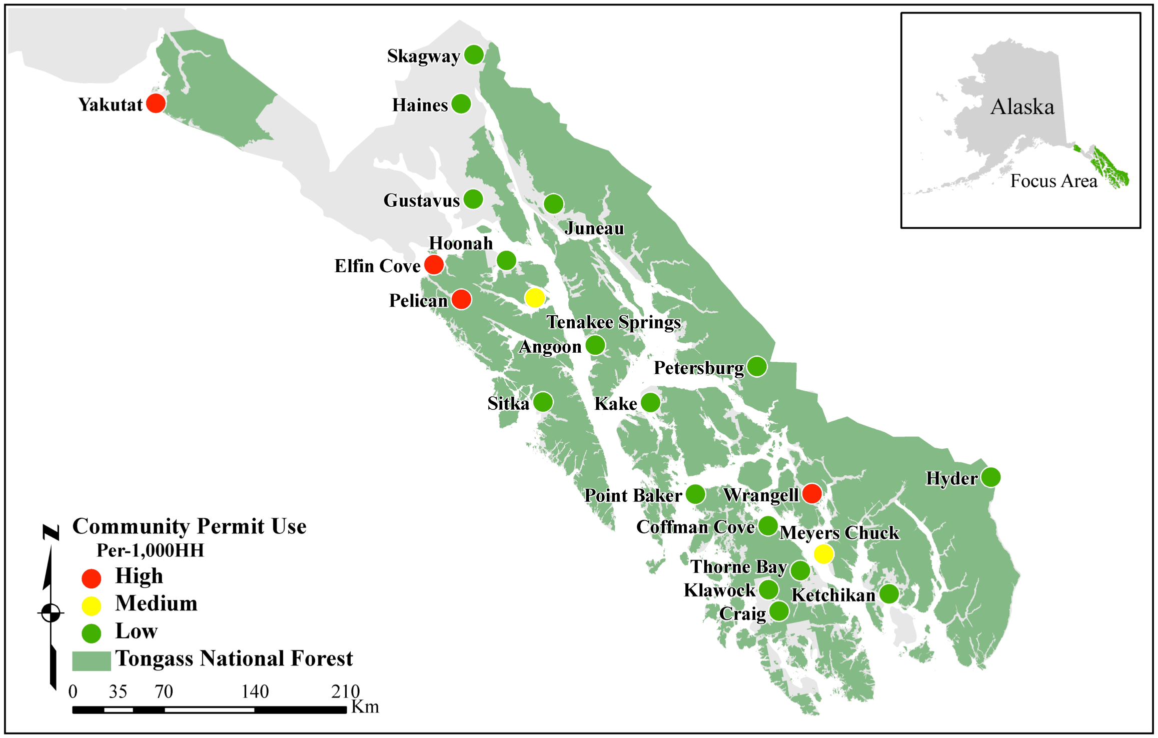
CNF (Cont…)

(-)			
Popn. Age 25 & Above Hold Highschool Diploma (%)	Popn. Age 25 & Above Hold Highschool Diploma Index	Popn. Age 25 & Above Hold Highschool Diploma Index Ranking	Ranked index of population age 25 & above hold highschool diploma weight scoring
48.9	0.0643	2	15
54.2	0.3743	6	11
47.8	0.0000	1	16
59.9	0.7076	13	4
55.8	0.4678	9	8
55.5	0.4503	8	9
61.8	0.8187	15	2
52.9	0.2982	4	13
64.9	1.0000	16	1
49.9	0.1228	3	14
59.9	0.7076	12	5
56.9	0.5322	10	7
53.7	0.3450	5	12
60.4	0.7368	14	3
55.5	0.4503	7	10
57.3	0.5556	11	6

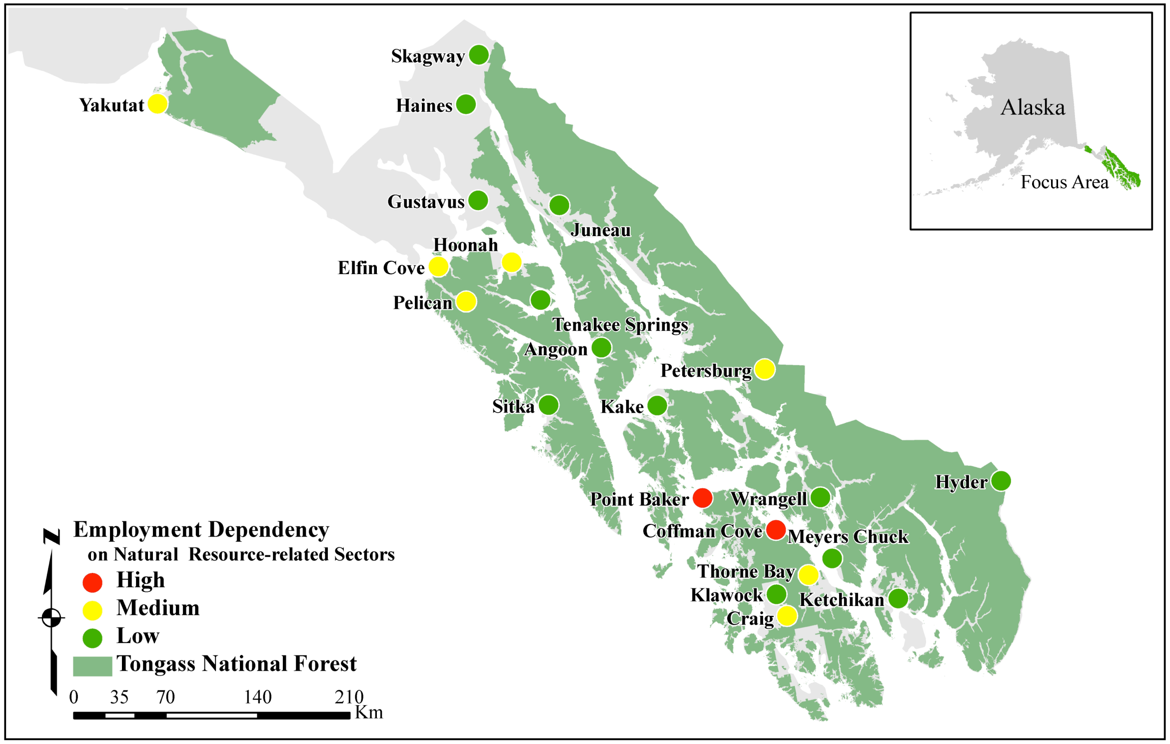
CNF (Cont…)

(-)					
Community employment diversity index	Community employment diversity index ranked from highest to lowest	Community employment diversity index weight scoring	Average sum of community vulnerability index based on variables index weight scoring	Community	Community vulnerability rank
1.91	6	11	13.83	Copper Center	16
0.94	1	16	12.33	Hope	15
1.93	8	9	10.33	Palmer	14
1.82	5	12	9.83	Seward	12
1.80	4	13	9.83	Port Alsworth	11
2.08	12	5	9.50	Kasilof	13
1.99	11	6	8.33	Gakona	10
1.96	9	8	7.83	Soldotna	7
1.69	2	15	7.67	Cooper Landing	5
2.09	13	4	7.50	Wasilla	8
1.96	10	7	7.33	Homer	6
2.11	15	2	7.17	Cordova	9
1.78	3	14	7.17	Moose Pass	2
1.91	7	10	6.83	Sterling	4
2.11	14	3	5.67	Anchorage-Girdwood	3
2.16	16	1	4.83	Valdez	1

Appendix F. Maps Showing Tongass Area Community Permit Use and Employment Dependency on the Natural Resources-Related Sectors.

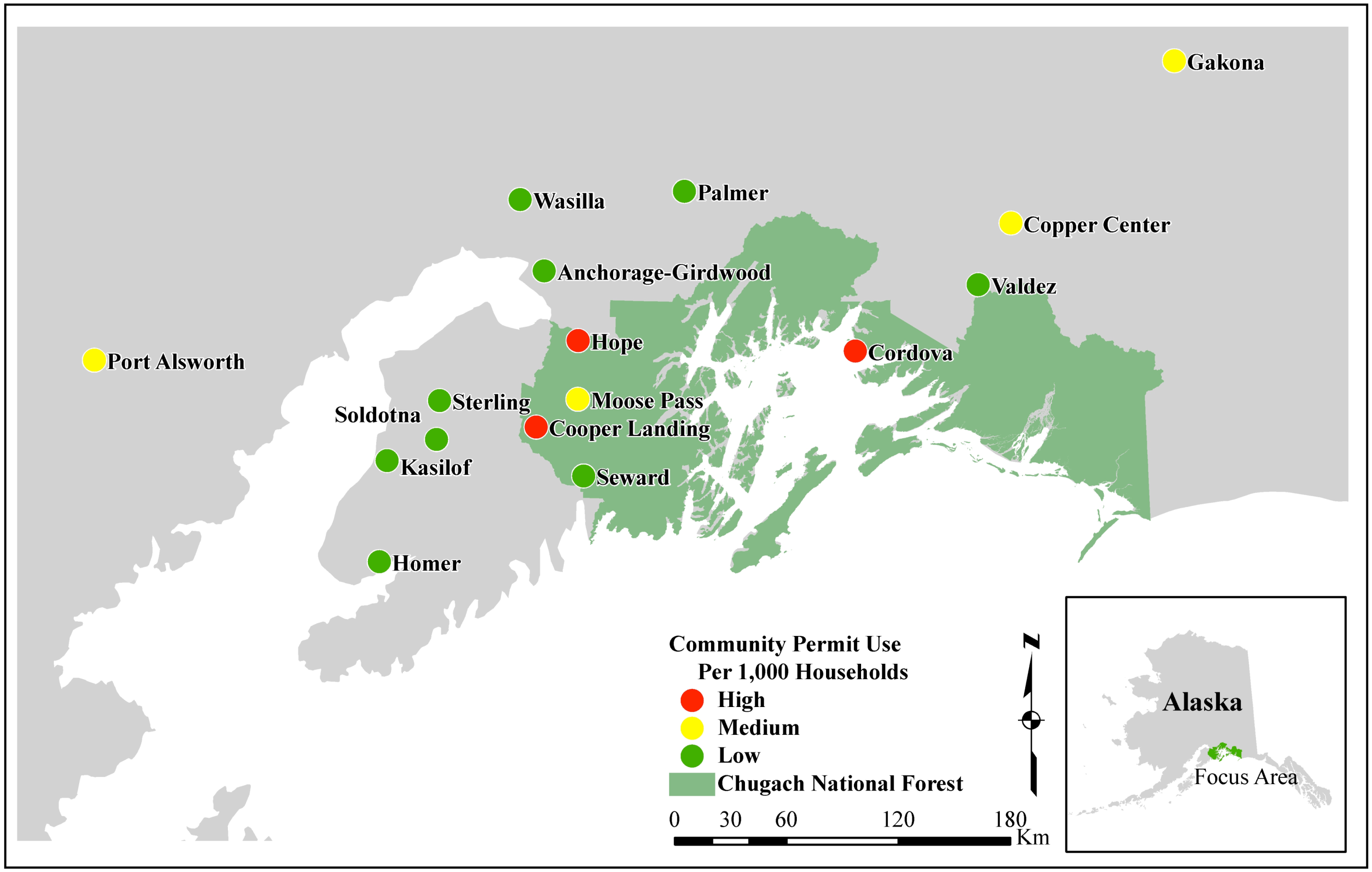


Tongass Area Community Permit Usage.

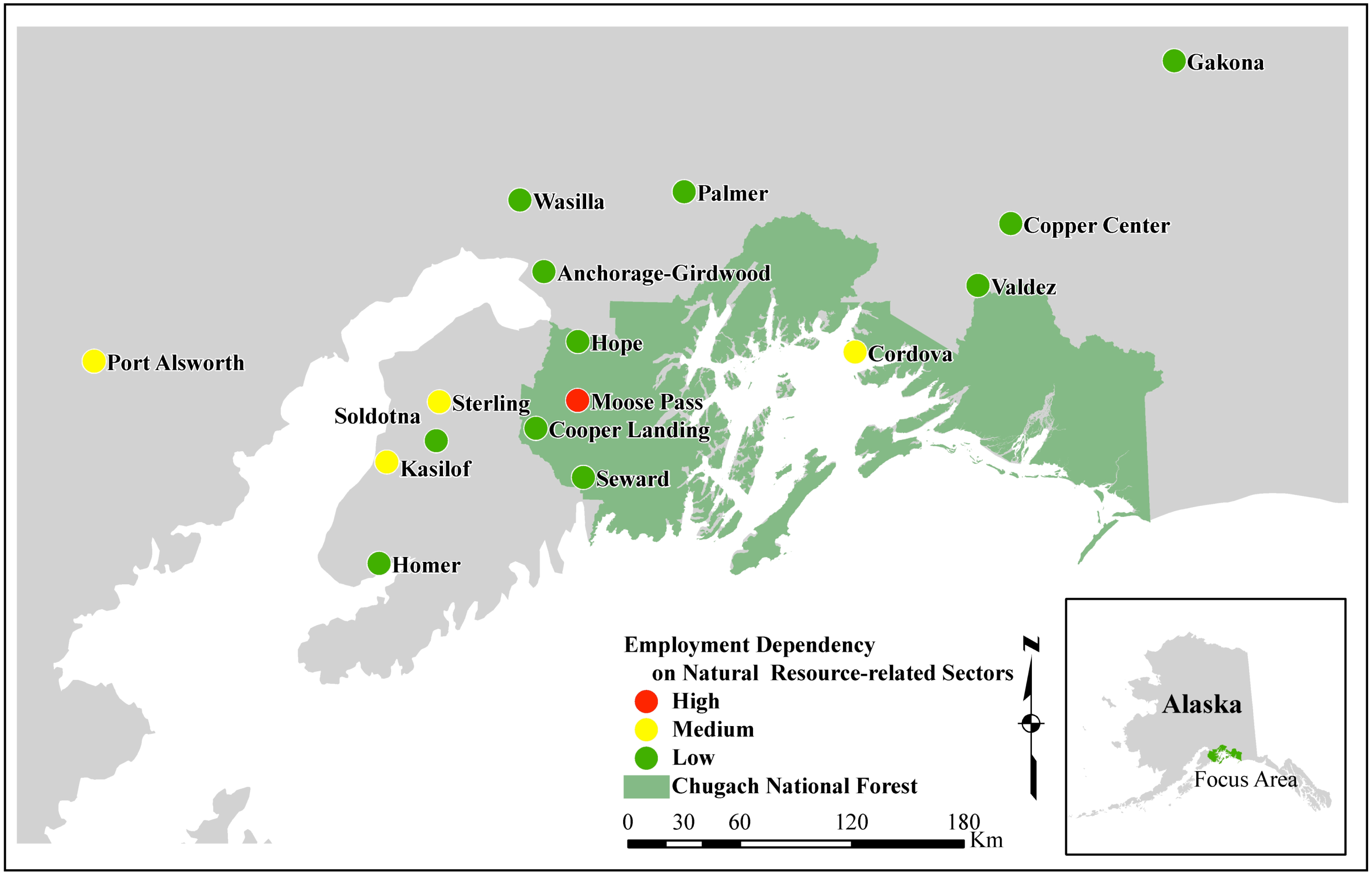


Tongass Area Community Employment Dependency on the Natural Resources-Related Sectors.

Appendix G. Maps Showing Chugach Area Community Permit Use and Employment Dependency on the Natural Resources-Related Sectors.



Chugach Area Community Permit Usage



Chugach Area Community Employment Dependency on the Natural Resources-Related Sectors.

CURRICULUM VITAE

Mekbeb Eshetu Tessema

EDUCATION

2011 **Ph.D, Human Dimensions of Ecosystem Science and Management,** Utah State University, Logan, Utah, United States of America

2004 **MS, Conservation Biology,** University of Kent, Durrell Institute of Conservation and Ecology (DICE), Canterbury, Kent, United Kingdom

1998 **Associate Degree, Wildlife Management,** College of African Wildlife Management, MWEKA, Moshi, Tanzania

1988 **Associate Degree, Forestry,** Wondo Genet College of Forestry, Shashemene, Ethiopia

JOURNAL PUBLICATIONS, TECHNICAL PAPERS AND PEER REVIEWED PROCEEDINGS

Mekbeb, E. T., R. J. Lilieholm, Z. T. Ashenafi and N. Leader-Williams. 2010. Community Attitudes toward Wildlife and Protected Areas in Ethiopia. *Society and Natural Resources*, **23** (6): 489-506.

Mekbeb, E. T., R. J. Lilieholm, D. J.Blahna and L. E. Kruger. 2009. Resource Use, Dependence and Vulnerability: Community-resource Linkages on Alaska's Tongass National Forest. *Ecology and Environment*, Vol.122: 263-272.

Mekbeb, E. T., R. J. Lilieholm and N. Leader-Williams. 2007. Community Perceptions of Wildlife and Protected Areas in Ethiopia. Peer reviewed proceeding, the George Wright Society, Biennial Conference on Parks, Protected Areas and Cultural Sites, St. Paul, Minnesota.

Mekbeb, E. T., R. J. Lilieholm and D. J. Blhana. 2007. Using Agency Data to Estimate Community-resource Linkages in the Grand Staircase-Escalante National Monument. Peer reviewed proceeding, the Grand Staircase-Escalante National Monument Science Museum: Learning from the Land, Bureau of Land Management, Cedar City, Utah.

Lilieholm, R. J., R. S. Krannich and M. E. Tessema. 2006. "2005 Utah Angler Survey." Salt Lake City, Utah: Utah Division of Wildlife Resources.

Mekbeb, E. T., M. Gashaw and K.Wakjira. 2002. Management Plan of Kafta Shiraro Wildlife Reserve in the Tigrai Region of Ethiopia. Tigrai Regional Bureau of Agriculture and Natural Resources, Mekele, Ethiopia.

Mekbeb, E. T. and B. Netsereab. 1993. An Assessment of Attitude of Local People towards Conservation Activities of Abijata Shalla Lakes National Park. Unpublished research paper submitted to Ethiopian Wildlife Conservation Organization, Addis Ababa, Ethiopia.

WORK EXPERIENCE

Graduate Research/Teaching Assistant, Department of Environment and Society, Utah State University (January 2005 – May 2011)

- Participated in Utah Anglers Survey Project funded by the Utah Division of Wildlife and co-authored a technical report submitted to the Utah Division of Wildlife Resources

- Conducted a study on Community Resource-use Linkages, Dependency, and Vulnerability in Southcentral and Southeast Alaska, a Project funded by Pacific Northwest Research Station of the U.S. Forest Service.
- Co-investigator of a research project (Community Resource-use Linkages to the Grand Staircase-Escalante National Monument) and, co-authored a peer-reviewed proceeding submitted to Learning from the Land Science Symposium, Cedar City, Utah.
- Participated in ecological field research (Avian Habitat Restoration on the Virginia Barrier Islands, Virginia), a joint project administered by Utah State University, the Nature Conservancy, and Virginia Museum of National History.
- Conducted a survey on forest visitors experience and satisfaction in Utah, a National level visitor experience and satisfaction survey funded by the US-Forest Service.
- Assisted teaching and grading ENVS1990 (Professional Orientation for Environment and Society 1990), a 2 credits course for incoming graduate students.
- Co-organized ENVS6800/7800 (Environment and Society Departmental Seminar), a 1 credit course offered in spring 2007.

Wildlife Expert, Park Warden, Park Development and Supervision Expert, Junior Wildlife Expert, former Ethiopian Wildlife Conservation Organization, Ethiopia (September 1988 – September 2002)

- Oversaw and coordinated management activities of various National Parks.
- Supervised National Parks staff and managed financial resources.
- Participated in periodic national-level wildlife survey and monitoring activities to determine quotas for commercial sport hunting.
- Participated in park planning and monitoring activities and co-authored management plan for various National Parks.
- Played a leading role in identifying community-based projects that assisted many local communities surrounding protected areas in Ethiopia through integrated development programs.
- Participated in a national-level evaluation process of community-based wildlife conservation and development programs.
- Collaborated with various stakeholders to normalize relationship between local communities and protected areas management.
- Secured funding ($25,000) from international donors for community-based conservation and development activities surrounding National Parks.

SHORT COURSES, WORKSHOPS AND FIELD TRAININGS

- **Certificate for Participation in Cameroon's Tropical Rainforest Expedition** organized by the Earthwatch fellowship program, Cameroon, 1999.
- **Certificate in Planning for Management of National Parks** in the context of community-participation and resource protection, Ngoronogoro Conservation Area, Tanzania, 1998.

- **Certificate for Planning for Resource Protection and Visitor Experience** in A destination Park (Lake Nakuru) in Naivasha, Kenya, 1997.
- **Certificate for Participation in an Environmental Education Workshop** organized by Ethiopian Wildlife and Natural History Society (EWNHS), Awasa, Ethiopia, 1996.
- **Certificate for Participation in Environmental Education Workshop organized** by the Ministry of Education, Nazareth, Ethiopia, 1993.

AWARDS AND SCHOLARSHIPS

- Research and Teaching Assistantships Award, Department of Environment and Society, Utah State University, and the Pacific Northwest Research Station of the USFS, January 2005-May 2011.
- University of Kent Overseas Student Scholarship Award, 2002-2004.
- The Charlotte Fellowship Program Scholarship Award of African Wildlife Foundation (AWF), 2002-2004.
- German Foundation for International Development (DSE) Scholarship Award 1996-1998.

PAPER PRESENTED TO INTERNATIONAL AND NATIONAL CONFERENCES

Mekbeb, E.T., R. J. Lilieholm, D.J. Blhana, and L.E. Kruger. Measuring Community Resource Access, Dependency, and Vulnerability in South-central and Southeast Alaska. Paper presented to the 17th International Symposium on Society and Resources Management, Madison, Wisconsin, USA, June 4-8, 2011.

Mekbeb, E.T., R. J. Lilieholm, D.J.Blahna and L.E. Kruger. Resource Use, Dependence and Vulnerability: Community-resource Linkages on Alaska's Tongass National Forest. Paper presented to the 17th International Conference on Ecosystem and Sustainable Development, Chianciano Terme, Italy, July 8-10, 2009.

Mekbeb, E.T., R. J. Lilieholm, D.J. Blhana and L J. Kruger. Using GIS and US-Forest Service permits data to describe community-forest linkages in Southeast Alaska. Paper presented to the 14th International Symposium on Society and Resources Management, Burlington, Vermont, USA, June10-14, 2008.

Mekbeb, E.T., R. J. Lilieholm, Z.T. Ashenafi and N. Leader-Williams. Community Perceptions of Wildlife and Protected Areas in Ethiopia. Invited paper presented on the 13th International Symposium on Society and Natural Resources Management, Park City, Utah, USA, June 17-22, 2007.

Mekbeb, E.T., R. J. Lilieholm and N. Leader-Williams. Community Perceptions of Wildlife and Protected Areas in Ethiopia. Paper presented on the Biennial Conference on Parks, Protected Areas and Cultural Sites, St. Paul, Minnesota, USA, April 16-20, 2007.

Mekbeb, E.T., R. J. Lilieholm and D.J. Blhana. Using Secondary Data to Estimate Community-resource Linkages in the Grand Staircase-Escalante National Monument. Paper Presented on Learning from the Land Science Symposium, Grand Staircase-Escalante National Monument, Cedar City, Utah, USA, September, 12-14, 2006.