4. Affected Environment

This chapter describes the physical, biological, social, and economic components of the ecosystem that could be affected by actions associated with management of Tetlin Refuge. This chapter is divided into six major headings: 4.1 Physical Environment Setting; 4.2 Biological Environment; 4.3 Human Environment; 4.4 Wilderness Values; 4.5 River Values; and 4.6 Refuge Infrastructure and Administration.

4.1 Physical Environment

Encompassing about 932,000 acres in the lower Chisana and Nabesna river drainages, Tetlin Refuge lies in an upland basin at the head of the Tanana Valley. Refuge boundaries form a rough triangle: the base runs east-west between the Canadian border and the Mentasta Mountains along the boundary of the Wrangell-St. Elias National Park and Preserve; the northeast boundary parallels the Alaska Highway; and the northwest boundary borders Tetlin Native Corporation lands. The Ladue and Fortymile river basins and their tributaries lie to the north of Tetlin Refuge.

4.1.1 Land Status

Tetlin Refuge, along with several additional national parks and wildlife refuges in Alaska, were established under the Alaska National Interest Lands Conservation Act of 1980. Drawn based on major ecological features, the boundaries for these new parks and refuges incorporated many lands already owned or selected by private individuals, organizations, or the State. The following discussion provides an overview of land actions occurring both before and after 1980, which shaped the current land ownership patterns within Tetlin Refuge.

Tetlin Refuge includes a large amount of State and private property within its borders. Native corporations own or have claims on approximately 16 percent of these lands, while the State of Alaska claims roughly five percent. There are also numerous Native allotments and privately owned small parcels within the Refuge. The Refuge is bordered on the northeast by the Alaska Highway, with one community, the Native village of Northway, located within the boundary. Two other villages, Tetlin and Tanacross, are located outside but near the Refuge.

World War II brought enormous changes to the Alaska Territory. For the first time, Federal funds and labor (mostly from the War Department) were sent north to build roads, airports, and other facilities. At the same time, numerous land grants, withdrawals, and other land actions occurred in the vicinity of what was to become Tetlin Refuge. In 1941, the Federal government withdrew from the public domain large areas of land near Northway and along the Alaska Highway for various military and civilian purposes. In 1954, private citizens began acquiring lands for homesites and commercial activities under the Trade and Manufacturing Act. Four years later, the first homestead was approved; the following year the State of Alaska began acquiring land in this area. In 1965, the Northway village site was officially deeded to the residents for a townsite, and two lots along the Alaska Highway were sold to private individuals. The Northway Airport was conveyed to the State of Alaska in 1966, and the first Native allotment was conveyed in 1967. Following the passage of the Alaska Native Claims Settlement Act (ANCSA) in 1971, village and regional corporations began selecting large blocks of land surrounding the village of Northway.

The passage of the Federal Land Policy and Management Act in 1976 repealed the authority for new entries under public land disposal laws. The remaining unappropriated land was retained in

Federal control. Although there are still some land selections within the refuge boundary that have not been reviewed, the Bureau of Land management has processed most existing, private land claims over the last 25 years. Current land ownership patterns within the Refuge are unlikely to change substantially (Figure 4-1).

Table 4-1. Land Status of Tetlin Refuge (all acreage figures based on BLM case file records)

Land Status Surface Estate	Acres Conveyed	Acres Selected	Acres Other	Acres Total	Percent Total
Northway Natives Incorporated					
Townsite	48	0	0	48	0.0%
ANCSA Village 12(a)(1)	76,280	4,083	0	80,363	8.6%
Doyon Limited					
ANCSA Regional 12(c)	60,565	1,296	0	61,861	6.6%
Ahtna Incorporated					
ANCSA 14(h)(1)	0	186	0	186	0.0%
ANCSA 14(h)(8)	0	6,669	0	6,669	0.7%
Native Allotments	6,957	1,449	0	8,406	0.9%
Private Landowners					
Highway Lots	12	0	0	12	0.0%
Homesites	13	0	0	13	0.0%
Trade & Manufacturing	76	0	0	76	0.0%
State of Alaska	45,070	971	0	46,041	5.0%
Withdrawals					
Civilian	0	0	185	185	0.0%
Military	0	0	45	45	0.0%
Submerged Lands[1]			45,375	45,375	4.9%
Tetlin National Wildlife Refuge	0	0	682,604	682,604	73.3%
Overlapping Land Selections	0	-384	0	-384	0.0%
All Lands	189,021	14,270	728,209	931,500	100.0%

1 This acreage figure is an estimate of all submerged lands contained within the Tetlin Refuge boundary. Using the 1/63,360 scale hydrography coverages prepared by the U.S. Geological Survey, the combined acreage of all lakes greater than 50 acres, and the Nabesna, Chisana, and Tanana rivers within the refuge boundary were calculated using ArcInfo software.

Major legislation affecting land ownership on Alaskan refuges includes the Alaska Statehood Act, the Alaska Native Claims Settlement Act as amended, the Alaska National Interest Lands Conservation Act as amended, the Homestead Act of 1862, and the Native Allotment Act as amended. These acts transferred lands from Federal to State and Native ownership.

The land status of Tetlin Refuge changes regularly as selected lands are conveyed, exchanged, or relinquished. Table 4-1 summarizes land status within the Refuge as of September 2005. Figure 4-1 shows the ownership of uplands, wetlands, and lakes smaller than 50 acres within the Refuge. Of the nearly one million acres within the refuge boundary, approximately 73 percent is owned by the Federal government. The remaining land has been selected or conveyed. Selected lands are administered by the Refuge until conveyance.

Figure 4-1. General Land Status – Tetlin National Wildlife Refuge

4.1.2 Climate

The continental subarctic climate of Tetlin Refuge is characterized by large seasonal temperature extremes (see Figure 4-2). Summer temperatures may be as high as 95 degrees Fahrenheit, although they usually range from 40 to 80 degrees Fahrenheit. Winter temperatures recorded at Northway are frequently the lowest in the state, dropping as low as -72 degrees Fahrenheit. Winds are uncommon during these very cold and dry periods. These conditions make the Upper Tanana Valley one of the coldest inhabited places in North America.

More than half of the 9.6 inches average annual precipitation occurs during the summer, usually the result of thunderstorms. Though recent summers have been very dry, extended rainy periods do occur during some summers. Snow can occur during any month, but the Refuge is usually snow free from mid-June to mid-August. Average annual snowfall is 37 inches with total accumulations of 12 to 24 inches. Snow in the region typically has a low density, resulting in low water content.

In addition to rain, summer convective storms also produce lightning, the primary natural cause of fires within and around the Refuge. Surface moisture and differential heating due to topography and vegetation are contributors to convective activity (Dissing and Verbyla 2004). South of the Refuge, the Nutzotin Mountains are too high to produce much lightning. The broad flat topography that characterizes most of the Refuge produces a much greater density of lightning strikes than the high country to the south, but significantly fewer strikes than the more mountainous terrain of the Fortymile and Ladue river basins to the north (Butteri 2004).

It is widely accepted by the scientific community that the earth, which has always experienced climate variation, is now undergoing a period of rapid climate change that is enhanced by anthropogenic atmospheric carbon enrichment during the past 100 years (Inkley et al. 2004). Historical trends and projections of declining snow cover during this century portend changes in boreal and alpine ecosystems. If air temperatures increase at projected rates, alpine snow cover will likely recede (IPCC 1996). Even small amounts of warming may eliminate some wetland plant and animals species in alpine regions (Burkett and Kusler 2000). Interactions and changes in forest dynamics due to disease and insects are also very likely in areas where warming is greater (Inkley et al. 2004).

Such climate change has the potential to affect fish, wildlife, and plants throughout North America— either directly or indirectly through responses to changing habitat conditions. The geographic ranges of North American flora and fauna are expected to shift upwards in elevation and northward over the next 100 years (IPCC 2002). Although the response will be diverse, such shifts could cause significant restructuring of existing plant and animal communities (Inkley et al. 2004).

4.1.3 Topography

Elevation across the Refuge averages 1,800 feet, ranging from 1,650 feet at the Tanana River to 8,000 feet along the crest of the Mentasta Mountains. The Nabesna, Chisana, and Tanana rivers, their tributaries, and associated sloughs and wetlands characterize the topography in Tetlin Refuge.

The Black Hills provide some relief between the Nabesna and Chisana rivers. East of the Chisana River at the southeast end of the Refuge, the high ground from Airs Hill to Wellesley Mountain constitutes a segment of the divide between the Tanana and White river basins. Northeast of the Black Hills, the broad floor of the Tanana Valley is dotted with innumerable lakes, ponds, and meander scars on a nearly flat plain at most 15 miles wide. Superimposed on this plain are large,

vegetated, windblown dunes of glacial flour. The largest concentration of dunes are southeast of Northway and in the area of Big John Hill.

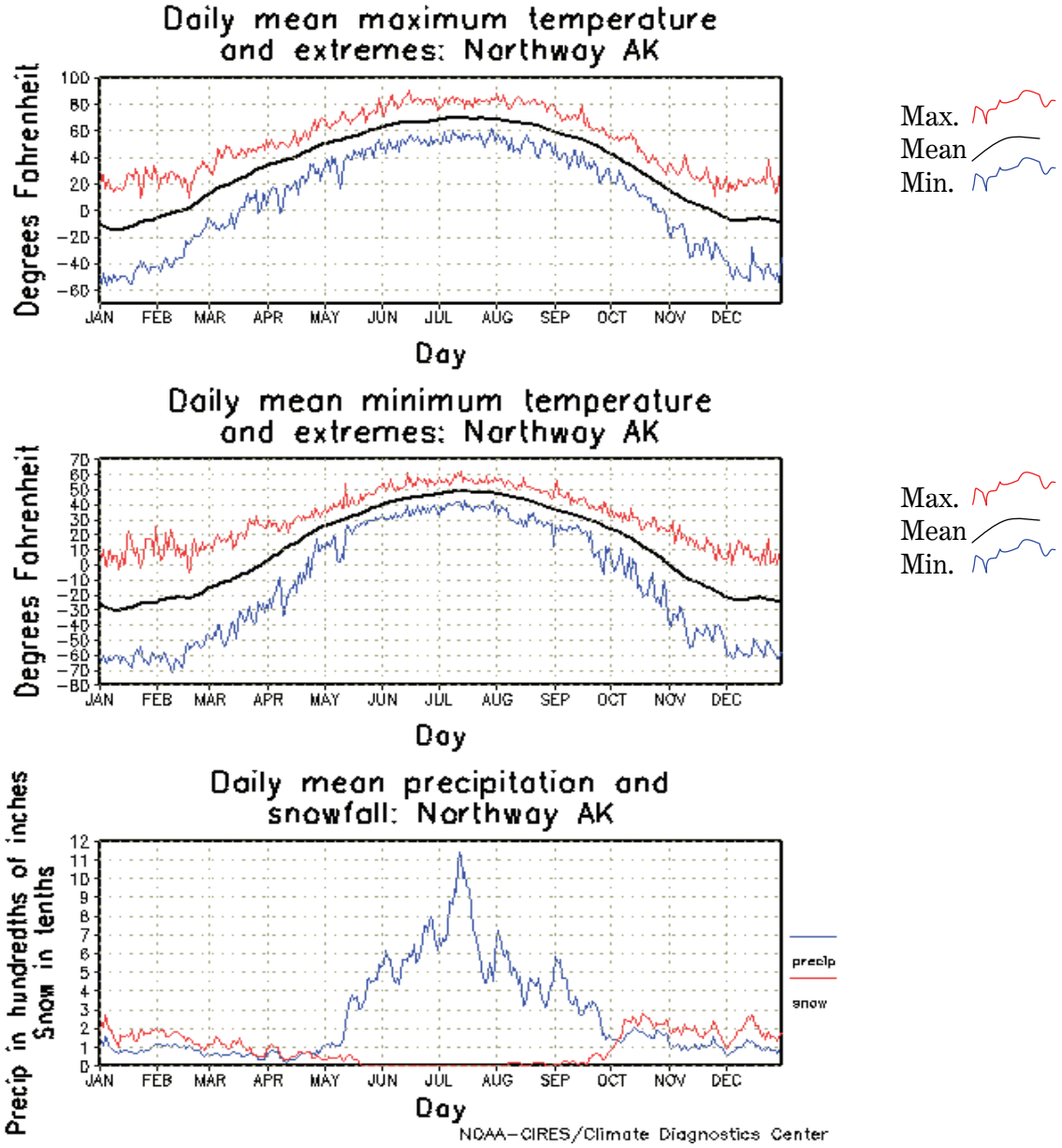


Figure 4-2. Climate information at Northway, Alaska

4.1.4 Geology

Alaska is geologically a mosaic of sutured land masses that geologists refer to as "terranes". The oldest terrane on the Refuge, the Yukon-Tanana, is also the oldest part of Alaska, or the first to be added to the margin of ancient North America perhaps 180 to 200 million years ago (Jones et al. 1982). The Yukon-Tanana is distinctive in that it is one of the few terranes made of rock originally formed as continental rock. The youngest terrane is Wrangellia; it collided with what was then the continental margin about 90 million years ago.

The rocks that make up these various terranes vary depending upon their initial formation. Most terranes associated with the Refuge contain granitic bedrock, conglomerates, coarse sandstone, lava flows and igneous intrusions (USFWS 1987a).

Two major "strike-slip" fault systems are associated with these terranes, and earthquake activity is frequent. The Denali and Totschunda fault systems extend northwest to southeast across the southwest corner of the Refuge. Along the Denali fault, earthquakes of up to 7.9 on the Richter scale have occurred as recently as November 2003 in the Northway and Mentasta Lake areas.

4.1.5 Glaciation

Formed by glacial processes, the large and flat Northway basin of the Upper Tanana Valley is filled with sediments deposited in moraines and outwash plains. These Quaternary age (0-2 million years before present [B.P.]) unconsolidated glacial, glaciofluvial, and fluvial deposits of silt, sand, and gravel several hundred feet thick cover nearly all the Refuge (Bascle et al. 1988). They were carried directly by huge glaciers from the massive ice cap covering the Wrangell Mountains, whose maximum extent once ranged as far north as the Black Hills, or indirectly by their meltwater streams and waterbodies. Quaternary deposition within the Refuge began during two major Pleistocene glacial periods: the Black Hills glaciation of Illinoian age, and the more recent Jatahmund Lake glaciation of Wisconsinan age. The Mesozoic sediments (slate, graywacke and conglomerate) that form the Mentasta and Nutzotin Mountains of the Alaska Range were also covered in ice with only the highest peaks protruding at the time of maximum glaciation (Moffit et al. 1910). The resulting landscape is dominated by lakes, ponds, wetlands, streams and the braided, glacier-fed Nabesna and Chisana rivers. Several small receding remnant glaciers remain in the southwest corner of the Refuge on high peaks at the head of the Cheslina River drainage.

Eolian deposits of sand and silt (loess) carried by winds off the glaciers formed dunes now found along much of the Alaska Highway corridor in roughly parallel waves, which stabilized from late Wisconsinan and post-glacial times (12,400-6,200 years B.P.).

4.1.6 Mineral Occurrences

Few igneous rocks (the primary source of metallic minerals) have been found within Tetlin Refuge, indicating little or no potential for valuable mineral deposits in most areas. Large portions of the Upper Tanana Valley have been investigated for mineral potential (Richter et al. 1975b). These investigations indicate deposits of valuable minerals, such as precious metals, are located primarily to the north and south of the Refuge.

An area from the Black Hills to Mirror Creek contains undivided sedimentary and mafic volcanic rock, possibly favorable for copper, zinc, silver or gold deposits (Anderson 1982). Other igneous intrusions are on the west side of the Refuge near Fern Lake and are the probable source of Cheslina River placer gold deposits reported by Moffit (1954).

Stream sediments contain anomalous amounts of gold in streams west of Jatahmund Lake and in a northern tributary of the Nabesna River. These anomalies indicate the existence of upstream sources that may contain concentrated metal, although no such sources have been identified to date. Stream sediments south of the Black Hills, from Mirror Creek to Stuver Creek, are anomalously high in chromium and nickel. Magnetic anomalies in the area between Mirror Creek and Takomahto Lake are a possible sign of above-average nickel and chromium content. Although this area is mostly covered by surficial deposits, an outcropping rich in iron and magnesium is

located south of Mirror Creek, with an isolated fragment of massive chromite (chrome oxide) nearby (Richter et al. 1975a).

4.1.7 Soils and Permafrost

The soils of Tetlin Refuge are dominated by fine-grained silts and clays mixed with pockets of sand, gravel, and organic deposits. Drainage through these soils is generally poor, resulting in discontinuous layers of permafrost at or near the surface. The extensive stands of black spruce that cover shallow permafrost areas are a good indicator of its presence. Black spruce stands are punctuated by white spruce, balsam poplar and aspen on the south and west facing slopes of hills and along the fringes of larger waterbodies where a combination of more soil warmth and/or better soil drainage reduce or eliminate surface permafrost.

Historical trends and projections of declining snow cover during this century predict many changes in boreal and alpine ecosystems. For example, duration and depth of snow cover are key variables in determining the hydrology of alpine wetlands (Inkley et al. 2004). Tetlin Refuge is in a zone of discontinuous permafrost, although frozen areas outnumber unfrozen areas. Permafrost influences plant growth because it impedes the downward penetration of roots, keeps the active soil layer cool, and inhibits water percolation. The active layer (the layer of soil that freezes and thaws each year) insulates permafrost. As permafrost thaws in alpine areas and Arctic regions, changes in groundwater mobility and increased slumping and flooding may occur, converting forests to grasslands and bogs (Parson 2001). Permafrost thawing affects the groundwater table as well, and is a significant factor in lake drying. Presence or absence of permafrost is probably the most important threshold regulating the structure and functioning of Alaska's boreal forest (Chapin 2004).

4.1.8 Nutrients and Nutrient Cycling

In the absence of any major disturbance (such as fire or flooding), boreal forest communities tend to accumulate large amounts of nutrients in plant tissue and other organic matter. In the cold Arctic climate, the process of decomposition is very slow in comparison with other temperate forest communities, and as forest succession progresses, these processes are slowed further. Where permafrost is present, many nutrients are tied up in frozen organic layers and are unavailable to plants (Heilman 1966; Heilman1968). The formation of permafrost prevents root penetration and water movement, which removes or leaches soil nutrients and effectively locks up many nutrients for decades or centuries. As shrub and deciduous trees are replaced by white and black spruce, nutrients available for grazers such as moose in the form of willow and alder decline and are instead concentrated into large trees and thick organic layers of feather mosses and lichens. The cooling of this organic matter from a dense overstory of mature spruce further reduces the microbial and insect activity that tends to break down dead and decaying plant matter.

4.1.9 Water Resources

Approximately five percent of Tetlin Refuge is covered in water—including rivers, streams, lakes, and ponds. Flooding is a natural disturbance process that helps to maintain habitat complexity and recharge lake and riparian nutrients. Flooding occurs after ice breakup during spring runoff in the non-glacial streams. Ice jams commonly block rivers already swollen by snowmelt runoff. Although the flood waters quickly recede, vegetation patterns, water quality and drainage patterns may be altered over large portions of the Refuge, affecting habitat availability and

quality for many fish and wildlife species. This annual flooding is responsible for creating and maintaining the diverse habitats that support the rich wildlife community of this Refuge.

4.1.9.1 Rivers and Streams

Tetlin Refuge is drained by the Nabesna and Chisana Rivers. Both rivers originate from glaciers in the Wrangell Mountains within the Wrangell-St. Elias National Park and Preserve, south of the Refuge. They braid and meander north to their confluence near Northway Village, where they form the Tanana River. The Kalutna River, a tributary of the Tanana River, forms a portion of the Refuge's western boundary. Watersheds on Tetlin Refuge are poorly defined, as the land between major rivers has very low relief (Lyons 2002).

Discharge from the glacial Nabesna and Chisana rivers begins to increase in late April or May due to melting snowpack. By the time the snow is gone, the glaciers begin to melt and the discharge continues to increase. The peak in the annual discharge normally occurs in late July to early August, with variations each day as the headwater glaciers thaw each day and freeze each night. By late August to early September, the discharge steadily decreases to winter low flow conditions.

For example, based on 23 years of gage measurements for the Chisana River, the average discharge ranged from a winter low of about 800 cubic feet per second to a summer high of about 6400 cubic feet per second. The greatest discharge recorded was 12,000 cubic feet per second on June 28, 1964.

The Chisana River is approximately 110 miles long and drains 3,300 square miles. Important tributaries of the Chisana include Stuver and Mirror creeks, which drain the southern plateau; Scottie and Desper creeks, which flow from the Tanana Uplands northeast of the Refuge; and Gardiner Creek, which originates in the Tanana Uplands north of the Refuge.

The Nabesna River is approximately 75 miles long and drains 2,100 square miles. Important tributaries of the Nabesna include the Cheslina River, which flows down the only high mountain-enclosed valley on the Refuge, and Lick Creek, which drains a portion of the Nutzotin Mountains.

Non-glacial streams are smaller and originate in the foothills that lie both north and south of Tetlin Refuge. In general, the discharge increases rapidly in May with the melting snowpack, peaking by early June, and then returning to a medium to low flow. Sharp spikes in the discharge may be expected during the summer in response to thunderstorms.

4.1.9.2 Lakes, Ponds, and Wetlands

Lakes and ponds range in size from less than an acre to nearly 3,000 acres. The northern portion of Tetlin Refuge is almost entirely occupied by wetlands. Smaller wetlands can be found near the eastern boundary along Scottie and Desper creeks, Mirror Creek, and American Wellesley Lakes. On the southern plateau, there are also small concentrations of ponds around Jatahmund Lake and Pickerel Lake. Fish and wildlife productivity is greatest in the lowland complexes of ponds, marshes, and streams in the northern portion of the Refuge.

4.1.9.3 Surface Water Quality

Both the Chisana and Nabesna rivers carry large loads of suspended solids that are deposited in the lowlands. Normal summer sediment concentrations from streams draining the Wrangell Mountains range from 500 to 2,000 milligrams per liter (USFWS 1987a). Most river waters contain only natural minerals in moderate amounts, but certain water quality samples taken

within the Refuge have exceeded Alaska water quality criteria for protection of aquatic life. This is not entirely unexpected, as the Refuge contains highly mineralized soils that contribute to elevated background mineral concentrations in stream water. Water quality parameters can be very different for highly turbid waters of glacial rivers such as the Nabesna and Chisana rivers. The Chisana and Nabesna rivers have fairly hard water, normal pH, and relatively high levels of calcium and magnesium (USFWS 1987a). One lake in the northwest corner of the Refuge has been documented with an iron content above recommended State drinking water standards (0.71 milligrams per liter).

There are no documented long-term water quality problems associated with placer mining in the Cheslina River, Nabesna River, and Scottie Creek drainages upstream from the Refuge. However, accurate and detailed assessments of water quality for these streams have not been completed. There is little known pollution entering the Refuge, and past incidents such as fuel spills adjacent to the Refuge have not been shown to have any negative effects on refuge resources.

4.1.10 Fire Regime of the Upper Tanana Valley

At a regional scale, the occurrence, frequency, size, season of occurrence, distribution, intensity, and severity of fire in the upper Tanana Valley remain much as they have for several thousand years. The most significant changes to this natural fire regime are confined to road corridors and areas surrounding local communities.

4.1.10.1 Fire Occurrence and Frequency

There is evidence of wildland fire through most of the upper Tanana Valley below 2,500 feet in elevation. Though reliable records have only been kept since the 1950s, fire has played a major role in influencing both distribution and diversity of habitats in the upper Tanana. Until the 1940s, nearly all fire occurrences were the result of lightning, although there is evidence that local Athabascan residents used wildfire for various purposes. From 1956 through 2006, 66 percent of the 1,100 fires in the Tok Area fire management zone were human-caused (see Figure 4-3).

4.1.10.2 Fire Size

Although lightning is responsible for only 33 percent of 1956-2006 ignitions in the Upper Tanana Valley, lightning fires account for nearly 90 percent of the total number of acres burned over that same period (Figure 4-4). Human-caused fires are most prevalent in populated areas where values at risk often require aggressive suppression efforts. Most human-caused fires are initially attacked and suppressed at a small size, whereas many remote lightning fires are allowed to burn until they go out naturally. In the absence of active suppression, the final sizes of Upper Tanana Valley fires are determined by a variety of factors. The later in the season a fire starts, the less time it has to spread. Weather is important not only on ignition day but over the duration of the fire. Fires can hold over during long periods of moist weather and become active again after a drying period. High winds can cause a fire to quickly grow. Fuel continuity also determines whether a fire can continue to grow. Waterbodies and rocky areas are firm barriers that can only be breached by spotting. Hardwood stands, wet areas, and old burns may also serve as barriers; reduced fuels within these areas will usually limit fire behavior and slow spread. Consequently, some fires may burn only a few square feet, while others that continue throughout a summer burn thousands or even hundreds of thousands of acres. From 1956 through 2006, 1,172 Tok Area fires burned 2,263,956 acres. Just sixteen fires accounted for over 2 million of these acres, and in 2004 alone, 3 million Tok Area acres burned.

Record temperatures and drought conditions in 2004 allowed six lightning-caused fires in the Upper Tanana Valley and adjacent Fortymile River Valley to burn over 1.7 million acres— more area than all fires in the previous 45 years combined. The 42,600-acre Black Hills fire in 2003 accounted for more than 40 percent of all acreage burned by wildfire within the Refuge over the past 18 years. It was the largest single wildfire in the Refuge's 25 year history.

4.1.10.3 Fire Season

Fire season in the Upper Tanana Valley is highly variable (Figure 4-5). In some years, it begins as soon as the snow has melted in early to mid-May. Typically, these early fires are human caused, though lightning-caused fires may also occur. Because of the low moisture content in local snow, the severity of this early season is more dependent on spring breakup conditions than it is on the amount of overwinter precipitation. Rapid thawing allows moisture to percolate downward, leaving surface fuels dry, while a slow breakup impedes drying by holding moisture close to the surface above frozen layers. Early season fires tend not to burn deeply but may burn intensely and spread quickly across the surface.

As green-up progresses and live fuel moistures rise during late May and early June, fires become less frequent for a time. As days lengthen further, increased differential heating becomes more conducive to convective activity, and causes surface fuels to dry in the absence of significant rain. This effect peaks from mid-June to mid-July and is the basis for the main upper Tanana lightning fire season. This period coincides with increased human presence in the wildlands and the majority of human-caused fires. The most active fire years are often characterized by large, stable high-pressure systems over the interior, which results in prolonged periods of hot, dry weather and more frequent low-precipitation thunderstorms. Other years are characterized by a series of low-pressure systems that sweep across the valley and bring widespread rain.

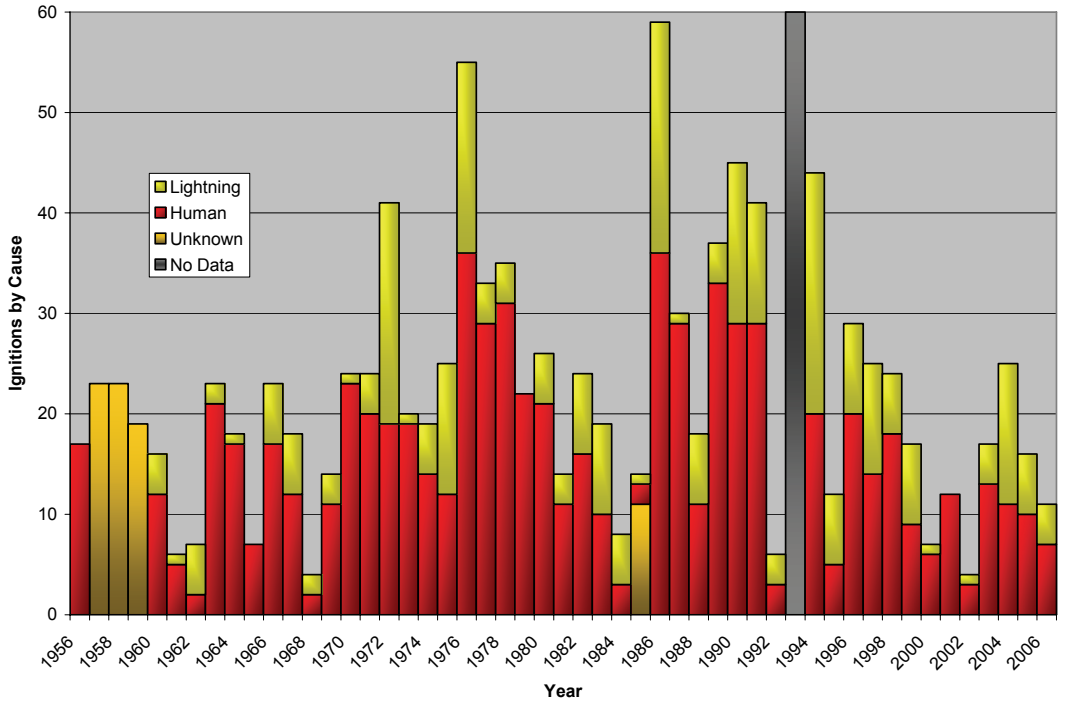


Figure 4-3. Tok Area Fires by Cause 1956-2006

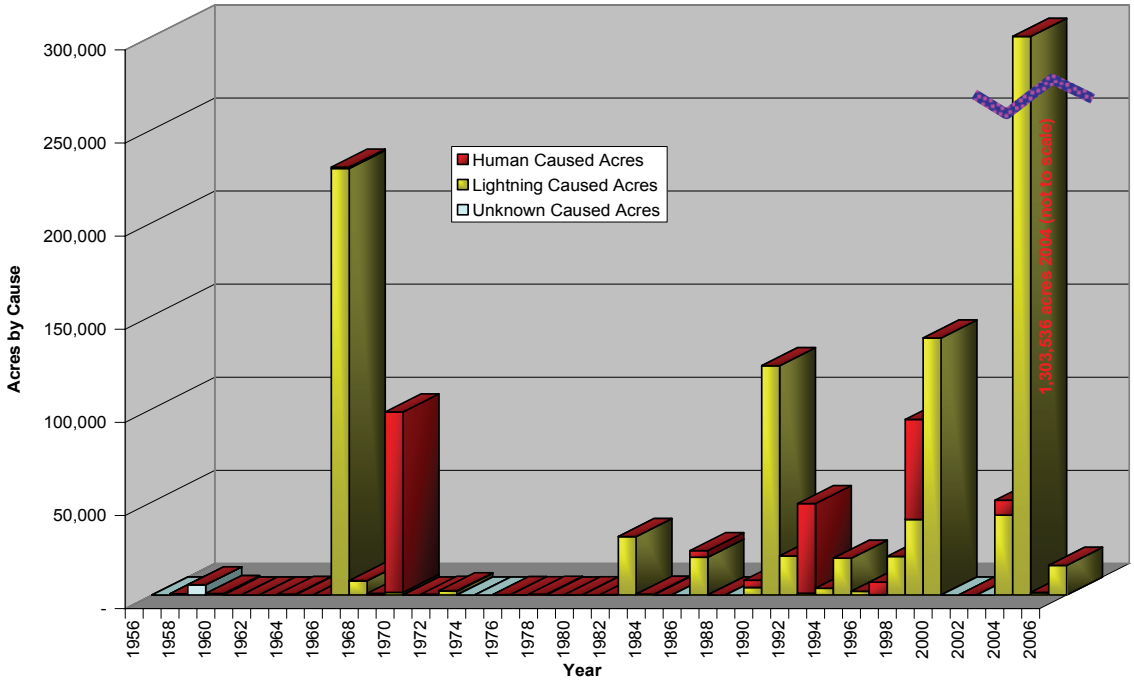


Figure 4-4. Tok Area Burned Acres by Cause 1956-2006

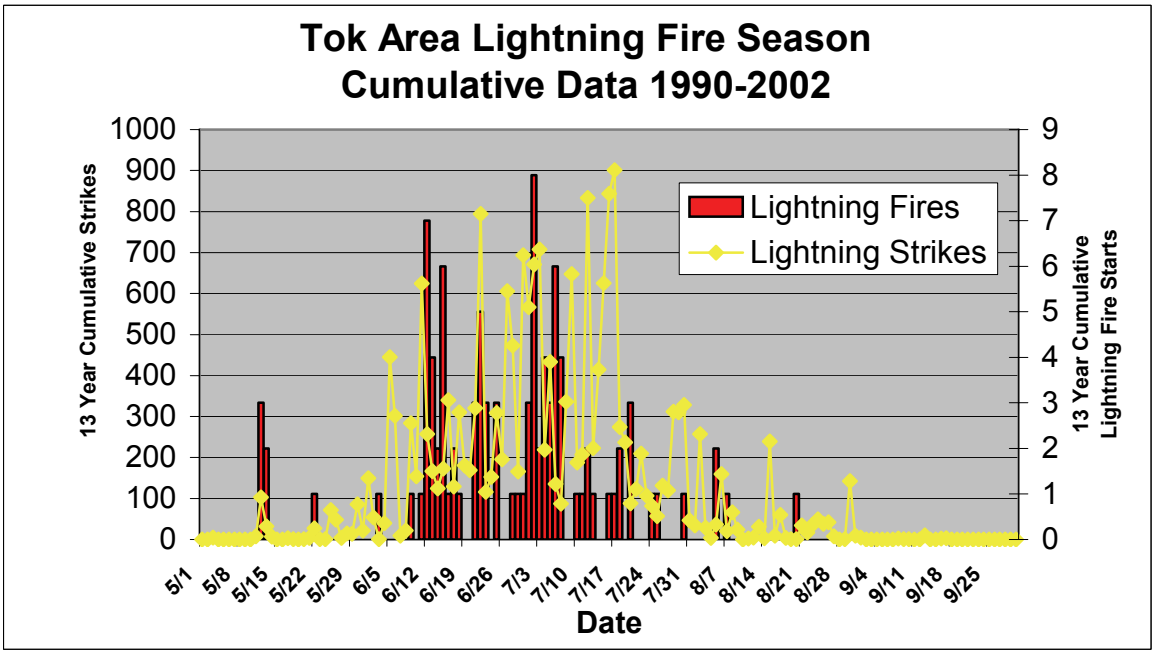


Figure 4-5. Tok Area Lightning Fire Season, Cumulative Data 1990-2002

By mid July, thunderstorm activity begins to lessen due to shorter days and less intense sunlight. Fuels can remain dry, allowing ongoing fires to continue burning; however, new ignitions occur less often. Typically, large high-pressure systems give way to systemic moisture sometime in August. Without moisture, a late season can extend into September, usually relying on careless hunters for ignition sources. Although fires can burn into October if snowfall is delayed, rarely do they spread significantly.

4.1.10.4 Fire Return Interval

In spite of the difficulties in determining fire return intervals in Alaska, several researchers have estimated the length of the fire cycle in interior Alaska. In forests dominated by black spruce, fires typically occur every 50 to 100 years (Heinselman 1983; Rowe et al.1974; Viereck 1983). In wetter lowland bog areas and muskeg, conditions must be dryer and more extreme for large sustained fires. Typically these areas burn every 100-150 years (Heinselman 1981). The frequency of wildfire in white spruce or mixed white spruce/hardwood forest varies considerably (50-300 years) depending upon local climate and topography, but generally occur less frequently than in black spruce forests (Duchesne and Hawkes 2000; Rowe et al. 1974).

4.2 Biological Environment

4.2.1 The Boreal Forest Ecosystem

The presence of people predates the modern-day boreal forest in Alaska, which has evolved over approximately the past 9,000-6,000 years. Chapin (2004) provides the following overview of the boreal forest. It is the second most extensive terrestrial biome on earth (Whittaker 1975) and has many characteristics that set it apart from other ecosystems. It has a cold, dry climate, making it potentially sensitive to climate change. It has few dominant tree species, so changes in these tree species have large ecosystem impacts. It is relatively undisturbed by current human activities. Productivity and diversity is low relative to other forests (Grower et al. 1997; Waide et al. 1999), but boreal forests provide habitat for fish, grazers, and birds.

A defining characteristic of the boreal forest ecosystem is the cycle of wildfire and its influence on the distribution, abundance, and connectivity of various plant community types and habitats. Because of this significant relationship, the boreal forest is often referred to as a "fire dependent" ecosystem—meaning if fire were entirely removed, there would be a dramatic and permanent change in the vegetation, fish, wildlife, and habitats which now exist.

4.2.2 Vegetation

Vegetation communities found on the Refuge range from closed black spruce forests to alpine tundra and shrublands. Most of the communities are interspersed with wetlands. The southern half of Tetlin Refuge is primarily forested uplands, while the northern half consists of a low floodplain including large areas of muskeg. Within Tetlin Refuge, forest cover types dominate at elevations below treeline (3,200 feet). Open (25-60 percent tree cover) stands of black spruce are particularly common in low-relief, wet terrain. White spruce, sometimes growing with paper birch and aspen, can be found in better drained and warmer sites. Paper birch, willow, and aspen may dominate following fire, especially on southern exposures.

Willow, arctic dwarf birch, lowbush cranberry, cottongrass, and Labrador tea are common on most sites. Feathermoss covers the ground in well-drained sites and forests. Poorly-drained

wetlands consist primarily of tussocks of cottongrass and sedges. Above treeline, arctic dwarf birch, willow, lowbush cranberry, crowberry, and white mountain avens dominate.

The vegetation of Tetlin Refuge and the surrounding area was mapped at the 1:250,000 scale, using Landsat satellite imagery. The Landsat photo, taken in September 1977, was interpreted at the U.S. Geological Survey EROS field office in Anchorage by interactive digital manipulation (Talbot et al. 1984, USFWS 1987a). Five major vegetation cover classes were distinguished during this process (Talbot et al. 1984, USFWS 1987a).

1. Forest (65 percent of refuge landcover): These forested areas are characterized by trees 16 feet tall or taller, or in the intermediate successional stage less than 16 feet tall but growing. Depending upon soils and topography, climax forest communities are dominated by an overstory of either black or white spruce.

The majority of forest on the Refuge is dominated by black spruce, which is found in cooler wet lowland sites and north-facing slopes. A carpet of feather mosses and lichens is very common as a primary component of the understory. Graminoid tussocks, various shrub willow species and ericaceous shrubs such as blueberry, crowberry, leatherleaf, and labrador tea may also be present. Sphagnum moss may be present on moister sites.

White spruce forests are more commonly found on warmer well-drained sites such as alluvial deposits. On lowland sites, paper birch and balsam poplar may be components of the overstory, with quaking aspen as a component on upland sites. The understory may include tall shrub willow, alder, prickly rose, and a shallow carpet of feather mosses.

Mid-successional stage forest communities are dominated by broadleaf hardwood species (quaking aspen, balsam poplar, and paper birch) or mixed stands of spruce and hardwood species. Aspen species are well adapted to regeneration following fires and will quickly recolonize an area from suckers on their extensive root system, which is well insulated from the heat of most fires by the surface layer of organic matter and soil. Both aspen and paper birch can also regenerate from their root collars where the roots spread out from the base of the stem (Duchesne and Hawkes 2000). The ability of the tree to regenerate depends upon fire intensity and severity.

2. Deciduous Scrub (5 percent of refuge landcover): Sites of this vegetation class are composed predominantly of deciduous shrubs ranging from 1.5 to 16 feet in height. On the Refuge, scrub occurs primarily along water courses, in poorly drained sites, in alpine and subalpine zones, and as early successional stage plant communities in disturbed or burned areas. Scrub stands on well-drained sites are typically dominated by willow and alder, which are important forage species for animals such as moose and snowshoe hare. Shrubs quickly revegetate burned areas and provide important forage and habitat for wildlife, and nutrients, such as nitrogen, which all plants need to grow. Browsing by moose and snowshoe hares, combined with nitrogen added by symbiotic bacteria, help the forest progress to the next stage of succession (Chapin 2000).

3. Dwarf Scrub (21 percent of refuge landcover): Sites in this vegetation class contain slow-growing dwarf shrubs less than 1.5 feet tall, chiefly in the heath and crowberry families. An abundance of mosses and lichens grow among the dwarf shrubs. Dwarf shrub-graminoid tussock peatland covers much of Tetlin Refuge.

4. Herbaceous Vegetation (3 percent of refuge landcover): This includes graminoid marshes, which are wetlands periodically inundated with standing or slowly moving water, found along lake

shores and in alluvial sites. There is also the aquatic forb subclass, which consists of freshwater communities of rooted aquatic plants structurally supported by water.

5. Sparsely Vegetated Areas (3 percent of refuge landcover): In this class, plants are scattered or absent, and bare mineral soil or rock dominates the landscape.

Several inventories have documented a variety of plants occurring on Tetlin Refuge, including surveys of lichens and bryophytes (Schofield and Talbot 2001, Talbot et al. 2007). The Refuge also maintains a herbarium and associated database.

4.2.2.1 Invasive Non-native Plant Species

Invasive non-native plant species pose a significant risk to ecological stability and integrity. Species observed along the highway corridor include: common yarrow, common plantain, smooth brome, narrowleaf hawksbeard, alsike clover, white sweetclover, and yellow sweetclover. White sweetclover is the most widespread and is often found along the highway in contiguous stands 75 to 150 feet long. There is concern that sweetclover could invade riparian corridors on the Refuge. The establishment of more noxious weeds is also a concern; Russian and spotted knapweed have already been reported in the Yukon and other parts of Alaska.

4.2.3 Boreal Forest Succession and Habitat Mosaics

As shown in Figure 4-6 (Chapin 2004), the relationship of soil moisture and soil temperature greatly influence forest succession and are significant factors influencing climax boreal forest communities. On the wettest and coolest soils, climax forests are characterized by black spruce with an herb seral stage in secondary succession. At the opposite end of the spectrum, in the driest and warmest soils, climax forests are characterized by aspen, also with an herb seral stage. In between these extremes are more complex secondary succession processes with climax overstories of white or black spruce, and seral stages of herb communities followed by aspen or birch, depending upon soil moisture and temperature. These succession cycles tend to remain relatively constant. However, changes in environment, disturbance regime, or post-disturbance seed availability can shift a stand to a new successional trajectory (Chapin et al. 2006).

Foote (1983) identifies six seral stages of secondary succession in white and black spruce forests following fire disturbance: newly burned, moss-herb, tall shrub-sapling, dense tree, hardwood or mixed hardwood-spruce and spruce. Essentially, if forest succession on both white and black spruce sites is broken into these six seral stages, there is a potential for 12 different forest communities to occur across the landscape at any given time. When combined with other landcover types, such as tundra, wetlands, and lakes, the potential for a diverse mosaic becomes readily apparent.

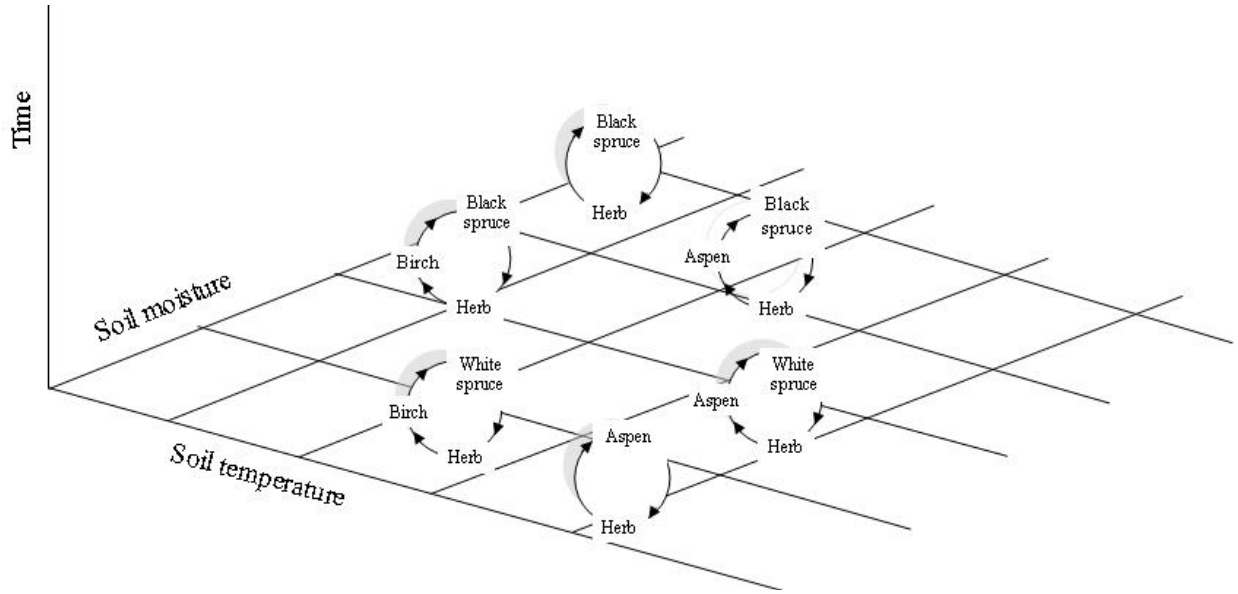


Figure 4-6. Successional trajectories in interior Alaska along soil temperature and moisture gradients (Chapin 2004)

4.2.4 Fire Severity

4.2.4.1 Fire Severity–Black and White Spruce Forests. Fires in the boreal black spruce and white spruce ecosystems are large and frequent due to the dry continental climate, the flammable nature of the forest, and the continuity of fuels extending from ground level to the forest crown (Heinselman 1981; Viereck 1983). Feathermoss understories typical of the type also form large, horizontally continuous, and well-aerated fuelbeds. Most fires in black spruce forests are either severe ground fires or crown fires of sufficient intensity to damage or kill both the overstory of spruce and the entire understory vegetation (Duchesne and Hawkes 2000). However, these fires do not burn with consistent intensity or severity over these large areas, and often a patchwork of unburned, lightly burned, and moderately burned areas is created with a very irregular line of burned and unburned vegetation along the fire perimeter (TNWR 2001). Spruce fires can smolder deep in the duff and hold over through long periods of high relative humidities and moderate rainfall.

4.2.4.2 Fire Severity–Hardwood and mixed spruce/hardwood forests. While not as significant in terms of acreage, this forest type plays an important role in terms of wildlife habitat and wildfire behavior.

The shading overstory and deciduous leaf litter of hardwood and mixed forests create moist, cool conditions and compact litter layers with less available fuel than is found in spruce forests. Fire fuels in these hardwood and mixed hardwood forests typically do not form a continuous ladder from the ground to the tree crowns, usually resulting in surface fires. Because of these forest characteristics, hardwood stands often serve as natural fuel breaks where fires typically smolder in the forest understory and spread slowly.

4.2.4.3 Fire Severity–Shrublands and sedge tussock-mixed shrub tundra. Next to spruce forest, this is the most common vegetation type found on the Tetlin Refuge. It is characterized by light flashy fuels whose moisture content responds quickly to modest changes in relative humidity. These

fires tend to burn quickly and intensely, skipping over and around standing water between the tussocks and pockets of sphagnum moss. Wind contributes to high rates of spread and short- to medium-range spotting. With a little moisture, these fires go out quickly; they do not hold over for long. Moderately intense fires may kill the above-ground plant parts, but seldom burn the below-ground parts or kill the plant (Bliss and Wein 1972; Van Wagner 1983; Viereck and Schandelmeier 1980). In dryer conditions, fires in these shrublands and tussocks may have high rates of spread and intensity (TNWR 2001) which can easily carry the fire into adjacent spruce forests.

4.2.5 Amphibians

Of the six species of amphibians known to occur in Alaska, only the wood frog occurs on Tetlin Refuge. Increased sightings of malformed frogs throughout North America raised concerns about possible exposure to environmental contaminants. The U.S. Fish and Wildlife Service began investigating the prevalence of abnormal amphibians in 2000 on refuges across the United States (Trust and Tangermann 2002); work within Tetlin Refuge began in 2003. Preliminary results found most sites at Tetlin have had more than three percent abnormal frogs (Reeves and Trust 2006). Abnormalities include malformations, such as shrunken limbs and abnormal eyes. Except for one site sampled in 2005, only developed sites have been assessed at Tetlin. The abnormalities at Tetlin are similar in nature and number to abnormalities at Kenai, and the prevalences are as high as or higher than documented in most published studies of North American wild frogs.

4.2.6 Fish

Fourteen species of fish occur on Tetlin Refuge (Appendix C). Although salmon occur in the region, they are not abundant and are not targeted in the local fishery. Local subsistence users report that chum salmon were once caught in large numbers within Tetlin Refuge, but they are only occasionally harvested now. Chinook salmon are found in the Tanana drainage but only incidental catches are reported from the Chisana River (USFWS 1990).

4.2.6.1 Humpback Whitefish

A historic and traditional whitefish subsistence fishery is located near Northway and Fish Lake; humpback whitefish is the primary species harvested. Surveys completed in the 1980s estimated the average household harvest of whitefish to be 375 pounds per year in Northway (Case 1986) and 569 pounds per year in Tetlin (Halpin 1987). A more recent survey indicates an average of 16,156 pounds per year harvested by Northway residents in 2005-2006 and 10,756.52 pounds per year harvested by Tetlin (Friend et al. 2007).

Local residents have expressed concerns about possible declines in humpback whitefish populations. In response to these concerns, a five-year telemetry study of adult humpback whitefish was initiated in 2000 (Brown 2006). This study found that humpback whitefish in the upper Tanana River basin exhibit distinct migratory movements and consistently return to the same areas year after year during their migrations. In spring and early summer, adult fish can be found feeding in various lakes throughout the valley. By late summer, they have dispersed downstream from these lakes into the Tanana River and its major tributaries. As fall approaches, these same fish move upstream to congregate in discrete sections of the Nabesna and Chisana rivers to spawn. Once spawning is complete, they return downstream to overwinter primarily in the Tanana and Chisana rivers. During the study, adult humpback whitefish were captured in four different locations spanning approximately 70 miles of the Tanana River, but were shown to spawn in only two small spawning areas (10 to 12 miles long) within the Refuge on the Nabesna and Chisana Rivers (Brown 2003).

4.2.6.2 Burbot

Burbot are also an important fish resource within Tetlin Refuge. A 1983 telemetry study demonstrated that most of the 21 fish captured remained within the Tanana, Nabesna, and Chisana rivers throughout the year, including upstream movements between November and March. The proximity of individual fish during winter suggested a potential spawning area (Breeser et al. 1988). Burbot have also been found in both Jatahmund and American Wellesley lakes.

4.2.6.3 Other Fish

Northern pike are widely distributed in lakes and streams throughout the Refuge and are an important component of both subsistence and recreational harvest. Pike are also a major predator of fish, frogs, and ducklings and may even take small mammals (Morrow 1980). Arctic grayling is also a species important to recreational and subsistence harvest. Grayling are caught in many clear water creeks on the Refuge. Many local people ice fish for burbot and pike during late winter.

Longnose sucker is found in most streams on the Refuge and is an important forage species for other fish. Longnose suckers spawn in refuge streams in early spring. Large concentrations of fry commonly occur during summer. Lake chub and slimy sculpin are also found within Tetlin Refuge, but little is known about these widely distributed populations.

Other species found on the Refuge that are important to the recreational harvest are lake and rainbow trout. Lake trout are known to occur in Jatahmund and Wellesley lakes and may occur elsewhere. However, rainbow trout are not indigenous to refuge waters; the species was introduced by ADF&G to Hidden Lake near the Alaska Highway in 1982 (Figure 4-6). ADF&G continues to periodically stock Hidden Lake under a put, grow, and take management concept. There has been no documentation of rainbow trout escaping from Hidden Lake into other refuge waters.

Local people have reported that Dolly Varden char occur within the Refuge, but these reports have been not been confirmed.

A more detailed description of fishery resources, issues, and management strategies can be found in the Tetlin Refuge Fisheries Management Plan (USFWS 1990) and the Alaska Statewide Stocking Plan (ADF&G 2007).

4.2.7 Birds

There are 186 species of birds known to occur in the Upper Tanana Valley and the Tetlin Refuge (Appendix C). The Tanana Valley is a major migration corridor, and a number of species reach their northern range limit there. Several species found locally are rare elsewhere in Alaska (e.g., sharp-tailed grouse, blue-winged teal, American coot, and sora).

The majority of landbirds arrive in the Upper Tanana Valley in late April and early May (Cooper et al. 1991). The pattern of migration is similar to other parts of interior Alaska with three major peaks: swans, geese, and dabbling ducks pass through in mid- to late-April; sandhill cranes in early- to mid-May; and most passerines, diving ducks, and shorebirds in mid- to late-May. One hundred and sixteen species of birds are known to breed on the Refuge, including 75 species of landbirds and 41 species of other birds (Appendix C).

A detailed discussion of bird monitoring efforts can be found in the 2004 Tetlin Refuge Biological Program Review (Johnson et al. 2004).

4.2.7.1 Passerines

Tetlin Refuge has a comprehensive landbird monitoring program that follows established protocols recommended for population inventory and monitoring in Alaska (Doyle and Andres 1998). The most common breeding species include alder flycatcher, tree and violet-green swallow, black-capped and boreal chickadee, gray jay, ruby-crowned kinglet, Swainson's thrush, American robin, varied thrush, bohemian waxwing, yellow-rumped warbler, Lincoln's and white-crowned sparrow, slate-colored junco, and rusty blackbird. Some uncommon breeders are red-winged blackbird (which is near the northern limit of its range), mountain bluebird, and Brewer's "timberline" sparrow. Habitats that support the greatest songbird diversity within the Refuge are mixed forest and tall scrub in wetlands (Spindler and Kessel 1980).

4.2.7.2 Waterfowl

Common nesting waterfowl species on Tetlin Refuge are: lesser scaup, ring-necked duck, American green-winged teal, bufflehead, American wigeon, common and Barrow's goldeneye, mallard, northern pintail, and canvasback. Less common nesters include: surf scoter, white-winged scoter, northern shoveler, blue-winged teal, and Canada geese. Canada geese breed on Tetlin Refuge in small numbers with an estimated 30 to 50 nesting pairs. Gadwall, redhead, greater scaup, long-tailed duck, harlequin duck, ruddy duck, common merganser, and red-breasted merganser occasionally occur on the Refuge but rarely breed. Spindler and Kessel (1977) reported a high of 362.4 birds per square mile and an average density of 256.9 birds per square mile in the southeast corner of the Refuge within and adjacent to the Scottie Creek drainage.

Ducks. Areas with the highest densities of ducks and highest production of young per pair are found primarily in the northern part of the Refuge, including selected and conveyed lands. Ponds with shrub grass complexes provide the best habitat for waterfowl. Nearby vegetation may be grassland, scrub, or forest. Productive ponds are often joined to sloughs or creeks and flood briefly in spring or during late summer rains (Murphy et al. 1984). Productive ponds in the northwestern part of the Refuge may also be fed by groundwater. Ponds and lakes south and east of Tsolmund Lake and near Scottie Creek are moderately productive but still yield many ducks. An estimate of the total number of young produced on the Refuge is obtained using actual brood sizes and expanding the stratified sample by area of open water on the Refuge. Average production over the last decade is approximately 45,000 ducklings per year.

Swans. The Upper Tanana Valley has a rapidly expanding breeding population of trumpeter swans, with the Refuge providing important habitat during spring and fall migrations. Breeding was first documented in the Valley in 1982 when 75 swans were counted. From 1980 through 2000, the population has shown dramatic growth; 1,906 swans were counted during the last census. The proportion of young in the population declined between 1994 and 2000. This may indicate that available breeding habitat is becoming saturated.

The Upper Tanana Valley is an important staging area on the primary migration route of tundra (whistling) swans entering and leaving Alaska. Several thousand birds sometimes stop on Tenmile Lake and other lakes. No tundra swans are known to breed on the Refuge.

4.2.7.3 Marsh and Waterbirds

Eight species of marsh and waterbirds occur on the Refuge. Horned grebe, pacific loon, and red-necked grebe are the most common breeders. Common loons are rare breeders on Tetlin Refuge

and red-throated loons are considered casual (do not occur annually). The Refuge is also one of the few places in Alaska where sora and American coot are regularly found.

A small number of sandhill cranes nest on muskeg flats near the north end of the Refuge. However, during spring and fall migration, up to one-half of the mid-continent population of sandhill cranes (approximately 200,000 birds) passes through the Tanana River Valley (Kessel 1984, Cooper et al. 1991). The numbers can vary annually depending on weather conditions affecting flight paths. In the fall, thousands of birds stop at Tenmile Lake, on the Tanana River flats in the northwest corner of the Refuge, or on the Chisana River flats near lower Gardiner Creek (Kessel 1979). In other years, the route passes across the Tanana Uplands north of the Refuge (Kessel 1984). Other major regional stopovers are on the lower Delta River and the upper Fortymile River (Kessel 1979), neither of which are managed primarily for wildlife. It is possible that disturbance on these staging areas could increase the importance of Tetlin Refuge as a staging area for migrating sandhill cranes.

4.2.7.4 Shorebirds, Gulls, Terns and Allied Species

While some 26 species of shorebirds occur on Tetlin Refuge, most are migrants passing between wintering and breeding grounds. The most abundant breeding shorebirds are lesser yellowlegs, Wilson's snipe, and spotted sandpipers. The American golden plover, upland sandpiper, and whimbrel breed in alpine areas. Red-necked phalaropes are commonly seen during fall migration. Mew and Bonaparte's gulls are common breeders on the Refuge.

4.2.7.5 Raptors

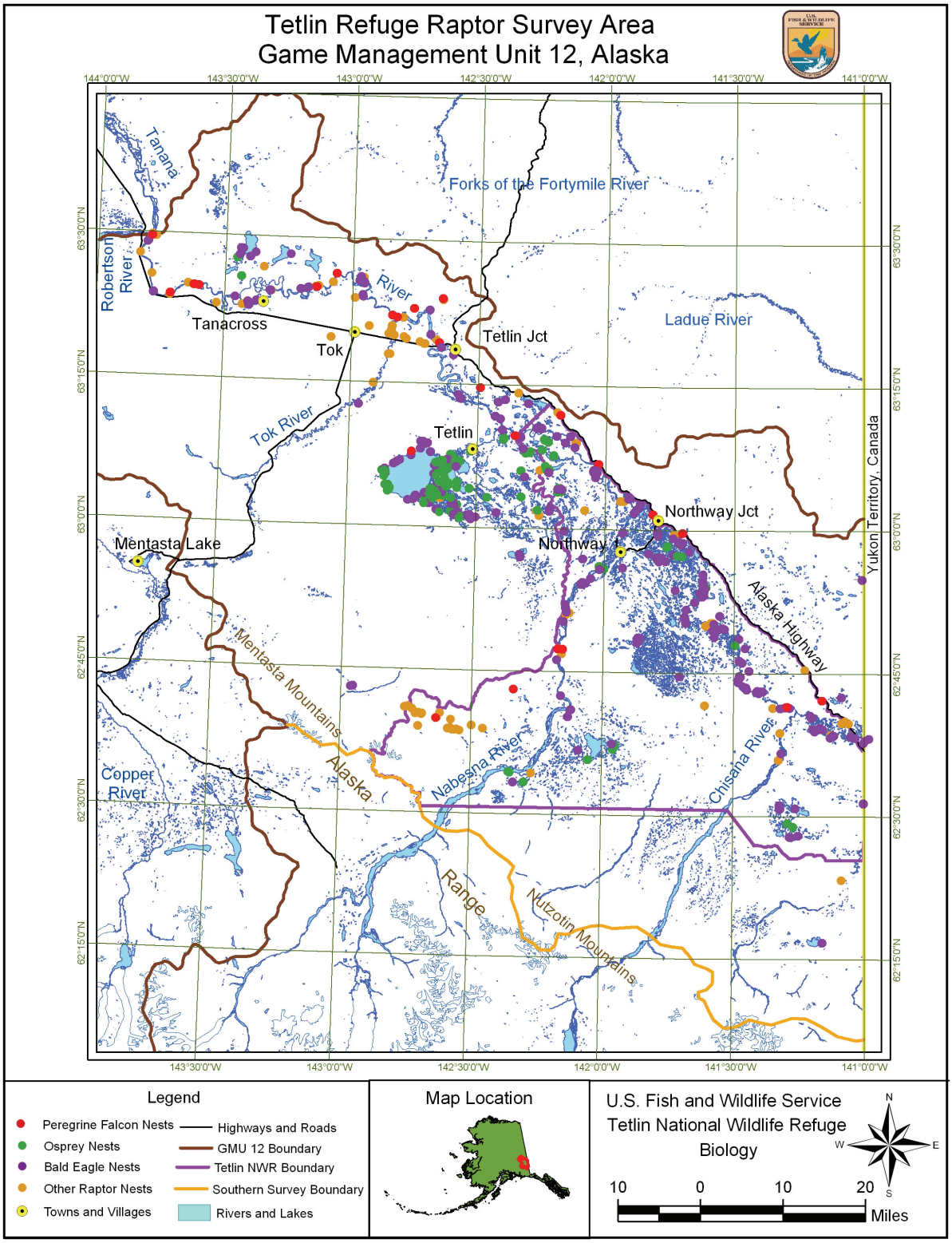
Predators at the top of the ecological web are indicators of environmental health because their existence and welfare depend on the levels below them (Cade 1988). Raptor monitoring efforts have emphasized such indicator species whose nesting sites are relatively easy to locate. These include American peregrine falcon, bald eagle, and osprey.

Fourteen species of hawks occur on Tetlin Refuge. Bald eagle, osprey, northern harrier, sharp-shinned hawk, red-tailed hawk, peregrine falcon, and American kestrel are uncommon breeders. Northern goshawk, golden eagle, merlin, and gyrfalcon are rare breeders on the Refuge. Rough-legged hawks are uncommon migrants. Turkey vultures and Swainson's hawks are casual visitors.

As of 2004, 479 nests in 253 nesting territories for 11 raptor species have been identified in GMU 12. Since 1961, bald eagles, osprey and peregrine falcon nests have accounted for 81 percent of known raptor nests in GMU 12. These raptor nesting areas are concentrated along major streams and lakes (see Figure 4-7). Nest observations of other raptor species have been recorded during surveys, includeing golden eagle, northern goshawk, red-tailed and Harlan's hawks, American kestrel, great horned owl, great gray owl, northern hawk-owl, and common raven.

Tetlin Refuge currently monitors occupancy and productivity on 17 peregrine falcon nesting territories in the Upper Tanana Valley with a mean (1991-2003) productivity of 2.20 young per occupied nest (Timm and Johnson 2003). They nest on bare ledges of cliffs, bluffs and occasionally man-made road cuts and quarries. Peregrine falcons were removed from the Endangered Species List in 1999, and the continent-wide population continues to recover. The local breeding population has expanded exponentially over the last decade with the number of known nesting territories increasing between 1993 ($n = 4$) and 2004 ($n = 19$), including new nests ($n = 6$) discovered on road cuts and rock quarries along the Alaska Highway between 1995 and 2004 (Timm and Johnson 2003).

Figure 4-7. Raptor Nesting Areas



Up to 65 bald eagle nesting territories have been monitored for occupancy and productivity by the refuge staff in GMU12 with a mean (1991-2003) productivity of 0.66 young per occupied nest (Timm and Johnson 2003). Bald eagles often nest in poplar or spruce trees near streams or lakes. They feed on a variety of fish, waterfowl, mammals, and carrion.

Tetlin Flats supports the largest concentration of nesting osprey in Alaska (USFWS 2001b). Of the estimated 200 osprey nesting pairs in the State, roughly 25 to 33 osprey pairs breed on or near the Refuge with a mean (1991-2003) productivity of 1.01 young per occupied nest (Timm and Johnson 2003, USFWS 2001b). Ospreys are highly dependent on wetlands as they feed almost entirely on fish. They prefer to nest in the tops of spruce trees next to lakes and ponds.

Five species of owls breed on Tetlin Refuge, the most common being the great horned owl. Northern hawk owls, great gray owls, and boreal owls can be common some years. The short-eared owl is a migrant and casual summer breeder. Additionally, the snowy owl is a casual visitor in fall and winter, but is not known to breed on the Refuge.

4.2.7.6 Upland Game Birds

Spruce grouse, ruffed grouse, sharp-tailed grouse, and ptarmigan are found on the Refuge. Spruce grouse occupy closed needleleaf or mixed forest; ruffed and sharp-tailed grouse live in tall scrub in lowlands and along rivers. Sharp-tailed grouse also use clearings in deciduous forests and burned areas in early- to mid-succession, and ptarmigan breed in subalpine scrub and tundra at the southern edge of the Refuge and descend to lower elevations in winter.

4.2.8 Mammals

Thirty-nine species of mammals are known or suspected to occur on Tetlin Refuge (Appendix C). A detailed discussion of inventory and monitoring efforts related to mammals within Tetlin Refuge can be found in the 2004 Tetlin Refuge Biological Program Review (Johnson et al. 2004).

4.2.8.1 Carnivores

Tetlin Refuge hosts a variety of large mammals; however, as in much of Alaska, the inter-relationship between moose, caribou, wolves, and bears receive much of the public interest. Besides wolves, both brown (grizzly) and black bears occur on the Refuge. Lynx, wolverine, coyote, and red fox are also present.

Wolf. Wolf density on Tetlin Refuge has been estimated between 2.8 wolves per 1,000 square miles (TNWR 1987) and 3.5 wolves per 1,000 square miles (Gasaway et al. 1992). Refuge studies of winter and summer wolf predation conducted during the 1980s found moose were a major component of wolf diets. Summer diets consisted of more moose calves, while wolves consumed more adult moose than calves during winter months (TNWR 1987, Doyle et al. 1988). However, the proportion of moose mortality attributable to wolf predation and its effect on moose populations on the Refuge are unknown.

Lynx. The abundance and distribution of lynx populations are affected primarily by natural cycles of their primary food source—snowshoe hares (see the snowshoe hare discussion later in this chapter). Based on track surveys, harvest data, and comments from area trappers, Gardner (2001a) identified peaks in the lynx population cycle in 1990-1992 and 1997-1999, with a low in the population cycle occurring in 1993. It was suggested the increase in both snowshoe hare and lynx numbers in the late 1990s was earlier than expected based on historical 10-year cycle (Gardner 2001a).

A lynx study conducted on Tetlin Refuge by Perham (1995) provided information relating to home ranges, habitat selection, and daily snow track deposition rates. Lynx preferred broadleaf and mixed forests and avoided dwarf shrub/tundra habitats.

Bear. Tetlin Refuge provides a mix of important habitats for both brown (grizzly) and black bear. Very little is known about the size or distribution of populations within the Refuge, but both species are considered common. In general, brown bears spend most of the fall season in alpine and subalpine areas and will also seek berries on dwarf shrub peatlands. Black bears are often found in a mix of semi-open forest, tall scrub, wetlands with emergent food plants, and dwarf scrub peatland.

Other Carnivores. Wolverines were once considered a common species throughout Tetlin Refuge, but they are currently found primarily in the foothills and inaccessible mountainous areas (TNWR 1997); historical populations are believed to have been much larger (USFWS 1987a). Coyotes have increased from being scarce to common in several areas based on staff observations; red fox populations are described as moderate (USFWS 1987a).

4.2.8.2 Ungulates

Tetlin Refuge provides habitat for three species of ungulates: caribou, moose, and Dall's sheep. Occasional observations of woodland bison and mule deer have also been recorded.

Caribou. Historical information and numerous studies since 1965 in Alaska and Canada document wide fluctuations in caribou population size and distribution (see summary by Hinkes et al. 2005). Studies in Alaska and Canada have also shown caribou herds to: (1) change their range and migration patterns on an annual or long-term basis; (2) make extensive lateral shifts away from traditional migration routes; and (3) sometimes join with other herds or split apart with unpredictable frequency (Hinkes et al. 2005). There are also indications that Alaskan and Canadian caribou herds peak every 60 to 90 years, or even longer, with each herd remaining at a relatively stable size during the intervening time periods (Haber and Walters 1980, Couturier et al. 1990, Hinkes et al. 2005).

Dramatic fluctuations of caribou populations are not unique, as it is well understood that animal populations in northern latitudes undergo drastic fluctuations. Currently, portions of four different barren-ground caribou herds (Nelchina, Fortymile, Mentasta, and Macomb herds) winter on or near Tetlin Refuge. The Nelchina Herd (greater than 30,000 animals) is most commonly found near or on the Refuge. The Fortymile Herd (greater than 40,000 animals) is generally found north of the Refuge during the winter, but does occasionally move onto refuge lands. The remaining two herds are much smaller (less than 600 animals each). The Mentasta Herd calves on the slopes of Mt. Sanford in the Wrangell Mountains with a few individuals lingering some years in the southwest portion of the Refuge. The Macomb Herd calves northwest of the Refuge on the Macomb Plateau, and rarely moves onto refuge lands. Surveys have been limited to cooperative monitoring of caribou radio-collars.

The Chisana caribou herd is the only woodland caribou herd that occurs in Alaska. The herd summers almost entirely in the Wrangell-St. Elias National Park and Preserve, and winters in the Yukon within the Kluane Wildlife Sanctuary. Although the Chisana herd is specifically mentioned in the purposes for Tetlin Refuge, our management involvement has been limited; the herd rarely, if ever, has been documented on refuge lands. The herd began declining in the late 1980s, and density estimates were the lowest recorded in the Yukon in 2001 (Farnell and Gardner 2002). Subsequently, the governments of the State of Alaska and the Yukon agreed it was essential to

develop a recovery plan for this herd; the herd was designated as a *species at risk* in the Yukon in 2002. As part of the recovery plan, a captive rearing program was initiated in 2002 and proved to be successful in releasing calves back into the wild. However, density estimates conducted in late 2003 documented a substantial increase in the population, leading to questions regarding the true nature of the population decline and the accuracy of monitoring techniques.

Moose. Tetlin Refuge provides a variety of spring, summer, and late winter habitat for a low density moose population (0.43 moose per square mile) (Collins et al. 2004a; Collins et al. 2005). Moose generally feed heavily on aquatic vegetation from spring thaw to late summer. During the fall as moose form rutting or breeding groups, they move to higher elevation habitats adjacent to the Refuge that provide late fall and early winter habitat.

Winter habitat includes deciduous scrub of various types, particularly tall alluvial and riparian scrub. In winter, moose particularly favor species such as felt-leaf willow growing on frozen pond margins. In 2004, Tetlin Refuge completed winter moose browse surveys to compare with earlier estimates (1982-1990) (TNWR 1986, Kelleyhouse et al. 1987). The Cheslina River drainage, a known concentration area for wintering moose, showed overall browse use over 50 percent; this may be representative of winter moose habitat quality where moose are concentrated (Collins et al. 2004b). Winter moose habitat on the Refuge may have been impaired by fire suppression from the early 1950s through the early 1980s, potentially resulting in browse that grew beyond the reach of moose or had been replaced by unpalatable species such as spruce. Future survey efforts will continue to refine methodologies and techniques.

Evidence shows that both migratory and non-migratory populations of moose occupy Tetlin Refuge. Annual trend and composition surveys have been conducted on Tetlin Refuge and adjacent areas since 1982. Given our recent estimates of density, percentage of adult bulls (32 percent), calf production (47.8 calves per 100 cows), and yearling recruitment (16.2 yearling bulls per 100 cows), the moose population appears to be healthy and stable (Collins et al. 2005).

Dall's Sheep. Dall's sheep are found in the Mentasta Mountains within Wrangell-St. Elias National Park and Preserve and in the extreme southwestern portion of Tetlin Refuge. In 1987, refuge staff estimated that 125 individuals of the larger population were within refuge boundaries (TNWR 1988); no surveys have been completed since.

4.2.8.3 Furbearers

A variety of furbearer species occur on Tetlin Refuge. Wolves, lynx, wolverine, and red fox were discussed previously; beaver, muskrat, river otter, marten, mink, and weasel also occur. Population estimates are not available for furbearers.

Beaver. The highest concentration of beaver in the Upper Tanana Valley occurs along Scottie-Desper creeks (TNWR 1997); however, this area has been described as a poor beaver producing region, possibly due to scarcity of favorable lakes and streams with solid banks, stable water levels, and sufficient depth (Murray 1961).

Muskrat. Muskrat populations were noted as high during the mid 1970s and mid 1980s (Gardner 2001a). Then in the late 1990s, the muskrat populations appeared to be low but stable (TNWR 1997), following a decline during the winter of 1987-1988 (TNWR 1988). Another decline was observed in 1998 throughout the Upper Tanana Valley (TNWR 1998). It has been suggested that extreme cold temperatures and a lack of snow in 1995 and several years of drought were contributing factors (Gardner 2001a).

Other Furbearers. River otters are not considered common, but sign has been observed along open water during the winter. Marten are present in scattered locations and are trapped on the Refuge. Numbers fluctuate naturally, due in part to variations in the vole population, the marten's most important prey species. Marten prefer spruce forest alternated with small open areas of scrub, sedges, and grass that provide for optimal hunting (Koehler and Hornocker 1977, Buskirk 1983) but will also use burned areas in early post-fire succession (Paragi et al 1996). Mink are present along ponds, marshes, lakes and streams on the Refuge. Mink prey on muskrats, hares, and rodents, and their population fluctuates generally with prey numbers (USFWS 1987a).

4.2.8.4 Small Mammals

Small mammals are important prey for many furbearers and raptors. Little is known about the distribution and abundance of most small mammal species that occur on Tetlin Refuge. However, many species of voles, shrews, and mice are known or suspected to occur (Appendix C). Porcupine, little brown bat, red squirrel, and northern flying squirrels are also residents. Initial efforts to inventory small mammals across habitat types started in 2000 following procedures outlined in the 1998 Tetlin Refuge Wildlife Inventory and Monitoring Plan.

Snowshoe Hare. Snowshoe hare are an integral part of the boreal ecosystem. Hare population densities are cyclical across boreal North America over an 8 to11 year period (Keith 1963, Krebs et al. 1986, Keith 1990), with amplitudes of 5 to 25 fold (Hodges 2000). Hares are an important food item for a wide variety of terrestrial and avian predators (Keith 1990, Hodges 2000); hare densities can greatly influence production and recruitment of a variety of species. Hare densities are also positively correlated with other species such as spruce grouse, willow ptarmigan, and arctic ground squirrel (Boutin et al. 1995). Great-horned owl and northern goshawk production and densities are also strongly influenced by hare density (McInnaville and Keith 1974, Keith et al. 1977, Boutin et al. 1995, McIntyre 1995). Other species such as wolves, red fox, marten, and red-tailed hawks may be less dependent on hares, but use likely increases during cyclic highs (Wolff 1980, Todd et al. 1981, Carbyn 1987).

The close correlation between population densities of hares and other boreal forest fauna, and the predictable hare cycle, suggest monitoring hare populations can provide predictive information for other species, especially lynx (Nellis et al. 1972, Poole 1994, Mowat et al. 1996, Slough and Mowat 1996) and coyotes (Prugh 2004). Lynx rely heavily on snowshoe hares for food, and lynx populations cycle along with those of its cyclic prey (Keith 1963, Brand and Keith 1979).

From 1960 through 2000, the snowshoe hare cycle has been largely synchronous across Canada and into Alaska (see summary by Hodges 2000). Cyclic peaks occurred roughly at the turn of each decade (1960-1961, 1970-1971, 1980-1981, 1990-1991) with lowest densities typically occurring three years later (1963-1964, 1973-1974, 1983-1984, 1993-1994) (Hodges 2000).

Annual pellet counts have been conducted within the Refuge to monitor snowshoe hare population trends (1990 to 1994 and 2000 to present) (Collins et al. 2004c). Snowshoe hare populations on Tetlin Refuge apparently reached their cyclic low in 1993 and peaked in 1997-1999; the next cyclic high can be expected 8-11 years following the previous peak (Hodges 2000, Collins et al. 2004c).

4.2.9 Threatened, Endangered, and Sensitive Wildlife and Plants

As discussed previously, the Chisana Caribou Herd is a small, biologically distinct, woodland caribou herd that ranges across the Alaska-Yukon border. The herd was designated as a *species at*

risk by the Yukon Government in 2002 under the authority of the Yukon Wildlife Act (Farnell and Gardner 2002).

Peregrine falcons were removed from the Endangered Species List in 1999, and it was recommended that the Tanana River peregrine population be monitored for at least five years after removal (Wright and Bente 1998). Refer to the discussion earlier in this chapter for more information about peregrine falcons within the Refuge.

Birds of Conservation Concern (USFWS 2002) identifies species, subspecies, and populations of migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act. Eight species were identified for the Northwestern Interior Forest region and three (peregrine falcon, American golden-plover, and whimbrel) are known to breed on the Refuge.

Boreal Partners in Flight developed a list of priority landbird species breeding in each biogeographic region in Alaska (Boreal Partners in Flight Working Group 1999). The rankings are based on species abundance in North America, the degree to which breeding and wintering distributions are restricted and threatened, the proportion of the species' range occupied by the Bioregion, and population trends. Nineteen priority species occur in the Central Alaska Region, of which 15 breed on Tetlin Refuge. These include sharp-tailed grouse, great gray owl, boreal owl, black-backed woodpecker, olive-sided flycatcher, Hammond's flycatcher, gray-cheeked thrush, varied thrush, bohemian waxwing, Townsend's warbler, blackpoll warbler, golden-crowned sparrow, rusty blackbird, and white-winged crossbill.

The State of Alaska has also identified species and subspecies of fish and wildlife native to Alaska that have entered a long-term decline in abundance or are vulnerable to a significant decline. Vulnerability to decline includes low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. On Tetlin Refuge, Species of Special Concern include peregrine falcon, olive-sided flycatcher, gray-cheeked thrush, and blackpoll warbler.

No threatened or endangered plants have been identified on Tetlin Refuge. However, one species (*Cryptantha shackletteana*), which has been documented near the village of Eagle and at Calico Bluff approximately 100 miles north of the Refuge, is ranked by the Alaska Natural Heritage Program as critically imperiled in the State. One sensitive species (vulnerable to climate change but not currently threatened), *Montia bostockii,* has been documented in the easternmost Wrangell Mountains and the Yukon-Tanana Uplands of Alaska (Murry and Lipkin 1987).

4.3 Human Environment

4.3.1 Cultural Resources

4.3.1.1 Prehistory of the Upper Tanana Valley

The Upper Tanana Valley contains one of the most concentrated areas of pre-historic settlement in interior Alaska and has been the region with the most intensive archaeological research. Large scale excavations have been conducted at Healy Lake, Dihthaad, the Terrace Site, Broken Mammoth, Gerstle River, and other locations within the region. Despite this work, the prehistory of interior Alaska is known only in the barest outline.

Dated material from Yukon Territory, Canada, may indicate the presence of people in the area 14,000 years before present (B.P.) although the relationship between the articles found at this site

and human activity is tenuous and has not been confirmed. The indigenous people believe that they have always been here. The earliest securely dated sites with clear human associations belong to the Paleoarctic tradition present in interior Alaska between 12,500 and 6,000 years B.P. (Clark 1981, Clark 2001, Holmes 2005, Odess 2005). The earliest known sites from this tradition near Tetlin Refuge are the 11,000-year-old village site at Healy Lake, about 100 miles to the northwest; and at least one site near Beaver Creek, Yukon Territory, approximately 30 miles southeast of the Refuge with artifacts dated to 10,200 years B.P. (Clark 2001).

A separate and distinct Northern Archaic tradition began about 6,000 years ago. In addition to microblades and side-notched points used by people of the Paleoarctic Tradition, the Northern Archaic people used leaf-shaped spear points, large bifaces, a variety of endscrapers, choppers and hidescrapers, and notched stone net sinkers. This stage is thought to be an adaptation to the boreal forest that was becoming the dominant vegetation type in the interior. This tradition continued with minor variations until about 2,000 years B.P. Sites from this tradition have been found at Healy Lake and at other locations near the Refuge.

This period is followed by a distinct hiatus, perhaps caused by drastic environmental changes following eruptions of Mount Churchill that occurred between 1887 and 1147 years B.P. and deposited up to two feet of ash in parts of the Upper Tanana Valley. The remaining layer of ash in the soil (known as the White Ash Layer) is important for dating artifacts, charcoal, and other remains throughout the region. As people returned to the area about a thousand years ago, they brought with them a tool kit that included the small, tapered-stem Kavik-type projectile point, thought to be one of the earliest indicators of Athabascan culture in Alaska (Reynolds and Jordan l982). This period (1000 years B.P. until European contact about 160 years B.P.) is characterized by these points and by groundstone hide and woodworking tools, bone implements, and limited use of native copper. Archaeological sites dated to this period are larger than those of previous periods and contain semi-subterranean houses and cache pits. This period continues with little change until the increasing presence of trade goods make it difficult to tell the camp of a Native trapper from that of his non-native counterpart (Clark 1981).

4.3.1.2 Prehistoric and Cultural Use of Fire

The boreal forest in the region not only evolved with natural lightning-caused fire, but also with anthropogenic fire. Human habitation in the Upper Tanana Valley predates the development of the boreal forest ecosystem, which began approximately 6,000 years B.P. Athabascan people were nomadic hunters, and the use of campfires, signal fires, and fires for rejuvenating browse for moose and snowshoe hare was common (Pyne 1982).

Broadcast fire was used intentionally to remove underbrush and improve mobility and visibility; to create clearings especially suitable for moose hunting; for use in hunting or trapping muskrats; and to kill large stands of spruce and birch, which could then be uprooted from the shallow soil and aligned into fences (Pyne 1982). As migrating herds of caribou followed these fences, they would be channeled toward waiting hunters, snares and deadfalls.

During his 1885 expedition as the first Euro-American to travel through the Upper Tanana Valley, Lieutenant Henry Allen (1900) wrote:

> "heavy smoke, caused by extensive timber fires, obscured the sun the entire day, so that an observation was impossible. The smoke had originated from signal fires which were intended to give warning of our presence in the country…for nearly two days we barely caught a glimpse of the sun except through the heavy spruce smoke."

Another common use of anthropogenic fire was to keep mosquitoes at bay. Describing a military reconnaissance to interior Alaska in 1884, Frederick Schwatka (Lutz 1959) wrote, "evidences of conflagration in the dense coniferous forests were everywhere frequent," and that the cause was incendiary fires set by the Indians "with the idea of clearing the district of mosquitoes."

4.3.1.3 Modern History of the Upper Tanana Valley

The indigenous people of the Upper Tanana Valley (including what is now Tetlin Refuge), at the time of European contact, called themselves *"Dindee" or "Dindee iin"* (The People). Early explorers and researchers called them the Upper Tanana Indians or Nabesna Indians or Nabesnatana (from Nabesna, the Native term for the upper Tanana River). By the time the first anthropological studies were begun in the 1920s, the Upper Tanana Athabascan population was estimated to be 152 people, divided into five local bands and occupying an area of about 17,500 square miles. These bands used distinct portions of the Upper Tanana Valley, but interacted and exchanged food and other goods with one another on a regular basis.

Until the 1900s, the Upper Tanana Athabascans were nomadic hunters and gatherers, concentrating on moose, sheep, berries, and most importantly, caribou. As the upper Tanana River contained few salmon, fishing activities focused on freshwater fish such as whitefish, pike, grayling, burbot, and suckers. Other food sources included hare, muskrat, ducks, geese, swans, and cranes, primarily harvested in spring or summer.

The Upper Tanana Athabascans lived in semi-permanent houses in winter and in permanent summer houses. Most summer houses were located near reliable fishing spots. Lean-to, brush, or bark-covered shelters were used for hunting and traveling.

Beginning in the early 1900s, Athabascan people moved away from their traditional semi-nomadic lifestyle toward a more stationary lifestyle centered on a mixed cash-subsistence economy made possible through commercial trapping, mining, logging, and new technologies such as motor boats, snowmachines, and chainsaws. This change altered Upper Tanana Athabascan culture, the pattern of anthropogenic fire, and the way in which people viewed the role and value of wildfire.

The Upper Tanana Athabascans were involved in Alaska-wide trade networks with ties to the Ahtna to the south and the Han and Tutchone to the north and east (McKennan 1959). They may have had access to European trade goods along the Yukon River via the British near Fort Yukon and the Russians at Nulato as early as the 1840s (Simeone 1995). Trade between the Upper Tanana Athabascans and the Chilkat Tlingit Indians in southeast Alaska was also accomplished through the Kluane Lake Tutchone as intermediaries (McClellan 2001).

The first trappers and explorers from the Yukon River and northwest United States arrived between the late 1870s and 1885. Most subsequent activities by explorers, miners, and missionaries took place near the present location of Tanacross, but some traders did maintain posts within or near what is now Tetlin Refuge at the mouth of the Kalutna River, Moose Creek, Nabesna River, and at Gardiner Creek. A brief gold rush in the early 1900s brought hundreds of people to the area by steamer, most of whom returned home empty-handed within a few years. In the 1930s, with the establishment of schools, the Upper Tanana Athabascans abandoned their seasonal movements and settled in permanent villages.

The Upper Tanana Valley remained one of the most isolated areas of the United States until the Alaska Highway was constructed during World War II (Simeone 1982; Ducker 1982). A large work camp was established west of the Tok River, at the present day location of the community of

Tok, to assist with construction of the road. Soon after construction, the first gas station along the highway in Alaska was constructed at a place now called Seaton's Roadhouse. There are no longer any buildings at this site, but an abandoned section of the Alaska Highway, a few small clearings, and scattered barrels, cans, bottles, and other articles remain as evidence of its existence. Remains of a World War II construction camp (used during construction of the highway) are also found near the site of Seaton's Roadhouse.

4.3.1.4 Modern Use and Management of Fire

Anthropogenic fire may have reached its apex between the time of the Alaskan gold rush and 1940. During this period, the population of the State was at its peak, and the use of open fire and machinery led to a rapid increase in the number of wildfires across the State. During this time, it is estimated that nearly 80 percent of all land in Alaska burned at least once (Pyne 1982). However, the infrastructure and technology to move people and resources needed to find and extinguish fires throughout the vast remote wilderness of Alaska were simply not available. Suppression was confined to those fires which began near settlements, mining camps, and rail lines, much as it was during the early European settlement of the lower 48 states.

During the early 1940s, fire suppression in Alaska increased exponentially with technological improvement in aviation, the construction of military airstrips and highways, the Bureau of Land Management's (BLM) mandate to attack all wildfires throughout the State, and the funding necessary to do so.

By the late 1950s, the BLM was operating the largest civilian paracargo operation in the world and a smokejumper base in Fairbanks in its attempt to suppress every fire in the State (Pyne 1982). Enormous amounts of money were spent to protect vast inaccessible and uninhabited areas of boreal forest where wilderness and wildlife values far outweighed commercial timber values. However, these efforts led to the hiring of many firefighters throughout the State who became both an important source of income and pride for remote communities throughout Alaska.

By the 1970s, it became apparent that by attacking every fire, the BLM's fire suppression costs were far exceeding the value of resources being protected. Through the 1970s, the number and complexity of fire effects and fire behavior studies increased, and so did the understanding of the role fire plays in the northern boreal forest (Pyne 1982). Ecologists, wildlife managers, and other professionals began to more fully recognize the importance of natural fire in conserving healthy functioning ecosystems, and they began to question the wisdom of total fire suppression. By 1974, the BLM required a team evaluation for all fires that escaped initial attack. This new approach led to classifications of lands in Alaska's interior based on resource value, and a new dispatch system that took these values into account (Pyne 1982). Building upon this new approach to classifying lands and prioritizing suppression efforts based upon resource values, fire management plans were written for 13 geographic regions of Alaska. Further refinement led to the 1984 Alaska Interagency Wildland Fire Management Plan (AIWFMP), which allowed each land manager or owner to apply a combination of four fire suppression options to their lands based upon legal mandates, policies, regulations, resource management objectives and local conditions. With some amendments by the Alaska Wildland Fire Coordinating Group in 1998, the AIWFMP continues to provide a fire suppression framework for virtually the entire State of Alaska (AWFCG 1998).

A detailed description of the three fire suppression options applied to Tetlin Refuge can be found in the Management Direction section of chapter 3.

4.3.1.5 Historic and Cultural Sites

Currently, hundreds of sites and trails associated with prehistoric inhabitants, subsistence hunting and fishing, trapping, mining, and military construction within or adjacent to the Refuge have been cataloged. Many sites are located near the Alaska Highway, large rivers, lakes, and streams, making them susceptible to both intentional and unintentional damage, future development activities, flooding, and wildfire.

In addition to several historically and culturally important areas located on private lands within the Refuge, six areas managed by the Refuge may have particular historic and/or cultural value. These include the Deadman Lake area, the western Black Hills and lower Cheslina River areas, the Moose Creek/Chindagiekne Creek area, the southern portion of the Refuge in the vicinity of the Nabesna River, and the Scottie/Desper creek area. There have been only sporadic and scattered archaeological investigations conducted in these areas.

From these investigations and oral history interviews, we are learning more about sites such as Big Scottie Creek, which has historically been a place rich with natural resources, especially fish. Local residents attest that its richness continues today. It was a place where long ago, food was traditionally stored against lean times. People are said to have traveled from as far away as Chistochina (approximately 150 miles overland) to save themselves from starvation during calamities such as the White River ash fall. Additionally, there exist in this area burial grounds, caches, trails, cabin remains, and at least one documented stone fishing weir.

Many recent historic sites associated with the fur trade, the brief mining rush in the early 1900s, construction of the Alaska Highway, and various roadhouses are located adjacent to the Refuge. However, a few documented sites and artifacts of this nature are located within Tetlin Refuge, including the site of Seaton Roadhouse and Gasoline City.

4.3.2 Population Trends and Composition

The communities of Northway, Northway Junction, Northway Village, Tetlin, Tok, Tanacross, Delta Junction, Big Delta, Deltana, Fort Greely, Mentasta Lake, Chistochina, Tazlina, Copper Center, Gakona, Gulkana, Chitna, and Cantwell were selected for discussion because their residents either regularly use Tetlin Refuge for subsistence and recreation activities, or the communities have been designated by the Federal Subsistence Board or the Alaska Migratory Bird Co-Management Council as communities with customary and traditional use in GMU 12.

The community of Tok, the largest community in the Upper Tanana Valley, is located 30 miles from the Refuge. Tok serves as the subregional supply center for the upper Tanana and Fortymile areas. It is also considered a rural community having noncommercial production and exchange. The population of Tok includes, among others, former residents of Tanacross, Tetlin, Northway, Eagle, and Mentasta. These people retain strong ties to their former communities and continue to harvest resources with friends and families from these villages.

Construction efforts associated with the National Ballistic Missile Defense Shield continue at Fort Greely. Once completed, the military base will provide full-time employment for approximately 270 people (DCED 2003). Current efforts are underway to begin gold ore production at the Pogo Mine near Delta Junction. The mine is expected to employ 300 people annually during the 11-year life-span of the mine (DCED 2003). Efforts are underway to finalize agreements and permits associated with the potential construction of the Alaska Natural Gas Pipeline along the Alaska Highway to Canada. Other planning efforts are evaluating an extension of the Alaska Railroad to

Fort Greely. The combination of these activities, if undertaken, will result in growth in the local economy and population in the Upper Tanana Valley over the next 15 to 20 years.

Population projections for communities with customary and traditional use of subsistence resources in Tetlin Refuge are from the Alaska Department of Labor (2004). The Alaska Department of Labor estimates the population of the entire Southeast Fairbanks Census Area will increase 28 percent by the year 2018. There are several variables which affect population changes, and it is possible the regional population could actually decrease by 5 percent or increase by as much as 67 percent. Figures presented in Table 4-2 depict a 28 percent increase in population for Tanana Valley communities and a 2.4 percent decrease in the population of Copper River Valley communities. However, changes affecting communities in the Delta areas will likely account for a greater proportion of the population growth, and other communities may actually remain stable or slightly decline. As shown in Table 4-2, the population of the Tanana Valley increased approximately 43 percent from 1980 to 2000, with Delta area communities and Tok representing most of the overall increase.

In 2000, the composition of the population of Tanacross, Tetlin, and Northway was approximately 82 percent Native Alaskan. The larger community of Tok was 13 percent Native Alaskan.

4.3.3 Sociocultural Systems

Since the early part of the 20th century, the nomadic way of life of the Upper Tanana Athabascans has been replaced by a more sedentary existence revolving around stable settlements, although some families still follow the tradition of setting up seasonal fish camps in the summer (Vitt 1971).

4.3.3.1 Subsistence Way of Life

For generations, rural residents of Alaska have lived a lifestyle that includes a strong dependence upon fish, wildlife, plants, and other natural resources available to them. Until the late 1800s, the indigenous people of the Upper Tanana Valley lived a nomadic lifestyle, traveling through the taiga and boreal forest in small bands, isolated from the outside world. They followed the seasonal migrations of caribou, waterfowl, and fish, gathering berries, hunting, and trapping large and small mammals and game birds, totally dependent upon the resources available to them. The entire culture and social organization revolved around a reciprocal agreement with the natural resources and neighboring tribes. The people were to harvest only what they needed and not waste, share with others, and be respectful of the resources. Cultural ceremonies, morals, and values reinforced this view daily.

A subsistence lifestyle includes much more than simply the harvest and use of natural resources. For the Athabascan people, subsistence was and is deeply embedded in their culture and traditions, which together form the basis for social organization within and between communities. Today, the residents of Tetlin, Tanacross, and Northway in many instances have adopted modern Western means of hunting to fit their basically traditional lifestyles, but subsistence is still much more to them than simply the harvest and use of natural resources. For the Athabascan people, subsistence is a way of life which provides food for the body, mind and spirit.

Table 4-2. Population characteristics of communities with customary and traditional use of Tetlin Refuge: 1960-2000

Community	1960 Census	1970 Census	1980 Census	1990 Census	2000 Census	Forecast 2018[4]	Percentage Change '90–'00
Alcan Border	0	0	0	27	21	27	-22
Dot Lake	56	42	67	70	19	24	-73
Dry Creek	0	0	0	106	128	164	21
Tok	129	214	589	935	1,393	1,783	49
Northway communities[1]	196	40	185	324	274	351	-15
Tetlin	122	114	107	87	117	150	34
Tanacross	102	84	117	106	140	179	32
Delta area communities[2]	0	2,523	2,898	2,398	3,657	4,681	53
Copper River area communities[3]	419	670	649	1,176	1,394	1,361	19
Total All Areas	1024	3,687	4,612	5,229	7,143	8,720	37

[1] Northway communities include: Northway, Northway Junction, and Northway Village.

[2] Delta area communities include: Delta Junction, Deltana, Big Delta, Healy Lake, and Fort Greely military base.

[3] Copper River area communities include: Mentasta Lake, Chistochina, Gakona, Gulkana, Copper Center, Tazlina, Chitna, and Cantwell.

Source: DCED 2004

Residents of all five Athabascan villages in the Upper Tanana Valley make use of the cultural and natural resources found on and around refuge lands. Historically, these bands of indigenous people lived a semi-nomadic lifestyle, following the movement of the harvestable resources surrounding them. Today, similar patterns are seen with adaptations imposed by a partial cash economy. Later arrivals on the scene conform to a greater or lesser extent according to their income sources and subsistence needs.

4.3.3.2 Kinship and Social Organization

The Upper Tanana Athabascan society has traditionally been divided into exogamous matrilineal kin groups with emphasis placed on the nuclear family (i.e., marriage to an opposite clan and kinship based on the mother's side of the family). Families within a local band were fairly autonomous, moving as subsistence needs required. Local bands were flexible, changing size and composition over time while larger regional bands were more stable. Each band had a recognized leader or *hałke*. This position was based on leadership ability, concern for the whole, hunting skill and luck, and the ability to command allegiance (McKennan 1959).

People in local communities retain a strong sense of pride in their cultural heritage. Kinship, social bonds, and strong ties to the land cause many people to stay in smaller communities despite limited employment opportunities and community services. Traditional ceremonies such as

potlatches, which reaffirm kinship and village ties, are frequently held in Northway, Tetlin, and Tanacross. The use of the Athabascan language in the home, particularly among the elderly, preserves social and kinship affiliations.

Kinship is an important influence in social interaction and exchange of subsistence resources. Subsistence harvests are shared with local family and clan members and with family members who have moved to other communities. Hunting, fishing, trapping, child care, and many social activities are often conducted along kinship lines. The importance of this exchange is magnified by the shortage of social services in isolated communities.

4.3.3.3 Intraregional Interactions

Fairbanks is the center of economic and social exchange in the Tanana Basin and serves as the regional transportation center for interior Alaska.

The subregional center of commerce and development for the upper Tanana and Fortymile area is Tok. Tok is strategically located at the junction of the Alaska and Glenn highways 90 miles northwest of the Canadian border. Because of this location, it is an important service area for travelers and tourists. As the largest community in the subregion, Tok has a relatively full complement of schools, shops, service stations, lodging, restaurants, and other basic infrastructure upon which smaller surrounding communities depend.

4.3.3.4 Community Infrastructure

The underlying framework or support system for a community is known as its infrastructure. Included in this infrastructure is local government, housing, schools, health services, local transportation, water, waste and utility systems, communication systems, and police and fire protection. Northway, Tetlin, Tok, and Tanacross possess the basic components of infrastructure to some degree. The components of these communities include a community hall, grade school, church, health clinic, post office, airstrip or airport, electrical power generation, and local groups that administer Federal assistance and other services (Darbyshire and Associates 1980). Of the four communities, Tok—having bolstered its commercial and tourist industries with motels, restaurants, service stations, and related businesses—has the broadest range of support facilities. Government spending also supports a large portion of the economic infrastructure and employment in Tok.

Tok, Tetlin, Northway, and Tanacross are all unincorporated and thus without taxing authority. Tetlin, Northway, and Tanacross are governed by tribal councils.

4.3.4 Economic Conditions

Subsistence plays a key part in the local economy. Because subsistence activities overlap with commercial activities, and because there are no market values established for commodities and services received, it is difficult to estimate the size or impact of any given subsistence economy (Berman 1983).

The subsistence sector—composed of fishermen, hunters, and trappers—engages in a cash economy for a portion of the year and in a subsistence economy for the remainder of the year. The economies of Northway, Tetlin, and Tanacross are in a transitional phase with mixed cash and traditional activities. Tok, however, has more of a cash economy, supplemented by traditional activities to offset the high cost of living.

Rural residents in Alaska's interior harvest an estimated 613 pounds of resources per person each year (Wolfe 2000). An estimated $1.15 per pound is spent on equipment, fuel, and other supplies for subsistence activities (Colt 2001). Using these estimates, the 2,500 residents in the Upper Tanana Valley spend as much as 1.7 million dollars annually on subsistence activities. The total value of these subsistence resources is much greater when the cost of replacing them with food bought from stores or farms is considered. At four dollars per pound, subsistence harvest by Upper Tanana Valley residents would be worth more than six million dollars annually. Tetlin Refuge plays an important role in providing healthy habitats and continued opportunities for subsistence uses in the Upper Tanana Valley.

The tourism industry in Alaska is the only private sector industry that has grown continuously since statehood and continues to grow (Colt 2001). In 1993, the average summer tourist driving the Alaska Highway spent about $596 in Alaska (McDowell Group 1998). Based on Colt's (2001) estimates, one job in the State is either directly or indirectly attributed to every 45 visitors to Alaska.

Tok serves as a "Gateway Community" to Alaska for people traveling the Alaska Highway, and tourism is a mainstay industry. Facilities such as gasoline stations, restaurants, a laundromat, recreational vehicle parks, retail businesses, air taxi/charters, and a visitor information facility make a significant contribution to the local economy. Tourism and government account for most of the stable employment in Tok.

The local economy is highly dependent on outside money due to the absence of local taxes. State, Federal, and tribal governments support the basic community infrastructure such as roads, schools, clinics, police, magistrate, fire department, and social programs.

4.3.4.1 Employment

Employment opportunities are more plentiful in Tok than in other communities in the Upper Tanana Valley. Wage employment opportunities in the small communities are generally limited to teaching, working for the regional or village corporations, summer construction, firefighting, and other Federal, tribal, or State jobs that sporadically become available. Nearly 32 percent of local jobs in the Upper Tanana Valley are supplied by State and Federal governments.

The high cost of living encourages people to supplement their incomes by harvesting natural resources, particularly because employment is seasonally dependent on tourism and other summer activities. Some residents take seasonal construction jobs outside the area for several months at a time, and then return home to a subsistence lifestyle. In winter, the unemployment rate in all communities is very high. Table 4-3 depicts the employment levels of local communities.

Many residents of the villages outside Tok make handicrafts to sell in gift shops in Fairbanks, Anchorage, Tok, and Northway Junction. Traditional Native handicrafts include a wide variety of hats, mittens, moccasins, beadwork, and birch bark baskets.

Tetlin Refuge contributes 19 permanent jobs,and just over one million dollars annually in payroll and local spending to the local economy.

Table 4-3. Employment and income for local communities: 2000

Community	Total potential workforce	Unemployed & seeking work	Government jobs (includes military)	Private sector jobs	Per capita income
Dot Lake	16	2	0	3	$18,521
Dry Creek	88	0	2	8	$7,779
Tanacross	115	32	9	15	$9,429
Tok	995	111	165	353	$18,521
Tetlin	70	15	8	9	$7,371
Northway communities[1]	209	22	52	40	$14,038
Delta area communities[2]	2,584	198	662	679	$17,811
Copper River area communities[3]	1,038	135	193	278	$16,683

[1] Northway communities include: Northway, Northway Junction, and Northway Village
[2] Delta area communities include: Delta Junction, Deltana, Big Delta, Healy Lake, and Fort Greely military base.
[3] Copper River area communities include: Mentasta Lake, Chistochina, Gakona, Gulkana, Copper Center, Tazlina, Chitna, and Cantwell.
Sources: DCED 2004

4.3.4.2 Income

Per capita incomes range from just over $7,000 in smaller, more isolated communities such as Tetlin and Dry Creek, to more than $18,000 in larger communities such as Deltana, Delta Junction, and Tok, which have more infrastructure and services (see Table 4-3) (DCED 2004). These figures do not include income derived from commercial fishing, trapping, firefighting, firewood cutting, craft sales, or the value of resources gathered for other subsistence uses, which usually represent a significant portion of the annual family income. Alaska Permanent Fund dividend checks, Social Security payments, unemployment compensation, and welfare payments presumably are a portion of the total personal income, but those data are not readily available.

4.3.5 Public Use

Wildlife observation, picnicking, photography, and camping are the most popular uses of Tetlin Refuge. Fishing and hunting (particularly waterfowl hunting) are enjoyed by many local and nonlocal users. Levels of nonconsumptive use such as wildlife-viewing, camping, and wildlife photography are high because the Alaska Highway runs 65 miles along the northeastern boundary of the Refuge. Each year from 1999 through 2003, an average of 117,000 summer travelers (bus passengers or in personal vehicles) crossed the Alaska-Yukon border and passed by Tetlin Refuge (U.S. Department of Transportation 2007).

4.3.5.1 Facilities

The Tetlin Refuge Visitor Center, seven interpretive sites along the Alaska Highway, eight information kiosks, Deadman and Lakeview campgrounds, the Chisana River boat launch, and a one-mile interpretive trail between the Alaska Highway and Hidden Lake are administered by Tetlin Refuge. These facilities provide opportunities for the public to observe wildlife and enjoy scenic vistas of the Refuge, and serve as centralized locations for refuge educational and interpretive programs. Each of these facilities is located entirely or partly on State lands or on private lands through ANCSA 17 (b) easements or lease agreements (see Figure 4-8).

The Tetlin Refuge Visitor Center was completed in 1988 and is located on State lands eight miles from the Alaska-Yukon border. The visitor center includes a large greatroom with interpretive displays, an Alaska Natural History Association sales outlet, a large viewing deck providing views of Scottie and Desper Creeks, and several restrooms (the only such facilities available 24 hours a day along the 113-mile section of the Alaska Highway between Tok and Beaver Creek, Yukon). The visitor center is open daily from mid-May through mid-September. Average annual visitation from 1999 through 2003 was 16,600 people, a little more than eight percent of all summer travelers estimated to have crossed the Alaska-Yukon border on the Alaska Highway.

Tetlin Refuge is currently working with the Alaska Department of Transportation and Public Facilities and the Alaska Department Economic and Community Development to design and construct a 9,500 to 10,000 square foot multi-agency visitor center in Tok. This project is still in its early stages, but once completed will provide both visitors and local communities a wide range of information and educational opportunities. A more detailed discussion of this facility can be found in the description of Alternative A (Current Management).

Facilities at Deadman Lake and Lakeview campgrounds include restrooms, boat launches, docks, picnic tables, fire pits, interpretive boardwalks, interpretive kiosks, and wildlife viewing platforms. Combined, these two campgrounds provide 23 sites (six sites are suitable for larger recreational vehicles up to 33 feet in length) and are used at or near capacity during the busiest summer months. They are managed and maintained under a 55-year lease from the State that expires in 2044.

Three administrative cabins located in remote parts of the Refuge are also available to the public when not needed for refuge field operations. Two cabins are accessible by floatplane and the third by boat. Each provides opportunities for wildlife viewing, wildlife photography, fishing, hunting, and trapping. The use of these cabins by the public is infrequent and sporadic, occurring primarily in the spring and fall in conjunction with waterfowl hunting, big-game hunting, and ice fishing, with some winter use occurring during trapping seasons. Table 4-4 lists the total number of groups and people known to have used these cabins from 1997 through 2004 (based upon refuge permit registration and visitor log books). Not all visitors using these cabins register with the Refuge prior to using the cabins. Log books at the cabins often include groups that refuge records indicate had made no reservations for their use.

4.3.6 Access and Transportation

Boat, canoe, snowmachine, and light aircraft are the most common modes of transportation on Tetlin Refuge. Off-road vehicles, including ATVs, airboats, and air-cushion vehicles, are not allowed on refuge lands, but are used on other lands. Areas suitable for landing wheeled planes are very limited, so most aircraft access on the Refuge is confined to airplanes equipped with floats and skis. It is estimated that more than 30 lakes within the Refuge are accessible by float and ski plane.

Boats and canoes gain access to the Refuge via Desper and Scottie creeks, and the Tanana, Nabesna, Chisana, and Kalutna rivers. Rafters and canoeists occasionally reach the Refuge by floating from Chisana, Nabesna, Jack Creek, or Orange Hill in the Wrangell–St. Elias National Park and Preserve. Public boat launches and access are maintained by the Refuge at Deadman Lake and at the Chisana River Bridge near Northway Junction.

Muskeg bogs, large wetland areas, the Chisana and Tanana rivers, and private lands between the Alaska Highway and refuge lands significantly limit the number of places the Refuge can be accessed from the Alaska Highway. Two primary areas for access include the Airs Hill area at the Canadian Border, a few hills northwest of the Refuge Visitor Center, and the Seaton Roadhouse area. A short hiking trail provides access from the Alaska Highway to Hidden Lake (see Figure 4-8).

Table 4-4. Number of groups (people) using Tetlin Refuge administrative cabins[1]

Year	Wellesley Lake groups (people)	Jatahmund Lake groups (people)	Nabesna River groups (people)
1997	4 (12)	4 (14)	6 (12)
1998	7 (27)	7 (19)	4 (6)
1999	1 (1)	1 (4)	4 (13)
2000	13 (36)	0	6 (17)
2001	11 (29)	3 (6)	10 (20)
2002	3 (9)	2 (5)	3 (8)
2003	9 (31)	1 (4)	1 (5)
2004	7 (21)	2 (6)	5 (10)

[1] Based upon refuge permit registration records and visitor log books

During periods of adequate snow cover, the entire Refuge is open to snowmachine use. Snowmachines are used for subsistence and recreation. A network of unmarked snowmachine routes cross the Refuge; the Refuge does not maintain or groom these trails.

In past years, permitted guides have used pack stock in southern portions of the Refuge, but distance, terrain, and the cost of feed often make their use impractical.

No major changes in transportation have occurred in the Upper Tanana Valley for 60 years. Now, three construction projects are currently underway, which could significantly affect the number of summer travelers along the Alaska Highway. A road-widening and asphalt-surfacing project will upgrade and improve the existing gravel portion of the Taylor Highway between Chicken and the Poker Creek border crossing. Plans are currently underway to extend a rail line from Fairbanks to Fort Greely to support the national missile defense program (construction could be completed as early as 2011) (Alaska Railroad Commission 2004). In 2004, the Alaska State legislature passed a bill authorizing the State to delineate a rail transportation corridor between the existing corridor and the Alaska-Yukon border.

4.3.7 Subsistence

Subsistence is defined as "the customary and traditional use by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of inedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade" (ANILCA Title VIII 1980).

The primary subsistence users of the Refuge live in the areas of Northway and Tetlin, and near the Alaska-Yukon border. Residents of Tok also use the Refuge for subsistence activities but to a lesser degree. Residents of Tanacross have a long history of infrequent or occasional use of Tetlin Refuge for subsistence purposes. Very little accurate information is currently available regarding the amount of subsistence resources gathered within the Refuge.

Moose, caribou, whitefish, pike, burbot, waterfowl, grouse, lynx, wolves, marten, red fox, hare, muskrat, berries, and firewood are the most important resources harvested on Tetlin Refuge for subsistence use. The majority of animals are harvested near the major rivers, streams, lakes, and ponds within the Refuge, and near the Alaska Highway. Different resources are harvested at different times of the year. The availability of resources, cash income, and legal hunting seasons are the primary factors determining when harvests occur.

Most large-game hunting within Tetlin Refuge is by local residents in and around Northway, Tetlin, and Tok. Moose and caribou are taken during the fall and winter Federal permit seasons. Moose are also harvested at other times throughout the year for consumption at ceremonial potlatches. Dall's sheep are occasionally sought by some local subsistence hunters in the fall.

Moose are hunted primarily in the northwestern panhandle or by boat along the Nabesna, Tanana, and Chisana rivers, and on tributaries, including Moose, Desper, Scottie, and Mirror creeks. Other less accessible areas, such as Tlocgon, Nuziamundcho, and Big John lakes, and the lakes directly west of Riverside, are used less frequently. Other moose are taken within walking distance of the Alaska Highway. Each year, 20 to 30 Federal subsistence moose permits are issued for hunting within Tetlin Refuge in late November, but no harvest has been reported to date. ADF&G estimates 170 to 200 moose are harvested annually in GMU 12 (an area of approximately 6.4 million acres that encompasses Tetlin Refuge) as part of the general season, which includes estimated moose harvest for both recreation and subsistence uses (Gardner 2002). The majority of harvest in GMU 12 is by local residents and occurs along the Alaska Highway and Tanana River (Gardner 2002).

4.3.7.1 Large Mammals

Caribou hunting occurs primarily along major rivers and streams and within walking distance of the Alaska Highway. During periods of adequate snow cover, hunting areas throughout Tetlin Refuge are reached by snowmachine. Currently, only federally qualified subsistence users are permitted to hunt for caribou on the Refuge. Seasons typically occur during the winter, but may be extended, shortened, or canceled based upon a number of factors, including the presence or absence of caribou on the Refuge, snow depth and conditions, and the proportion of caribou from smaller herds such as the Mentasta Herd. The number of caribou hunting permits issued has been variable, ranging from 34 to 208 per year; the majority of permit holders are residents of Tok. Reported harvest has also widely varied from a low of 7 animals (2002-2003) to a peak of 43 animals (2000-2001). These harvest reports should be considered slightly below the total harvest of caribou within the Refuge. ADF&G estimates unreported harvest in adjacent GMU 20E to be less than 10 percent of the reported harvest (Gardner 2001b).

Figure 4-8 Facilities and Access

A relatively small number of brown and black bear are taken for subsistence on an opportunistic basis and were not historically sought out as a source of food.

4.3.7.2 Waterfowl and Other Migratory Birds

Waterfowl are taken primarily during spring and fall migrations. Waterfowl are harvested on a few bodies of water in the vicinity of Northway and along the Alaska Highway, on the Chisana River, Moose Creek, and in the Desper-Scottie Creek area.

Both subsistence and recreational hunting for waterfowl occur on Tetlin Refuge. A preliminary survey of subsistence users conducted by Tetlin Refuge staff in 1983 showed that ducks were used by over 70 percent of the households in Northway and Tetlin Village, as well as by Tok, Dot Lake, and Tanacross residents. Trappers are known to use the inedible parts of ducks for baiting traps and snares. Based upon observations by refuge staff, the number of younger waterfowl hunters has declined. These observations are reflected in Table 4-5.

Currently, residents in the Upper Tanana and Copper River valleys may harvest birds or eggs of 92 species, including waterfowl, waterbirds, seabirds, cranes, owls, and shorebirds. The bird harvest season is open from April 2 through August 31 with a closure from June 15 through July 15. Egg gathering is open from May 1 through June 14. There are no bag limits, and hunting may take place 24 hours per day.

Table 4-5. Comparison of migratory bird harvest in Upper Tanana Valley communities, Alaska: 1987 and 2000 (Andersen and Jennings 2001)[2]

Community	Dot Lake		Northway		Tanacross		Tetlin		Tok	
Year	1987	2000	1987	2000	1987	2000	1987	2000	1987	2000
Percentage of households using birds	46.7	26.7	71.1	35.7	55.6	34.6	79.3	36.7	22.5	15.5
Percentage of households harvesting birds	26.7	6.7	62.2	26.2	44.4	23.1	49.7	26.7	22.0	10.0
Ducks harvested	51	42	2652	432	207	126	810	420	2129	1131
Geese harvested	0	0	174	0	24	0	1	0	29	51
Birds per household	2.6	2.6	31.4	10.3	6.8	4.8	30.0	14.0	5.9	3.4

[1] The 2000 survey used different methodologies in Tok than in the villages. Only a subset (22 percent) of households in Tok were surveyed most of which were subjectively identified. The village surveys attempted to contact all households.

With the inclusion of all residents in highway communities within the Upper Tanana and Copper River valleys, approximately 5,200 people are now eligible to participate in the subsistence waterfowl hunting season (Table 4-2).

4.3.7.3 Whitefish, Pike, Arctic Grayling, and Burbot

Fish resources within the Refuge continue to be an important part of modern subsistence lifestyles in the Upper Tanana Valley. Historically, these resources were a key element for survival in the harsh environment of interior Alaska.

The majority of households surveyed in Northway fish within a five-mile radius of the community, primarily along Moose Creek, the Nabesna River, the Chisana River downstream from the Chisana River Bridge, and on Fish Lake. In addition, several traditional sites on the Refuge are used for fishing and fish camps.

Humpback whitefish are an important component of local culture and continue to be a primary subsistence fishery species within the Refuge. Presently, most of the whitefish harvest is by residents of Tetlin and Northway. In 1988, whitefish made up 42 percent of all subsistence resources used by residents of Northway and Tetlin (Marcotte 1991). Interviews with residents illustrate whitefish are not only an important food resource, but also an important part of their culture. (Robinson 2005).

The Chisana River is used to gain access to Moose Creek, which is fished heavily for burbot and pike. Other fishing areas include Tenmile Lake, Deadman Lake, the confluence of Stuver Creek and the Chisana River, and the Desper-Scottie Creek area. Fish Camp Lake (Tlechegn Lake) is used extensively for whitefish and burbot.

The Tanana River is fished for burbot. The Kalutna River is fished for pike and Arctic grayling. Gardiner Creek, accessible by foot from the highway, is also a popular place to fish for Arctic grayling.

A moderate amount of ice fishing for burbot takes place on Moose Creek and Jatahmund Lake and at Hidden Lake for rainbow trout.

Household surveys of residents in the Upper Tanana Valley were conducted in 1988. Estimates from these surveys show Northway and Tetlin residents harvested approximately 21,000 whitefish, 3,300 pike, 2,700 Arctic grayling, and 1,000 burbot between June 1987 and May 1988 (Marcotte 1991).

4.3.7.4 Upland birds

Spruce, ruffed, and sharp-tailed grouse, and willow ptarmigan are the most commonly harvested upland birds. Most harvest is incidental to other activities such as big-game hunting or fishing. Research and interviews indicate residents of Tok, Tanacross, and Dot Lake harvest upland birds primarily outside the Refuge (Marcotte 1991). Northway and Tetlin residents harvested just over 2,000 grouse and ptarmigan in 1988, with the majority of harvest occurring outside Tetlin Refuge or on private lands within the Refuge (Marcotte 1991, Halpin 1987, Case 1986).

4.3.7.5 Plant Resources

Common plant resources gathered for subsistence use include various berries, Indian potato (Hydysarum spp), wild rhubarb, mushrooms, Muskrat Cache (roots of Myriophyllum spicatum cleaned and stored by muskrats), birch bark, and firewood (Halpin 1987, Case 1986). Plants are primarily gathered along the Tanana River near Riverside and Fish Camp Lake, along the Alaska Highway, along Moose Creek, and between the village of Northway and the Alaska Highway.

4.3.7.6 Furbearers

A number of furbearer species are trapped by local rural residents. Some of these animals are used for food (e.g., muskrat and beaver), but the primary purpose for trapping is to sell, trade, or use the furs of these animals for making handicrafts or clothing. A more detailed discussion of furbearer trapping is provided in the Economic Use section of this chapter.

Subsistence trapping cabins and traplines. Creating and maintaining a trapline through the dense spruce forests within the Refuge takes considerable time and effort. Trappers tend to rotate use to different established lines over time, and some lines are passed down from parents to children (Halpin 1987). Although all areas of Tetlin Refuge are open to the public, trappers generally feel their efforts grant them exclusive rights to use these traplines. Others generally respect this unwritten code, but user conflicts do arise.

A few residents in the Northway area utilize large areas along established traplines in the central and northern portions of the Refuge or target a few highly productive areas. Tetlin residents trap primarily along the lower Kalutna River and around Big John Lake. Tok residents trap primarily in the northwestern panhandle, the Black Hills area, and the southern half of the Refuge, gaining access via ski plane or snowmachine. Most people no longer stay out overnight while trapping, but instead use shorter lines that can be covered within one day (Halpin 1987). This shift from multi-day trapping expeditions to single day trips has virtually eliminated the use or need for strategically located cabins along each trapline. Currently, there are five cabins administered by the Refuge which are used under special use permit for trapping and other subsistence activities. Several other cabins are located throughout the Refuge on private lands.

4.3.8 Recreation

Tetlin Refuge is relatively unknown as a recreation area, partly due to its distance from major population centers and the lack of access into the interior of the Refuge. As a result, most recreational users are either residents of the area or people driving by the Refuge, stopping at campgrounds, or at State-administered waysides and pullouts. Hunting, fishing, trapping, camping, wildlife observation, and photography are the primary recreational activities pursued within the Refuge.

4.3.8.1 Hunting

Waterfowl, bear, moose, and sheep are the major species hunted on Tetlin Refuge for recreation. Only federally qualified subsistence users are currently permitted to hunt caribou on the Refuge; currently, the general State season is closed. Local use of these species is discussed in the section on subsistence (section 3.4.7).

The number of people participating in recreational hunting trips is thought to currently be low and stable, but estimates for the number of recreational hunters using the Refuge are not available. Visitors generally charter or fly a personal float plane to Wellesley or Jatahmund lakes, boat the Nabesna, Chisana, and/or Tanana rivers, or hire one of two commercial big-game guides permitted to operate within Tetlin Refuge.

With the exception of guided client harvest, numbers of moose harvested by recreational hunters within the Refuge is unknown. Average harvest from the Refuge by commercially guided hunters is approximately one moose and one Dall's sheep each year, with black or brown bears harvested occasionally (TNWR 2005b).

Many waterfowl hunters come to the Refuge from Fairbanks and Anchorage, but as with other recreational hunters, no estimates of participation within the Refuge are available.

4.3.8.2 Fishing

Fishing for rainbow trout, lake trout, northern pike, Arctic grayling, and burbot draws some recreational anglers to the area. Ice fishing occurs in late winter for rainbow trout, lake trout, burbot, and pike. Refuge visitors fish predominantly in the road-accessible lakes and streams or larger, more remote fly-in lakes (Figure 4-8); hunters on the Refuge often fish when the opportunity presents itself. Fishing guide services are available, but demand for these services is currently low. In 1983, approximately 15 people paid for guided fishing trips within the Refuge. However, there are currently no commercial recreation fishing guides operating within the Refuge, and there have been no permit requests in recent years. The number of fish harvested by recreational anglers is unknown, but based upon observations and knowledge of refuge staff, it is presumed to be minimal.

Facilities and trails throughout the Refuge provide recreational fishing opportunities. However, relatively low densities of lake trout, grayling, and rainbow trout, and limited road access to waters within the Refuge are factors limiting participation.

ADF&G continues to stock Hidden Lake with up to 4,000 rainbow trout annually (ADF&G 2007). The purpose of this stocking effort is to improve recreational opportunities. Preliminary estimates from refuge use data indicate that Hidden Lake received approximately 80 angler use-days during 2006.

4.3.8.3 Non-consumptive Recreational Use

Most of the 200,000 people who drive the Alaska Highway past Tetlin Refuge each year are visitors from the lower 48 states, Canada, and several other countries (primarily Germany, Switzerland, Great Britain, France, and Australia). Trends in the numbers of Alaska Highway travelers and people stopping at the Tetlin Refuge Visitor Center since 1995 have shown similar patterns, with changes in visitor center use more pronounced. However, more recently the number of summer travelers on the Alaska Highway declined 19 percent from 124,535 visitors in 2000 to 100,913 visitors in 2004 (U.S. Department of Transportation 2007), while use of the Tetlin Refuge Visitor Center increased by 50 percent (5,800 visitors) during the same time period (Figure 4-9). The vast majority of recreational use on the Refuge involves wildlife viewing, wildlife photography, camping, picnicking, and other non-consumptive uses. These uses are concentrated at the Tetlin Refuge Visitor Center (16,600 visitors annually), interpretive highway pullouts and overlooks, kiosks, trails, and two refuge administered campgrounds.

A small but increasing number of boaters and canoeists use Scottie and Desper creeks, and the Nabesna, Chisana, and Tanana rivers. While fishing and hunting are the primary reasons most people use these waters, these areas also provide visitors the opportunity to observe and photograph wildlife. People occasionally fly to Wellesley or Jatahmund lakes for similar activities.

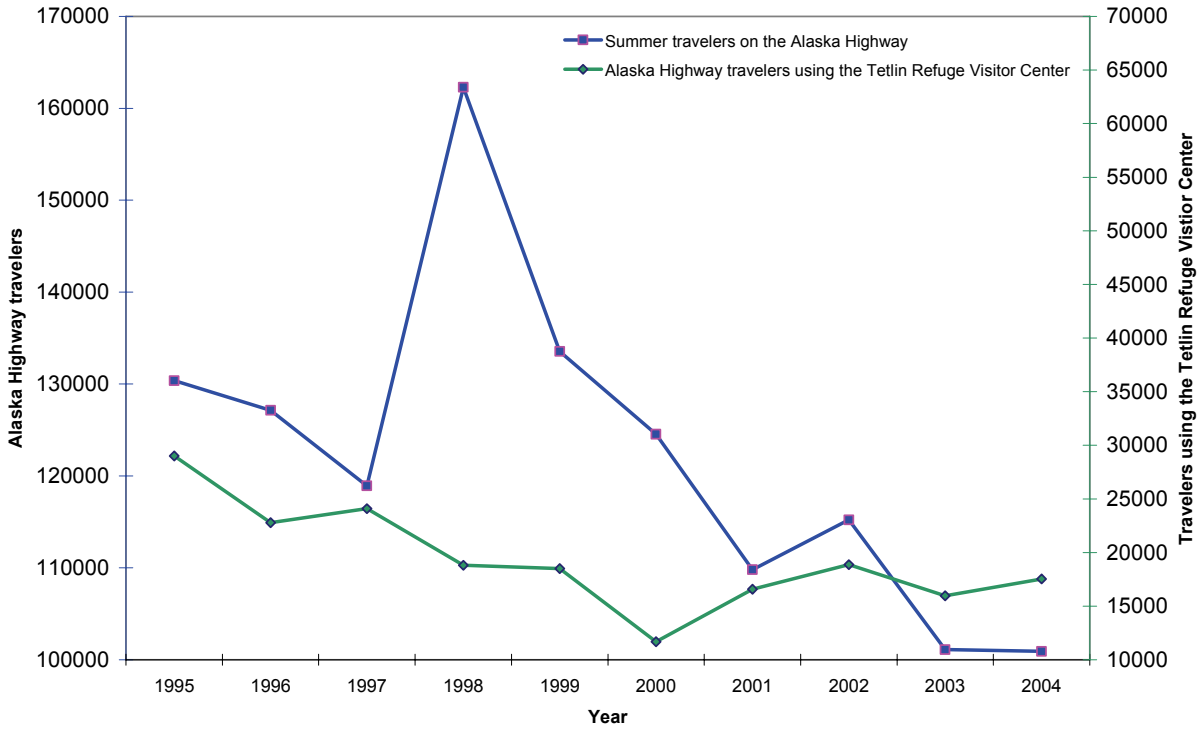
Guide services for these non-consumptive activities are available, but demand is low and sporadic, with only one or two groups using the Refuge from 2001through 2004. Currently one operator offers guided canoe and raft trips of varying lengths through Tetlin Refuge.

4.3.8.4 Environmental Education and Interpretation

Environmental education and interpretation is a primary purpose for Tetlin Refuge. Due to the number and diversity of programs and products produced by the Refuge, only an overview is provided here. A detailed description of the Refuge's interpretive program can be found in the Tetlin Refuge Public Use Management Plan (USFWS 1997a). Most activities take place at the Tetlin Refuge Visitor Center, Deadman and Lakeview campgrounds, or at off-site locations in local communities. Interpretive programs cover a broad range of topics, including identification of local flora and fauna, local geology, natural history, ecology, wildlife management, traditional lifestyles, and local history.

Each year, various refuge employees conduct hundreds of presentations in cooperation with Alaska Gateway School District school, local Native councils, Alaska Department of Natural Resources, ADF&G, Alaska Natural History Association, Tok Chamber of Commerce, Tok Lions Club, and a variety of other local community organizations.

Figure 4-9. Alaska Highway and Tetlin Refuge Visitor Center summer visitation 1995-2004. Source: U.S. Department of Transportation 2007



Programs are delivered through interpretive talks and nature walks, audio cassette or compact disk driving tours, traditional arts and craft demonstrations, literature classes, school visits, youth camps, Native culture camps, and a number of interpretive displays at the Tetlin Refuge Visitor Center, Deadman Lake Campground, and highway pullouts.

In addition to answering visitor questions, giving directions, providing items through the Alaska Natural History Association, and distributing Service and State brochures and pamphlets—a wide variety of educational materials are produced for the public. These materials include environmental curricula for elementary and secondary schools, the Tetlin Refuge Internet website, Tetlin Refuge brochure, and Tetlin Refuge Visitor Guide which is updated periodically to provide detailed and

current information about the Refuge. Refuge employees are also active participants in developing local school curriculums on a variety of topics ranging from fire to wildlife.

4.3.9 Economic Use

4.3.9.1 Trapping

Trapping is an important activity on Tetlin Refuge and throughout the Upper Tanana Valley. Depending upon the primary reason people choose to trap and their residency, this activity could be considered a subsistence, recreational, or commercial use. Because most animals are trapped for their pelts (which most often are sold or used to make items which are then sold), it is discussed here as an economic use of the Refuge.

Muskrat, lynx, hare, marten, red fox, wolf, and wolverine are the principal species trapped within Tetlin Refuge. In the early 1900s, and even into the 1960s and 1970s, trapping played an important role in the local economy. In 1983, between $70,000 and $100,000 worth of raw fur (mostly muskrat, lynx, marten, and fox) was taken on the Refuge by an estimated 25 trappers. These estimates do not include fur that was used locally for handicrafts. Wolves, wolverine, coyote, mink, river otter, and beaver were also harvested.

More recently, the value of furs and the number of animals harvested have both declined. Based on past interviews with local fur buyers (TNWR 1988) and the harvest estimates included in this discussion, the current value of furs taken from the Refuge is most likely in the range of $30,000 to $50,000 annually.

The Northway-Tetlin Flats area, which includes the northern portion of Tetlin Refuge, has been one of the most productive muskrat trapping areas in Alaska (Gardner 2001a). Muskrat, at one time, were probably the most harvested furbearer in the region (USFWS 1987a). Historically, tens of thousands of muskrat pelts were sold annually in the Northway and Tetlin areas. Household surveys estimate that nearly 4,000 muskrat were harvested by residents of Tetlin and Northway in 1988 (Marcotte 1991).

Lynx harvest tends to fluctuate according to their natural population cycles (see Section 4.2.8 of this document). Based upon a review of ADF&G sealing records for GMU 12 from 1978-1998, it is estimated 70 to 100 lynx were harvested from the Refuge during the peak of the cycles, with 30 to 40 harvested during the bottom of the cycles (TNWR 1998).

A similar review of ADF&G sealing records for wolverine indicates reported harvest within the Refuge remained less than six animals per year (TNWR 1998). More recent harvests were above average due to higher pelt prices, with trapping effort concentrated along the western and southern boundaries of the unit, outside Tetlin Refuge (Gardner 2001a).

Review of ADF&G sealing records for wolves indicates an average of four animals trapped per year within the Refuge between 1978 and 1990. However, these same reports indicate harvest increased to an annual average of 19 animals from 1991 through 1998 (TNWR 1998).

Household surveys estimate 4,600 snowshoe hare and 700 marten were harvested by residents of Tetlin and Northway in 1988 (Marcotte 1991); there is no harvest reporting requirement for these species under current regulations, and a more recent estimate of harvest is not available.

4.3.9.2 Guiding

All commercial guiding services within Tetlin Refuge are regulated by special use permits. Currently, two big-game guides, two air-taxi/transporters, and one nonmotorized boat transporter are permitted to operate within the Refuge. The number of big-game guides is limited at this time, with only two of the three guide areas requested through the 2003 prospectus bidding process.

Relatively low densities of big-game populations and Federal hunting regulations currently make areas outside the Refuge more attractive to commercial big-game guides. Guides take one or two clients into the Refuge each year with a typical total harvest of one sheep and one moose. Occasionally a hunter harvests a black bear or grizzly bear. Hunts may last as long as 10 days, but clients typically hunt 4 or 5 days within the Refuge. The average cost for a one week hunt is $6,500 to $7,500 depending on the number and type of animal taken.

Despite recreational fishing opportunities in the Refuge for Arctic grayling, northern pike, and lake trout, there is currently no demand for guided fishing services; no permits are currently active, and none have been requested.

Of the two permitted air-taxi operators, one provides the majority of air service for hunters, anglers, backpackers, photographers, and other recreational users. On average, 18 people are flown into the Refuge annually. Group size is generally two to four people; the average stay is eight days.

One permitted ecotourism operator provides canoe and raft trips within the Refuge, primarily on the Chisana and Tanana rivers.

4.4 Wilderness Values

Section 304(g) of ANILCA requires the Service to identify and describe the special values of the Refuge, including wilderness values. The term "values" is often viewed synonymously with a range of similar terms, from subjective beliefs and preferences (e.g., family values) to more objective functions, services, and benefits (e.g., ecological values). Of interest here are the objective kinds of values, specifically those that are related to the condition and character of the natural environment.

The 1964 Wilderness Act recognized wilderness as a resource in and of itself and also established a mechanism for preserving that resource in a national system of lands. The definition of wilderness found in the Act provides a framework for identifying and describing wilderness values. According to the Act, the fundamental qualities of wilderness are: undeveloped, untrammeled, natural, and outstanding opportunities for solitude, or a primitive and unconfined type of recreation. In addition, the Act states that wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Undeveloped. This is the most immediately observable and easily measured wilderness quality. Undeveloped simply means free from roads, structures, and other evidence of modern human presence or occupation. The undeveloped quality strongly influences other core wilderness values, in particular experiential opportunities for solitude and primitive recreation. A lone structure may have only minimal impacts on natural processes while still serving as a constant reminder of human influence for recreational visitors. Certain kinds of structures or improvements may be considered desirable in a given wilderness setting (e.g., trails) or acceptable according to specific legislation, but that does not diminish their negative impact on the undeveloped quality.

Untrammeled. The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man." In other words, wilderness is essentially uncontrolled or unrestricted by purposeful human actions. Synonyms for untrammeled include unhindered, unencumbered, free-willed, and wild (Landres et al. 2005). The untrammeled quality of the wilderness resource is diminished when ecological events or processes are constrained or redirected to suit modern human ends (e.g., by suppressing naturally ignited fires or introducing non-native plants or animals).

Natural. Naturalness is a measure of the overall composition, structure, and function of native species and ecological processes in an area. In contrast to untrammeledness, the natural condition of an area may sometimes be enhanced through purposeful human action (e.g., to restore an eroded stream bank or eradicate an invasive weed).

Outstanding Opportunities for Solitude. Solitude in the wilderness context is generally understood to mean freedom from sights, sounds, and other evidence of modern man (Landres et al. 2005). While the relative amount of freedom from these things necessary to experience solitude is highly personal and variable, the Wilderness Act states only that outstanding opportunities for solitude be provided. Accordingly, encountering other people, hearing mechanized sounds (from aircraft overflights, for example), or seeing the lights of a distant population center are all examples of things that may negatively affect solitude opportunities; while remoteness, low visitor density, and vegetative or topographic screening are things that may enhance solitude opportunities.

Outstanding Opportunities for a Primitive and Unconfined Type of Recreation. Primitive and unconfined recreation is nonmotorized, nonmechanized activity that occurs in an undeveloped setting and is relatively free from social or managerial controls. Primitive recreation is also characterized by experiential dimensions such as challenge, risk, and self-reliance. Dispersed use patterns, which frequently occur where there are no facilities to concentrate use, enhance opportunities for self-reliance and also enhance opportunities for solitude. Conversely, some actions aimed at maintaining opportunities for solitude, such as limited permit management systems, may negatively affect opportunities for unconfined experiences.

Other Special Features. Lands that exhibit the core wilderness qualities described above may also contain additional special features with scientific, educational, scenic, or historic value. While the Wilderness Act makes it clear that these features are not wilderness qualities in and of themselves, their presence may distinguish one area with wilderness values from another. In the context of Alaska refuges, special features might include such things as active volcanoes, unique abundance or concentrations of a given species, fossil deposits, or evidence of prehistoric cultures.

As directed by Sections 304(g) and 1317 of ANILCA, all Tetlin Refuge lands were reviewed during the first refuge planning process in the 1980s "as to their suitability or nonsuitability for preservation as wilderness." Four wilderness review units were identified for the 1980s review, and, with minor adjustment, those boundaries are used once again for the following identification and description of refuge wilderness values (see Figure 4-10).

4.4.1 Characteristics Common to All Units

Most of the Federal lands within the four wilderness review units meet the definitions of wilderness as defined by the Wilderness Act. They are largely undeveloped, untrammeled, highly natural, and support abundant opportunities for solitude and primitive recreation. All of these units support the full suite of fish and wildlife species and plant communities that represent the northern boreal forest of Tetlin Refuge. Although much of the Federal land within the units is

contiguous, some small parcels of private property, or inholdings, exist. The Alaska Highway borders portions of some units, and there are scattered cabins and remnants of other structures as well. However, within the interior of each of the units, few visible signs of human manipulation or a permanent human presence can be seen. The Refuge is large and offers outstanding opportunities for solitude. Opportunities for primitive recreation–use that is dispersed and does not require on-site facilities–are also abundant in all units.

4.4.2 Tetlin Flats Unit

This area consists of two parcels approximately 11,500 acres and 8,500 acres in size. These parcels are isolated from other Federal lands within the Refuge, and share only one common point. This broad wetland and river valley area located in the northern portion of the Refuge is dotted with innumerable lakes, ponds, and meander scars and is the most productive wetland within the refuge boundaries. The predominant vegetation type is open black spruce forest with deciduous scrub of alder, willow, blueberry, and dwarf scrub.

This unit remains largely undeveloped, appearing natural and undisturbed, with some improvements on private inholdings and parcels adjacent to refuge lands along the Alaska Highway. However, due to the overall the size of the unit, the unconnected position of the parcels that comprise it, and uncertainty relative to surrounding development and activities, it does not lend itself to long-term conservation of naturalness at a scale sufficient for wide-ranging species such as caribou or wolves.

Compared to the rest of the Refuge, this unit experiences substantial traffic noise and boat travel along the Tanana River, which decrease opportunities for solitude. Recreational opportunities are largely confined to the river corridor and to winter snowmachine trails.

4.4.3 South-Central Area

This unit includes approximately 419,000 acres of refuge-administered lands between the Alaska Highway (including the Nabesna and Chisana rivers) and the Refuge's southern boundary with Wrangell-St.Elias National Park and Preserve. Habitats are diverse—ranging from low wetland areas, to the rolling Black Hills, to the foothills of the Nutzotin Mountains. Numerous small ponds, large lakes, and various streams are found throughout the area.

The unit remains essentially in a natural, unaltered condition. Evidence of current and past trapping activities, hunting camps, various subsistence activities, and early travel south into the gold mining areas of the upper Chisana and Nabesna rivers is present but widely scattered. Extended travel into the area requires a boat, airplane, snowmachine, or dog team. Few people visit the area, with the limited use focused at a few key destinations such as Jatahmund Lake. As a result, opportunities for solitude and a variety of recreation activities are outstanding throughout most of the area.

4.4.4 Cheslina Area

This unit is located in the southwest corner of the Refuge and encompasses approximately 140,000 acres, including the much of the Cheslina watershed and refuge-administered lands east to the Nabesna River. The unit is dominated by high hills and steep, rugged mountains up to 8,000 feet in elevation. Vegetation is predominantly scrub and alpine or subalpine tundra. The area provides important habitat for moose, wolf, wolverine, and marten, and is the only habitat for Dall's sheep found within the Refuge.

Access to the area is by boating the Nabesna River, by small plane, or by a steep overland trail from the Nabesna Road located south of the Refuge in Wrangell-St. Elias National Park and Preserve. Due to its remote and rugged terrain, the area is only visited occasionally by hunters and provides outstanding opportunities for solitude and a variety of recreation activities.

4.4.5 Wellesley Lake/Scottie Creek Area

This unit encompasses approximately 120,000 acres bounded by the Chisana River, the Alaska Highway, the Canadian border, and Wrangell-St. Elias National Park and Preserve. Much of this area is characterized by the meandering channels of Mirror, Scottie, and Desper creeks and the numerous small ponds and lakes in these low wetland valleys. However, several areas of forested hills and uplands add to the diversity.

The unit remains essentially unaltered from its natural condition except for development along the Alaska Highway. Much of this area is easily accessible from the Alaska Highway but is not frequently used by visitors. Access is also possible from the Chisana River. While opportunities for solitude are limited near the Alaska Highway, portions of this area away from the highway provide outstanding opportunities for solitude in settings found few other places within Tetlin Refuge. Recreational opportunities in this area are more diverse and more easily accessible than in other portions of the Refuge due to boat access to Scottie and Desper creeks and overland access to Airs Hill and the Chisana River from the Alaska Highway.

Use of this area dates to prehistoric times and the number and variety of cultural resources documented make it the most valuable cultural and historic area managed by the Refuge.

4.5 River Values

4.5.1 Scottie-Desper Creeks

Scottie Creek is the Chisana River's largest tributary. It begins in the Yukon and flows southwest for approximately 50 miles, crossing the Alaska-Canada border to join with the Chisana River about 28 miles southeast of Northway Junction. Scottie Creek crosses the Alaska Highway at mile post 1223.4. The lower 12 miles of the stream meanders through a lowland area consisting of numerous lakes, ponds, and other wetlands. A prehistoric rock fishing weir was established in the lower segment of the stream (Yarber and Madison 1987, Tyone 1996). The stream substrate is mud with excellent water quality during the open water period. Scottie Creek is known to support northern pike, longnose suckers, humpback whitefish, arctic grayling, and burbot. Chum salmon also have been reported in Scottie Creek, and this stream also contains freshwater clams. The lower Scottie Creek watershed is considered by refuge personnel to be vital wildlife habitat.

Desper Creek originates in the foothills north of the Refuge in the Yukon-Tanana Uplands. It flows south and west 20 miles before joining with Scottie Creek about 31 miles southeast of Northway Junction. Desper Creek crosses the Alaska Highway at milepost 1225.7 near Border City Trading Post. From the highway, the stream meanders approximately 11 miles to Scottie Creek. The lower Desper Creek watershed is considered by refuge personnel to be important wildlife habitat. The stream has an abundance of aquatic vegetation. It freezes to the bottom during some winters or has shallow and anoxic water conditions under the ice. Desper Creek is known to support northern pike, humpback whitefish, burbot, and longnose suckers; grayling are also likely to occur in the drainage.

Although both Scottie and Desper creeks are easily accessible from the Alaska Highway, neither receives a noticeable amount of public use. A number of log jams and beaver dams make boat

Figure 4-10. Wilderness Review Units

travel difficult, but portages are possible. As a result, these two creeks provide outstanding opportunities for fishing, hunting, wildlife viewing, and wildlife photography characterized by high degrees of solitude in a primitive setting.

4.5.2 Chisana River

The Chisana River rises from the Chisana Glacier in the Wrangell Mountains south of the Refuge. It flows northeast then northwest approximately 110 miles, joining the Nabesna River to form the Tanana River about three miles northwest of Northway Junction. The Chisana watershed is approximately 3,300 square miles. About half of the river's length is within the Refuge, with the remaining upper half in Wrangell-St. Elias National Park and Preserve. The upper river segment is braided and has wide bank-to-bank widths, relatively shallow water depths, and a steep gradient with high water velocities. This is typical of rivers that flow through glacier moraines. The river substrate within the Refuge is variable with sand, gravel, and cobble in riffle areas, and sand and silt in pool areas. The Chisana is highly turbid during the open water season, but water quality improves considerably during the winter. Primary tributaries to the Chisana River include Stuver, Wellesley, and Mirror creeks, which drain the southern plateau; Scottie and Desper creeks run through important wetlands; and Gardiner Creek flows south onto the Refuge from the Yukon-Tanana Uplands.

Access to the Refuge along the Chisana River is not easy. Visitors must either boat down Desper or Scottie creeks to the confluence or boat upriver from the Chisana Bridge boat ramp more than 40 miles. However, during ice-free periods, the shallow, braided nature of the river upstream from its confluence with Scottie Creek makes boat travel difficult or impossible. Large gravel bars in this upper braided section make access by small wheeled planes possible.

Due to these access difficulties, the portion of Chisana River within the Refuge remains remote and infrequently traveled, providing outstanding opportunities for solitude in a primitive setting. The numerous wetlands, streams, ponds and lakes along this river corridor provide numerous opportunities for fishing, hunting, wildlife viewing and wildlife photography.

4.5.3 Nabesna River

The Nabesna River rises from the Nabesna Glacier in the Wrangell Mountains south of the Refuge. It flows northeast 73 miles, joining the Chisana River to form the Tanana River about 3 miles northwest of Northway Junction. The Nabesna River watershed is about 2,100 square miles. The upper third of the river is within Wrangell-St. Elias National Preserve. The river has a 0.8 percent gradient from its glacial origin for a distance of about 21 miles to the southern boundary of the Refuge, and a 0.16 percent gradient from the refuge boundary to it confluence with the Chisana near Northway. Water is turbid in the spring, summer, and fall but clears in the winter.

Portions of the Refuge are accessible by traveling a few miles up the Nabesna River beyond the village of Northway. The few cabins scattered along its banks and the occasional boat are the only noticeable signs of people. Near the confluence with the Cheslina River, the Nabesna enters an area of remarkable scenery characterized by high rolling hills dotted with ponds and lakes and the Nutzotin Mountains beyond. The diversity of terrain and habitats found along the Nabesna River provide opportunities for fishing, hunting, and wildlife viewing and photography not found anywhere else within the Refuge.

4.5.4 Kalutna River

The Kalutna River begins adjacent to and west of the Nabesna River, about 9.5 miles southwest of Northway. It flows north 26 miles to the Tanana River, approximately 23 miles southeast of Tok, Alaska. The refuge boundary follows the east bank of the Kalutna River, and the river proper is outside of the Refuge. The Kalutna River drains a large area in the northwest portion of the Refuge.

The Kalutna is only accessible from its confluence with the Tanana River. Its narrow, meandering channel is blocked by numerous deadfall, log jams, and beaver dams, making travel by small boat or canoe difficult. Due to these access difficulties, the Kalutna provides outstanding opportunities for fishing, hunting, and wildlife viewing and photography in a primitive setting with outstanding opportunities for solitude.

4.6 Refuge Infrastructure and Administration

4.6.1 Administrative Facilities

Administrative facilities include offices, visitor center/contact stations, residences (quarters), bunkhouses, maintenance shops, warehouse space, vehicle storage, hangar/airport leases/tie-down space/float ponds or docks, fuel and other hazardous materials storage sites, remote administrative cabins and/or sites, etc.

Tetlin Refuge administrative facilities are headquartered in Tok. Table 4-6 is a comprehensive list of all current administrative facilities used and maintained by the Refuge, including pertinent information on the adequacy of the facilities to meet current and projected refuge needs.

Table 4-6. Existing administrative facilities for Tetlin Refuge

Facility	Size (sq. ft.) or length (mi.)	Estimated Replacement Cost (2005 dollars in thousands)	Description
Visitor Center	N/A	2,701	Consists of a 1,730 sq. ft. main log building, parking lot, wildlife viewing platform, interpretive trail, information signs, drinking water and storage, and restroom facilities. Constructed in 1988. Roof and observation deck are failing; must be replaced.
Headquarters office	4,736	1,477	Consists of main log office building, bunkhouse, and framed outbuildings. Constructed in 2003.
Storage Building/ Garage	4,000	134	Frame constructed vehicle and equipment storage building. Constructed in 2003.
Northway Bunkhouse	2,024	684	Frame constructed bunkhouse; has well water, and driveway. Constructed in 1958. This aging structure has a failing roof and utility systems that are costly to maintain. It is scheduled to be replaced.

Facility	Size (sq. ft.) or length (mi.)	Estimated Replacement Cost (2005 dollars in thousands)	Description
Northway Warehouse	1,000	217	Facility is inadequate; must be replaced to meet current needs.
Residences (four owned, two leased)	1,355	571	Consists of frame constructed houses; has driveways, well water, outbuildings, fuel storage, and septic systems. Constructed in 1985. Outbuildings have deteriorated beyond repair; must be replaced.
Hangar (leased)	Approx. 3,500	1,200	Newer metal building with capacity for multiple aircraft and maintenance shop.
Fuel Storage	N/A	31	1,000 gallon aviation fuel storage tank at Yarger Lake. Constructed in 1996.
Administrative Cabins (2)	320	80	Remote log cabins. Constructed in 1987. Both cabins need maintenance and repairs.
Administrative Cabin	192	48	Remote log cabin. Constructed in 1975. Needs major structural repairs to meet public health and safety requirements.
Radio Repeaters (2)	N/A	211	Used for Refuge communication needs.
Remote Automated Weather Station (3)	N/A	180	Constructed at various times. Two located within the Refuge, one adjacent to the Refuge. Condition is good.
Deadman Lake Campground	N/A	4,068	Established in early 1950s. Consists of gated two-mile access road, 16 campsites, boat launch, outhouses, interpretive kiosk, wildlife viewing platform, and wooden boardwalk. Campsites are in need of rehabilitation. Boat ramp needs repairs.
Lakeview Campground	N/A	785	Consists of gated access road, 8 campsites, outhouses, and interpretive kiosk. Campsites need additional rehabilitation and maintenance.
Taiga Trail	0.25 mi.	42	Interpretive accessible trail consisting of 48 in. wide wooden boardwalk, interpretive signs, and lakeside wildlife viewing platform. Constructed in 1990.

Facility	Size (sq. ft.) or length (mi.)	Estimated Replacement Cost (2005 dollars in thousands)	Description
Visitor Center Trail	0.25 mi.	35	Interpretive accessible trails consisting of 36 in. wide trail of native material. Original trail established 1974 or earlier. Re-constructed in 2007. Design and materials for interpretive displays require additional funding.
Hidden Lake Trail	1.2 mi.	311	Consists of a parking area, interpretive kiosk, and 6,400 ft. walking trail with sections of wooden boardwalk.
Island Lake-American Wellesley Lake Trail	17 mi.	1,235	Winter trail. Established in 1965 or earlier.
Northway-Jatahmund Lake Trail	30 mi.	2,180	Winter trail. Established in 1980 or earlier.
Tetlin Flats Trail	1.5 mi.	210	Access trail. Established 1980 or earlier.
Airs Hill Trail	11 mi.	1,940	Non-maintained foot and stock trail. Established in 1965 or earlier.
Alaska Highway Interpretive Panels	N/A	49	Replaced in 2006.
Seaton Roadhouse Site	2 mi.	2,703	Consists of an abandoned section of the Alaska Highway. Condition currently unusable. Constructed in 1941.
Chisana River Boat Launch	15,365	227	Consists of a gravel parking area and ramp. Constructed in 1999.
Desper Creek Boat Launch	5,000	66	Area is currently undeveloped. Constructed in 1986.

Additional administrative facilities and infrastructure are necessary for implementation of the Refuge's current program of work, identified in Table 4-7. If additional facilities are required to implement a specific alternative, those facilities and associated costs are identified in the discussion of that alternative.

Table 4-7. Additional facilities needed to support current refuge programs

Facility	Size (sq. ft.)	Projected Cost (2005 dollars in thousands)	Description
Interagency Visitor Center	3,600 (of the total 10,000)	5,331	Currently in the final stages of Phase I planning. Land purchase pending final agreement. Construction pending Service funding.
Refuge Headquarters Office Annex	1,000	375	Existing facilities at capacity. An annex to this existing facility is required prior to any staffing increases.
Fire Cache	192	53	Existing 150 sq. ft. building inadequate. Fire equipment currently located in multiple buildings not designed for use as fire caches.
Hangar	3,600	1,455	Current leased facility is very expensive.
Northway Warehouse	1,600	360	Current facility does not meet existing needs. Upgrades would exceed new construction costs.
Maintenance Shop	4,000	1,508	Current facilities inadequate and located within the existing leased hangar facility scheduled to be replaced.

4.6.2 Refuge Staffing

The refuge staff presently consists of 22 permanent positions. In addition to 6 to 8 positions filled on a seasonal basis, the following are full-time positions unless otherwise noted:

- Refuge Manager
- Deputy Refuge Manager/Refuge Officer
- Refuge Operation Specialist
- Supervisory Biologist (Land Management Research Demonstration Program)
- General Biologist
- Wildlife Biologist (subsistence)
- Wildlife Biologist
- Fire Management Officer
- Forestry Technician (2 seasonals)
- Refuge Administrator/Computer Specialist
- Refuge Clerk
- Refuge Information Technician
- Supervisory Park Ranger
- Education Specialist
- Park Rangers (4 seasonals)
- Airplane Pilot
- Lead Carpenter

To effectively manage the Refuge's current program of work, 10 additional staff positions (permanent full-time and/or part-time) are needed:

- Law Enforcement Officer (LE; 1-2 FTEs)
- Maintenance Worker/Mechanic (0.75 FTE)
- Lead Interpretive Park Ranger (1 FTE/GS-09)
- Interpretive Park Rangers- Interagency Visitor Center (2-0.5 FTE/GS-05)
- Park Ranger (outdoor recreation) (0.75 FTE/GS-07)
- Education Assistant (0.5 FTE/GS-07)
- Refuge Information Technicians (2-0.5 FTEs)
- Biologist (Land Management Research Demonstration assistant) (0.75 FTE/GS-07)

In fiscal year 2005, Tetlin Refuge had a staff of 15 permanent full-time, four permanent part-time, six seasonal employees, and eight volunteers (with two positions vacant). Salaries for these employees totaled $1,117,769. In addition, $807,975 funded refuge maintenance and operations, inventory and monitoring work, trail reconstruction, and other refuge projects.