3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter describes the following uses and resources for the Traditional Use Area: soils, vegetation (including wetlands); water resources; visitor opportunities; wilderness; and subsistence opportunities. These subjects reflect the impact topics identified in Section 1.7.1 of this document.

3.2 SOILS

Soils information in the area of the TUA is primarily from a Natural Resources Conservation Service (NRCS) report, “Soil Survey of Denali National Park Area, Alaska, by Clark and Duffy, 2004 (NPS 2004d). This seven year soil-ecological mapping effort resulted in digital maps and descriptive products for several characteristics including climate zones, natural vegetation, permafrost areas, landforms, geomorphic processes, lithology, and soils temperature regimes, parent materials, life zones, and NRCS land classifications. Additionally, soils information is gleaned from field work done by an NPS botany/vegetation crew, mostly in the 2005 field season (Liebermann and Roland 2006).

3.2.1 Park Soils & the TUA Soils Setting

The TUA is located on the south side of the Alaska Range wholly within the *humid temperate* domain. The area is within two major soils provinces, 1) the southern marine regime influence, a soils climate subzone of Alaska Range Humid Taiga-Tundra-Meadow province, and 2) the Coastal Trough Humid-Taiga Province. Two soils sections, four subsections, and 11 ecomap landtype associations (detailed map units) are represented within these provinces and are generally described below. It is important to note that the entire TUA contains eleven detailed soils map units; however, only six units are affected by existing trails and routes within the unit (see Figure 3.1).

<u>Section M135A—Alaska Mountains</u>

This Section consists of steep, rugged mountain ridges separated by broad valleys. Elevation ranges from 650 feet in valleys to greater than 20,000 feet on mountain peaks. The dominant soils are classified within the Gelept Suborder of Inceptisols on mountains with the less common Orthent Suborder of Entisols on flood plains. Soils are formed primarily in colluvium with smaller areas of alluvium on flood plains. About two-thirds of the area has no soil. A substantial portion of the area is barren of vegetation.

Average annual precipitation ranges from 10 to 116 inches. Average annual temperature ranges from -8 to 30°F. Freezing conditions may occur year around.

M135A Sections include three subsections. The **Alpine Mountains Subsection** (mountains) includes sporadic permafrost, and major soil taxa consisting of Typic Eutrogelepts, Typic Haplogelolls, (Oxyaquic) Humic Eutrogelepts, and (Oxyaquic) Typic Haplogelolls. One detailed mapping unit (7MS31) exists within the TUA, but no trails are found within the unit. (See Figure 3.1: Soil Mapping Units, Trail Locations, and Trail Distances-Areas in the Cantwell TUA)

The **Glaciated Uplands Subsection** (till, outwash plains, and hills), sporadic permafrost and major soil taxa expected are: Typic Haplogelods, Typic Eutrogelepts, Typic Historthels, and Typic Histoturbels. Only one soil map unit (7TP) of this subsection type is found in the TUA, and involves portions of existing trails in the Windy Creek area. (See Figure 3.1)

The **Boreal Mountains Subsection** (mountain footslopes) involves sporadic permafrost, and major soil taxa consisting of Oxyaquic Eutrocryepts, Typic Eutrocryepts, and Typic Historthels.

One mapping unit (7MS2) of this subsection is found within the TUA with portions of trails in the Windy Creek and Bowl areas, Cantwell airstrip, and the Pyramid Peak vicinity. (See Figure 3.1)

<u>Section M135S—South Central Mountains</u>

This Section consists of steep, rugged mountain ridges separated by broad valleys. Elevation ranges from 650 feet in valleys to greater than 20,000 feet on mountain peaks. The dominant soils are classified within the Cryept Suborder of Inceptisols and Cryand Suborder of Andisols. Soils are formed primarily in colluvium and volcanic ash. About two-thirds of the area has no soil. A substantial portion of the area is barren of vegetation.

Average annual precipitation ranges from 20 to 136 inches. Average annual temperature ranges from -9 to 30°F. Freezing conditions may occur year around. Permafrost is generally absent in this section.

M135S Sections include the **Alpine Mountains Subsection** (mountains, till plains and fans) Major soils taxa include Andic Dystrocryepts, Humic Vitricryands, and Typic Humicryods, and generally no permafrost. Two mapped soil units of this subsection are within the TUA (9SA44 & 9TP) and represent a large portion of the existing trail use in the Cantwell Creek area (Figure 3.1). There are 11 Ecomap landtype associations (detailed map units).

3.2.2 Affected Soil Mapping Units and Existing Impacts

The following section discusses the existing trail and route conditions within the TUA, and ties those trails/routes with soils mapping units as mapped and described in the 2004 Soil Survey of Denali National Park Area (NPS 2004d). Figure 3.1, gives the soils units in the area, and trail lengths and disturbed areas by mapped soil unit. Table 3.1 attempts to identify the most sensitive soils by comparing physical conditions of the trails. This table uses specific trail location names/descriptions as those established by Liebermann and Roland (2006), as well as existing condition assessments as made by the Liebermann/Roland field crews. Portions of that data are used here to evaluate the soils component of the trail and route conditions. Certain collected data are itemized here to exemplify the soils impact assessment methodology:

1. Field crews GPS mapped each trail or route (or cluster of trails or routes) in the field giving them unique names for descriptive and comparative purposes. The names and associated physical parameters have been adopted here in this section as the soils database.

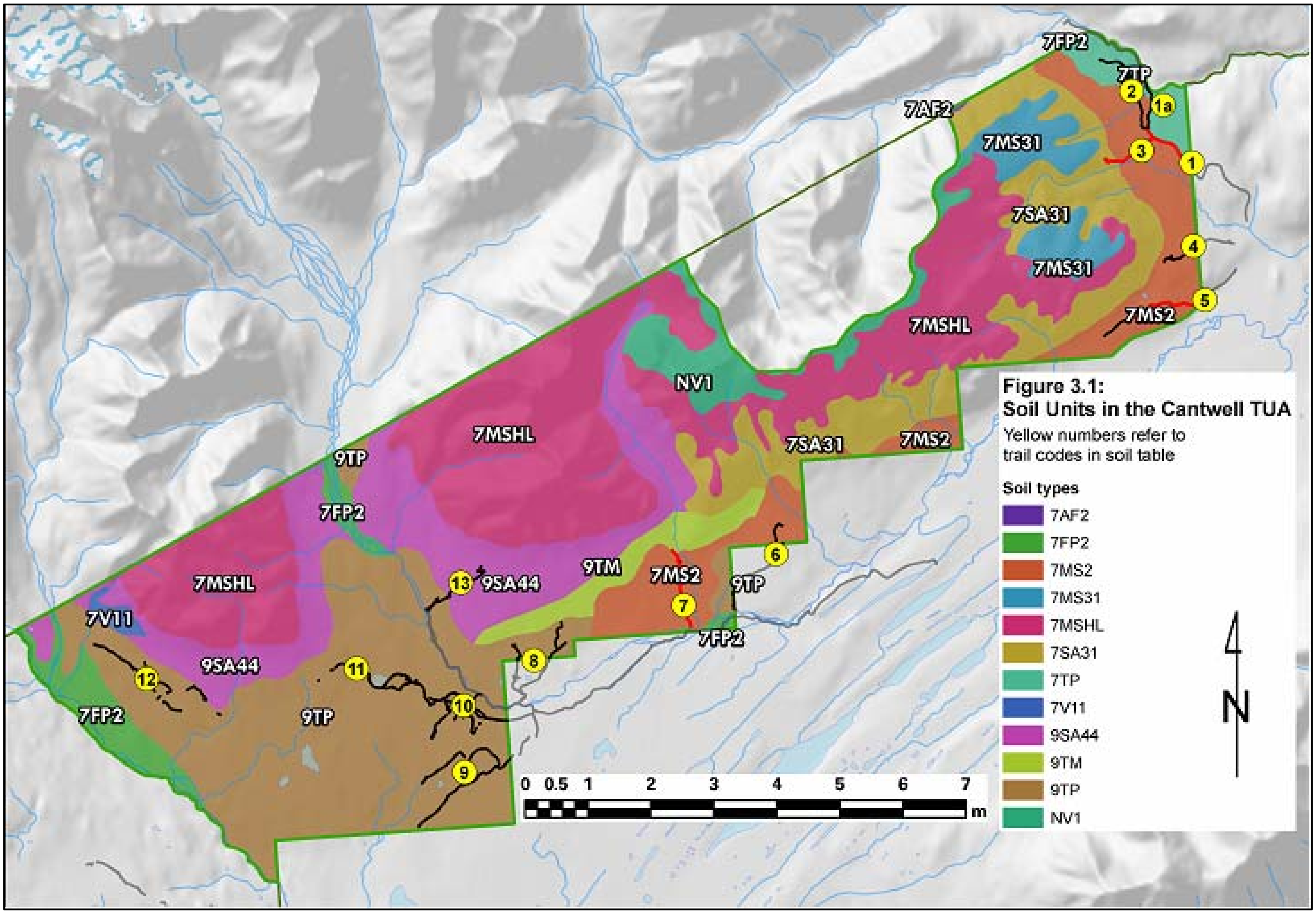


Figure 3.1: Soil Units in the Cantwell TUA

Trail Name →	Windy Ck Access	Windy Ck Ravine	Windy Ck North	Windy Ck Bowl	Cantwell Northwest	Cantwell Airstrip	Cantwell Northeast	Pyramid Peak	Cantwell Northwest	Cantwell W. Southeast	Cantwell West-Center	Cantwell West-Northw	Bull Riv. East	Cantwell NE Incursion	Tot Dist (feet)	Tot Area (acres)
Trail Designation	WC-CN	WC-R	WC-N	WC-SW	C-NW	CW-S	CCN-E	CCN-C	CCN-W	CCW-SE	CCW-C	CCW-NW	Bull R E	CC-NW		
Soil Map Trail Number →	1	1a	2	3	4	5	6	7	8	9	10	11	12	13		
7MS2 Linear Dist (feet)	3706	1286	4068	3828	2828	7797	1738	5845							31096	
7MS2 Area (Acres)	1.0	0.4	1.3	1.0	0.9	2.2	0.4	1.5								8.7
7TP Linear Distance (feet)	450	1929	3923												6302	
7TP Area (acres)	0.2	0.5	1.2													1.9
7SA31 Linear Distance (feet)				1276											1276	
7SA31 Area (acres)				0.4												0.3
9SA44 Linear Distance (feet)														5247	5247	
9SA44 Area (acres)														1.4		1.4
9TM Linear Distance (feet)								347							347	
9TM Area (acres)								0.1								0.1
9TP Linear Distance (feet)							578		5525	15577	23194	16942	12731	1748	76295	
9TP Area (acres)							0.1		1.4	4.6	7.1	6.1	4.1	0.6		24.0
TOTAL TRAIL LENGTH (feet)	**4156**	**3215**	**7991**	**5104**	**2828**	**7797**	**2316**	**6192**	**5525**	**15577**	**23194**	**16942**	**12731**	**6995**	**120563**	
TOTAL AREAS (acres)	**1.2**	**0.9**	**2.5**	**1.4**	**0.9**	**2.2**	**0.5**	**1.6**	**1.4**	**4.6**	**7.1**	**6.1**	**4.1**	**2.0**		**36.4**

Table 3.1 - EXISTING TRAIL & ROUTE CONDITIONS (APPLIED TO SOILS) AS OF 2005

Trail Symbol →	WC-CN	WC-R	WC-N	WC-SW	C-NW	CW-S	CCN-E	CCN-C	CCN-W	CCW-SE	CCW-C	CCW-NW	BULL R E	CC-NW
Trail Name	WC Access	WC Ravine	WC North	WC Bowl	Cant NW	Cant Airstrip	Cant C NE	Pyramid	Cant C NW	Cant C WSW	Cant C W-C	Cant C WNW	Bull R East	NE Incursion
Trail # on Soils Map 3.1	1	1a	2	3	4	5	6	7	8	9	10	11	12	13
Trail Length (miles) →	0.8	0.6	1.5	1.0	0.5	1.5	0.4	1.2	1.0	3.0	4.4	3.2	2.4	1.3
1) Width - single vehicle	100		78	99	86	90	100	85	83	70	76	50	59	96
> single vehicle	0		20	0	14	8	0	7	17	30	16	33	36	4
> 12 feet	0		2	0	0	3	0	4	0	0	8	18	1	0
2) Parallel Paths - single	100		100	100	92	100	87	100	92	100	85	82	99	97
multiple	0		0	0	8	0	13	0	8	0	14	18	1	3
3) Veg Stripping - none	11			12	35	2	53	21	35	79	62	37	35	29
wheel tracks	71		74	87	51	94	35	73	50	16	32	43	62	67
more than wheel tracks	18	0	26	0	0	4	12	7	15	5	7	20	3	3
4) Soil Damage - < 6" below	98		68	100	81	81	71	93	81	97	87	66	62	76
> 6" below	2	10	32	0	19	19	29	7	19	3	13	34	38	24
5) Erosion: % of Length	2	27	3	7	0	4	2	3	0	0	1	0	2	3
6) Muddy - none to little	96		46	99	59	82	41	39	59	66	39	21	2	47
muddy	2		19	4	29	12	6	40	29	23	40	28	41	17
muddy w/ holes	2	20	14	0	10	6	29	10	10	10	10	28	49	20
degraded	1	10	22	0	2	2	24	11	2	1	11	23	9	17
7) Surface Drainage -well drained	77	26	40	100	57	85	11	56	57	3	2	2	0	31
poor-moderatly drained	19	36	21	0	9	6	35	32	9	28	52	23	0	25
saturated to ponded	3	25	37	0	34	9	54	11	33	69	45	75	100	44
running water	2	13	3	0	3	0	1	0	3	0	0	0	0	0
8) Slopes - 0 - 6%	97		82	58	87	62	98		87	99	98	91	100	
7 - 20%	3		16	26	13	36	2		13	1	2	7	0	
21%+	0		2	16	0	2	0		0	1	0	2	0	
Condition Index from bolded items above.	20	105	159	7	90	55	164	60	107	118	125	249	239	118

All figures other than condition indices are percentages of overall trail length. Data from Liebermann & Roland, 2005. Full summary field data for WC-R is not available.

2. Nine parameters from this data set are specifically used. They are as follows:
    - Trail Length – Distance in kilometers, often involving multiple trails or routes both inside and outside the park TUA.
    - Trail width – reported as a percentage of the total length to include three categories; 1) single vehicle, **2) greater than single vehicle width, and 3) greater than 12 feet wide.**
    - Parallel Paths – reported as a percentage of the total length to include two categories: 1) single path, and **2) multiple paths.**
    - Vegetation Stripping - reported as a percentage of the total length to include three categories: 1) none (no missing vegetation), 2) wheel tracks, and **3) greater than wheel tracks.**
    - Soil Damage - reported as a percentage of the total length to include two categories: 1) Compressed less than 6´below natural grade, and **2) compressed to greater than 6" below natural grade.**
    - **Erosion -** reported as a percentage of the total length.
    - Muddiness - reported as a percentage of the total length to include three categories: 1) none to little, 2) muddy, **3) muddy with holes, and 4) degraded.**
    - Surface Drainage - reported as a percentage of the total length to include four categories: 1) well drained, 2) poor-moderately drained, **3) saturated to ponded, and 4) running water (on trail).**
    - Slope - reported as a percentage of the total length to include three categories: 1) 0-6%, 2)7-20%, and 3) >21%.
3. Nine values (**as bolded above**) from nine parameters are used as a "Trail Condition Index" for the purposes of assessing the existing impacts (see Table 3.1). The Trail Condition index figure is simply the summation of percent values for each "trail" and compares trail to trail with no regard to trail length or other measurements. Thus, the index has no units, and ranges from a low impacted value of "7" to a highly impacted value of "249." This evaluation is to be used for general guidance only, as the values and comparisons of each trail are only relative to each other trail in this EA.

3.2.3 Soil Mapping Units and Trails Contained in Each

9SA44 – Alpine Glaciated Lower Mountain Slopes

These areas generally consist of alpine-meadow mosaic (silty till) 35–70% gradient slopes, alpine scrub (gravelly till) 20 to 55% gradient slopes, and alpine dwarf scrub (gravelly till hummocks) at 15 to 55% gradient slopes. They are generally well drained, non-hydric, colluvial slopes, with an Andic Dystrocryepts, loamy-skeletal till soil taxa. Parent material is a mix of gravelly till with some silty volcanic ash, with the average sand-silt-clay percentages of the A horizon at 30-60-10%. Permeability is estimated at a moderate to moderately rapid, and the water table (May to September) is estimated at more than 60 inches below the surface. Only one trail falls within this soils unit as identified below.

Cantwell Creek NW 2005 Incursion (CC-NW – Trail # 13 on Fig 3.1 Soils Map): This trail traverses a distance of 0.99 miles within the 9SA44 soil unit. The affected disturbed area (footprint) is estimated at 1.4 acres. Another 0.33 of a mile of this route passes through the 9TP soil unit. Some 44% of the entire route is described as saturated to ponded, and 37% of the route is muddy or degraded. The condition index is **118**, a low medium level of status (see Table 3.1).

9TP - Alpine Till Plains and Hills

Areas of this type include alpine-scrub meadow mosaics (silty till) 7 to 30% gradient slopes, alpine dwarf scrub (silty till) hummocks, 0 to 24% gradient slopes, and gravelly wet till (swales), at 5 to 30% gradient slopes. The scrub meadow and dwarf scrub hummocks are generally well-drained and non-hydric Andic Dystrocryepts, loamy-skeletal till, while the wet till swales are poorly drained, hydric Typic Cryaquands, medial over loamy-skeletal till. Parent material is a mix of silty volcanic ash over silty eolian deposits and/or over glacial till. The average sand-silt-clay percentages of the A horizon are 40-70-15%, permeability is estimated at moderate to moderately rapid, and the water table (May to September) is estimated at more than 60 inches below the surface for the scrub meadow and scrub hummocks, while for the wet swales, the water table is estimated at 0 to 10 inches. Seven trails within the TUA fall into this soils unit totaling 14.4 miles distance, and occupying 24 acres of surface area, the largest soil unit representation in the TUA.

Cantwell Creek Incursion (CC-NW – Trail # 13 on Fig 3.1 Soils Map): Approximately 0.33 miles of this route traverses the 9TP soils unit, encompassing 0.6 acres of disturbance. Trail conditions are described above under 9SA44, and the condition index is **118.**

Bull River East Trails (Bull R E – Trail # 12 on Fig 3.1 Soils Map): This collection of trails involving 2.41 miles linear distance is reported wholly within the TUA and the 9TP soil unit. The area is described as saturated, swampy string-bog ground, probably of the Typic Cryaquands taxa. The field crews reported noticeable tracks (61.5% <6” deep and 38.5% > 6” deep) and a very large percentage of the route(s) as muddy and muddy with holes (89.3%). As seen in table 3.1, the Bull River East trails are 100% saturated to ponded and over 50% of the route is muddy with holes. The impact footprint involves approximately 4.1 acres, and has the second highest impact rating (**239** in Table 3.1) in the entire TUA trail system.

Cantwell Creek West-South-East: (CCW-SE – Trail #9 on Fig 3.1 Soils Map): This trail system involves a northern fork and a southern fork connected by a main stem for a total distance of 3.0 miles within the TUA. The total disturbed area is 4.6 acres. Some 69% of the route is saturated to ponded, and another 28% is poorly to moderately drained, while only 10% is described as muddy with holes, and 1.3% is degraded. The soils are likely dominate Typic Cryaquands, and are relatively sensitive soils. The Condition Index is **118**, a low medium impact value.

Cantwell Creek West Center (CCW-C – Trail #10 in Fig 3.1 Soils Map): This cluster of trails involves 4.39 miles of many paths, braids, and parallel trails Some 45% of the routes are saturated to ponded, and another 52% is poorly to moderately drained, while the muddiness is described as 10% muddy with holes, and 11% is degraded. The total length is 4.4 miles and the disturbed area is 7.1 acres. The Condition Index is **125** , a low medium impact value.

Cantwell Creek West-Northwest (CCW-NW – Trail #11 in Fig 3.1 Soils Map): This slightly braided route connects to the Cantwell West-Center trails, and involves 3.2 miles, all within the TUA and NPS lands. At least 75% of the route is saturated to ponded, and better than 50% of the route is muddy with holes or degraded. Both Dystrocryepts and Cryaquands taxa are involved. The trail is very wet, (100% saturated or ponded) very muddy (over 50% of its length is mud holes or worse degradation) and has the most parallel (braided) trails of any in the study area. The total disturbed area is estimated at 6.1 acres. The Condition Index of **249** is also the highest rating (poorest condition) for any trail in the TUA.

*Cantwell Creek North – West (CCN-W - Trail # 8 in Fig 3.1 Soils Map)***:** This system consists of two main trails totaling 1.0 miles and 1.4 acres within the TUA. The routes are described as 44%

saturated to ponded, and over 60% of it is muddy with holes. The condition index is **107,** a low medium impact value.

<u>7MS2 – Boreal Glaciated Lower Mountain Slopes</u>

Eight trails of the TUA are found within this soils unit involving 5.9 miles of linear distance and 8.7 acres of surface area. These areas include wet White Spruce/Willow woodlands, and White Spruce/green alder forests, in mountainous terrain with 12–45% gradient slopes. The Spruce/willow woodlands are poorly drained, silty eolian deposits over gravelly till, and classified as Oxyaquic Eutrocryepts, coarse-limy. The average sand-silt-clay percentages of the A horizon are 30-60-10%, permeability is estimated at moderate to moderately rapid, and the water table (May to September) is estimated at 20 inches.

Slightly contrasting are spruce/green alder woodlands, which are well drained, silty eolian deposits over gravelly till, and classified as Typic Eutrocryepts, loamy-skeletal. The average sand-silt-clay percentages of the A horizon are 40-70-15%, permeability is estimated at moderate to moderately rapid, and the water table (May to September) is estimated at more than 60 inches.

Windy Creek North (WC-N – Trail #2 in Fig 3.1 Soils Map): This trail is 0.77 miles long within the 7MS2 soil unit, and is entirely within the TUA. At least 40% of the route is well drained, while the rest (60%) is in poorly drained condition or saturated to ponded. Trail conditions are described as 14% muddy with holes, and 21% degraded. The disturbed area is estimated at 1.3 acres. The well-drained segment may represent the Typic Eutropcryepts, while the wetter portions could be Oxyaquic Eutrocryepts. The Condition index for this trail is **159** (table 3.1), ranking it the 4th most impacted trail in the TUA. An additional 0.74 mile of this trail is in the 7TP soils unit.

Windy Creek Southwest (WC-SW – Trail #3 in Fig 3.1 Soils Map) : This three-part trail is 0.73 miles long with the 7MS2 soil unit, and it traverses shrublands (99%) and wet spruce woodlands (1%). It is 100% well-drained, and is the only trail in the TUA that is not rated muddy and the overall condition index of **7** is the lowest impact rating of any trail in the TUA. The area disturbance coverage is 1.0 acres. An additional 0.24 miles of this trail is in the 7SA31 soil unit.

Cantwell Northwest (C-NW – Trail #4 in Fig 3.1 Soils Map): This trail leaves from the Northern Cantwell community roads to traverse westerly in dwarf birch shrublands and spruce-willow/alder woodlands. Approximately 0.54 miles of the trail is within the TUA and exclusively in the 7MS2 soil type. Surface water conditions are described as 34% saturated to ponded, 9% poorly drained, and 57% well drained. It is estimated at 30% muddy or muddy with holes. The impacted surface area of the trail is 0.9 acres. The condition index is **90**, a mid-low value.

Cantwell West-S (CW-S – Trail #5 in Fig 3.1 Soils Map) (Cantwell Airstrip): This trail leaves from the Cantwell Airstrip and traverses westerly within the TUA for 1.5 miles. The trail is estimated to be 84% well drained, 9% saturated to ponded, and 6% poorly to moderately drained. It is estimated that 6% is muddy with holes, while 0.2% is degraded. The trail disturbance area is 2.2 acres. The trail has a relatively low condition index of **55** (Table 3.1).

Cantwell Creek North-East (CCN-E – Trail #6 in Fig 3.1 Soils Map): This trail leaves from the Cantwell Creek floodplain and traverses North and East for 0.33 miles in the park and the TUA. Surface water conditions are described as 54% saturated to ponded, 35% poorly to moderately drained, 11% well drained, and 1% water running on trail. Muddiness is estimated at 29% muddy with holes, and 24% degraded. The disturbed surface area is 0.4 acres within the 7MS2 soil type. The condition index is **164** (Table 3.1), a high medium value compared to other trails in the TUA.

Cantwell Creek North - Center (CCN-C – Trail # 7 in Fig 3.1 Soils Map): This trail leaves Cantwell Creek and traverses northwest for 1.1 miles   It is described as 56% well drained, 32% poorly to moderately drained, and 12% saturated to ponded. The muddiness is estimated at 10% muddy with holes and 11% degraded. The total disturbed surface area is estimated at 1.5 acres within the 7MS2 soil unit. A small portion of the trail (0.1 mile) runs through the 9TM soils unit. The condition index is **60**, a comparatively low impact value.

Windy Creek Access (WC-CN – Trail # 1 in Fig 3.1 Soils Map): The Windy Creek access trail is a relatively well-drained route that leaves the northern Cantwell community road system toward the Northwest to reach the Windy Creek Ravine, Bowl, and North routes. The access route is approximately 0.67 miles within the TUA and involves some 0.53 acres of impact area. Trail conditions were not summarized for this route, but the evaluation factors for trail condition index appear to be very moderate. An index figure using 4 of the usual 8 factors gives a condition index of **20**, a low values suggesting a trail of reasonably good comparable condition.

Windy Creek Ravine (WC-R – Trail #1a in Fig 3.1 Soils Map): The Windy Creek Ravine trail drops down a tributary gully toward Windy Creek from the Windy Creek Access route. The Ravine trail is approximately 0.7 miles of travel over 7MS2 soils and involves some 1.0 acres of impact area. Trail conditions were not summarized for this route, but the evaluation factors for trail condition index appear to be moderate to medium, except for the highest susceptibility to erosion of all TUA trails inventoried. An index figure using 5 of the usual 8 factors gives a condition index of **105**, a low medium value. An additional 0.1 miles of this route traverses 7TP type soils.

<u>7SA31 Subalpine Mountain Slopes & Meadows</u>

One trail system encompasses 0.24 miles of distance and 0.4 acres of surface area in the 7SA31 soil unit. These areas include subalpine scrub slopes and meadow mosaics, and alpine scrub sedge-dwarf scrub slopes and mosaics in mountainous terrain with 8–70% slopes. Three soil types are typified here, with the slopes generally consisting of Typic Dystrocryepts, loamy-skeletal or Typic Haplogelods, loamy-skeletal taxa, and meadows and swales being Oxyaquic Eutrocryepts, coarse-loamy, drift.

Generally, the Dystrocryepts slopes (20–70%) are well drained, non-hydric soils, with a water table at more than 60 inches, with moderately rapid permeability. The average sand-silt-clay percentages of the A horizon are 30-60-10%. The Haplogeleods slopes (8–60%) are well drained, non-hydric soils, with a water table at more than 60 inches, moderately rapid permeability. The average sand-silt-clay percentages of the A horizon are 20-75-5%. The Eutrocryepts (10–50%) are somewhat poorly drained, non-hydric soils, with a water table at 4 to 20 inches and a moderately rapid permeability. The average sand-silt-clay percentages of the A horizon are 20-75-5%.

Windy Creek - Southwest (WC-SW- Trail# 3 in Fig 3.1 Soils Map, aka ”bowl trail“): As described above under 7MS2, this three-part trail has one reach that traverses through the 7SA31 soils unit for 0.24 miles and involves 0.4 acres of disturbed area. It is 100% well-drained, and is not rated muddy. The condition index for this route is **7**, the lowest rating in the TUA.

7TP Alpine Slopes and Mosaics

Three trails are within the 7TP soils classification involving a combined distance of 1.2 miles, and a surface area of 1.9 acres. These areas are alpine scrub sedge gravelly till slopes, alpine scrub meadow mosaics and swales, and Alpine scrub gravelly till circles. The gravelly till slopes are at a low gradient (2–16%), and consist of Typic Historthels, loamy-skeletal taxa, which are poorly drained hydric soils, with frequent permafrost (from 12 to 24 inches below the surface) and moderate permeability until the frozen layer is reached (at ~12 inches). Typical sand-silt-clay ratios are 30-60-5. The meadow mosaics and swales are at a low gradient (2-10%), and consist of (Oxyaquic) Humic Eutrogelepts, coarse-loamy, which are somewhat poorly drained non-hydric soils, with a water table at 0 to 20 inches. Their sand-silt-clay ratios are 20-75-5.

Windy Creek - North (WC-N – Trail # 2 in Fig 3.1 Soils Map): Described above under 7MS2, this trail is 1.5 miles long, of which 0.74 miles of this length traverses the 7TP soils unit. The disturbance area in this unit is estimated at 1.3 acres. At least 40% of the route is well drained, while the rest (77%) is in poorly drained or saturated to ponded. Trail conditions are described as 14% muddy with holes, and 21% degraded. The condition index is **159,** a mid-high value for impacts.

Windy Creek – Ravine (WC-R – Trail # 1a in Fig 3.1 Soils Map): Also described under 7MS2, this trail is 0.36 miles long, with 0.5 acres of surface disturbance in the 7TP soil unit. The condition index is **105**, a relatively low value of impact, although it has the highest susceptibility to erosion of any trail inventoried in the TUA.

Windy Creek Access (WC-CN – Trail # 1 in Fig 3.1 Soils Map): As described above, this trail is 0.8 miles long, of which only 0.1 miles is in the 7TP soil type, covering 0.2 acres. Trail conditions were not summarized for this route, but the evaluation factors for trail condition index appear to be very moderate. An index figure using 4 of the usual 8 factors gives a condition index of **20**, a low values suggesting a trail of reasonably good comparable condition.

9TM Alpine and Subalpine Meadow Mosaics

Cantwell Creek North – Center or "Pyramid Peak Trail" (CCN-C –Trail # 7 in Fig 3.1 Soils Map): This trail is described above under 9TMS2, and most of the distance is contained in that soil unit. A small part (0.1 mile traverses 9TM soils, and the surface disturbance area is 0.1 acres. It is described as 56% well drained, 32% poorly to moderately drained, and 12% saturated to ponded. The muddiness is estimated at 10% muddy with holes and 11% degraded. The condition index is **60**, a comparatively low impact value.

3.3 VEGETATION (INCLUDING WETLANDS)

3.3.1 Overview of vegetation mosaic in the Cantwell Traditional Use Area (TUA)

Information on the vegetation of the TUA was obtained during a comprehensive survey of ORV use and impacts of the TUA and area conducted in 2005 (Liebermann and Roland, 2006). Vegetation mapping and delineation were done in fall 2005 using satellite imagery and low altitude aerial photography combined with fieldwork observations to identify vegetation landscape types and their susceptibility to various ORV-related influences. The vegetation classification was made by Denali staff, and is based on landscape types in the TUA that were observed during fieldwork and are visible at the resolution of the satellite imagery; the report contains additional data on vegetation types, distribution, and impacts.

For the 2005 vegetation map, vegetation identification, boundaries, and extents are based on 1 meter resolution true-color Ikonos satellite imagery and low altitude helicopter aerial photography made during the 2005 field season. Vegetation classifications were based on vegetation associations observed during fieldwork that were visible and identifiable at the resolution of the satellite imagery and helicopter photography. A minimum single-side dimension of 50 meters was used for inclusion of vegetation features to keep the map accurate and relatively easy to read. For example, if a swale with dimensions approximately 65 by 25 meters was observed it would be mapped, but a similar feature 35 meters round would not be. Thus wider linear features were included on the map (e.g., ravines and swales), but small "outlying" features (e.g., a small wetland patch in a willow shrubland) were not.

The resulting map thus depicts ground features that were: 1) visible on the Ikonos satellite imagery, 2) were discernible on the satellite imagery (thus some vegetation types, such as saturated soil willow shrublands and mesic soil willow shrublands were not possible to differentiate in mapping), 3) are large enough in dimension to be included on the map.

Distribution of Vegetation

The landscapes of the TUA are a complex mosaic of environments varying across spatial scales (NPS 2004b, NPS 2004d, (Liebermann and Roland, 2006). Vegetation types in the area are distributed according to soil moisture, which is in turn controlled by slope and landscape position. Better-drained areas are occupied by dwarf birch- shrublands or woodlands on mineral soils, and depressions or areas of impeded drainage support open or shrub wetlands on organic soils. Areas between these extremes are occupied by transitional willow shrublands or willow-spruce woodlands.

Eastern areas of the TUA tend to have more abrupt transitions in elevation and thus vegetation transitions are sharper than the western areas. The eastern part of the TUA has higher relief than the western part, which has rolling topography. In the east, lower areas typically have dwarf birch vegetation; middle elevations spruce woodland; and higher elevations willow-alder shrubland. Vegetation in the western TUA is a complex mosaic of types that vary with more gradual topography. The predominance of wetlands on organic soils in the western part of the TUA is a conspicuous difference between these two areas.

Lower elevations are characterized by gently rolling hills and benches cut by ravines extending from the lower mountain slopes to valley bottoms. The higher areas, less likely to be used for ORV use because of their slopes and alpine habitat, rise on steep slopes to alpine rockfields. Vegetation of the region ranges from forested lowlands to rocky alpine meadows, and consists of a mosaic of systems that includes closed stands of spruce, willow and alder shrublands, willow swamps and floodplain backwaters, a variety of open wetlands, moist herbaceous meadows and swales, numerous ponds and wet depressions, and drier upland plant communities of low birch-ericaceous shrub on well-drained hills and slopes.

Photos 3.1 through 3.12 show many of the vegetation types, as well as some of the existing ORV impacts, in the TUA. Appendix 8 provides additional details about vegetation types, classifications, descriptions, and distribution within the TUA.

Photo 3.1 Well-drained soil at shrub-land transition to spruce-willow forest

Photo 3.2 Rutting and ponding in alder-spruce-willow woodland

Photo 3.3 Character of trail in upland willow-dwarf birch-spruce area

Photo 3.4 Character of trail through wet willow-dwarf birch-spruce wood

Photo 3.5 Character of wet sedge meadow

Photo 3.6 Character of trail in shrub woodland

Photo 3.7 Soil mixing, ponding, ruts and braiding on inundated sedge wetland

Photo 3.8 Mudhole on dwarf birch area

Photo 3.9 Rock outcrop vegetation (note lack of distinct path)

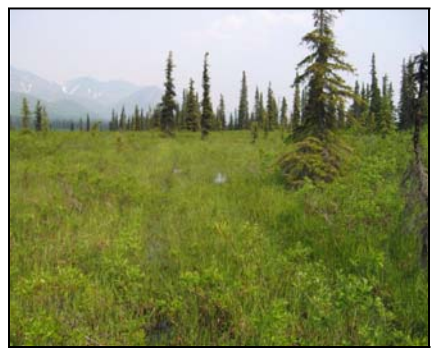


Photo 3.10 Character of trail on inundated wetland edge

Photo 3.11 Character of string bog

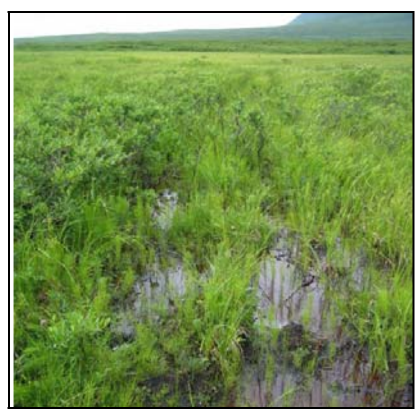


Photo 3.12 Transition from willow shrub swamp to open graminoid wetland

3.3.2 Overview of Wetlands in the Cantwell Traditional Use Area

Off-Floodplain Wetlands

According to the U.S. Fish and Wildlife Service ("Cowardin") system of wetland classification (USFWS 1979), all three systems of non-saline wetlands occur within the Cantwell TUA, including riverine, lacustrine and palustrine. Wetland systems in the TUA are topographically controlled, and highly variable based on soil hydrology, vegetation, and soils. These wetland conditions change rapidly in short distances, resulting in surface durabilities that often only persist for several dozen feet before changing markedly; this has important implications for resilience to vehicle impacts. Beaver (*Castor canadensis*) also influence wetlands through their constantly changing impoundment of streams, maintenance of ponds and channels, and manipulation of vegetation. Most wetlands in the area are dominated by herbaceous plants including grasses, rushes, and sedges, and mosses. Some have willow, alder, and, less commonly, dwarf birch shrubs as an important component as well.

Wetland systems play an important ecological and geomorpholgical role in efficiently capturing and controlling precipitation and runoff from the significant snowfall and summer rains that fall on nearby slopes of the Alaska Range and channeling it to the streams and rivers of the area. They also provide preferred habitat for moose as well as desirable high-visibility hunting areas.

Numerous small ponds, swales, swamps, and open wetlands are interspersed within the forest and shrubland areas of the TUA, underlain by glacial till and colluvial and floodplain deposits. Smaller (palustrine) wetlands are a dominant vegetation feature at low elevations west of Cantwell Creek, where they occur in a mosaic with better-drained upland systems. Wetlands often alternate with upland areas because of the pattern of depressions, low ridges and ravines characteristic of this area. Because of this landscape mosaic, it is nearly impossible to travel any significant distance in the area west of Cantwell Creek without transiting through wetlands, and overland travel passes in the TUA almost always transit some wetland terrain.

A few larger lacustrine wetlands occur west of Cantwell Creek within the TUA, associated with the the larger ponds that dot this area. The largest three of these are about 8.6, 14.8, 30.9 acres in size. Riverine wetlands occur along the floodplains of Cantwell and Windy Creeks and the Bull River.

Floodplain Wetlands

Portions of three rivers are in the TUA: Cantwell Creek, Bull River, and Windy Creek. Cantwell Creek has a generally more meandering and less braided path than the other two rivers in the TUA, and thus a greater number and diversity of habitats. Bull River has a wide floodplain in the north, but a much narrower one in much of the south. It has less meander than Cantwell Creek but a higher maximum flow and greater braiding upstream, resulting in a larger proportion of the floodplain in early successional vegetation than Cantwell Creek. Windy Creek has a steeper, eroded glacial valley with little meander and thus a narrow floodplain, though some areas of floodplain and abandoned meanders support distinctive floodplain vegetation.

The water tables of the floodplains fluctuate rapidly with variations in mountain climate and runoff. Because of their diverse microenvironments and disturbance regime, floodplains have a complex mosaic of vegetation occupying varying niches of topography, hydrology, and soils. Vegetation types that are significantly different can occur in a very small area as compared to those above the floodplain. River floodplain vegetation includes shrublands, backwater swamps, wet swales, sedge meadows, some open wetlands, and pioneer river bar communities. Primary successional vegetation of dispersed forbs and willow is common in newly abandoned channels and eroded areas, grading into often very dense thickets of willow (*Salix* spp.) and occasionally alder (*Alnus crispa*) on older surfaces. Many of these areas are wetlands or transitional to wetlands according to the US FWS classification. Numerous vegetation types were mapped as a single class on the vegetation map, because of limits in data and map scale, and they actually contain several discrete sub-types that are sufficiently unique in their hydrology, soils, configuration, and susceptibility to ORV impacts to discuss separately.

3.3.3 Plant Species of Management Concern That Occur in Area

Botrychium alaskaense occurs in river flats in this general area of Denali National Park, and thus surveys for this taxon along Cantwell Creek and Bull River should be performed before choosing designated routes through these areas.

3.3.4 Description of Specific Vegetation Types and Their Distribution in TUA

The major vegetation types found in the affected area are described in Appendix 8 and their distribution is shown in Figure 3.2. Vegetation on higher and steeper elevations where ORV use was not documented in the TUA is unlikely to be traveled on and is not included.

3.3.5 Causes and Types of Vegetation Impacts

<u>Impact Levels</u>

Impact levels in the TUA vary greatly by use pattern and intensity and landscape (Liebermann and Roland, 2006). Many important factors relating to ORV use and impact were not directly measured in the 2005 survey and remain estimates, including weather during and around the time of impact; vehicle speed and user behavior; number and temporal arrangement of passes; and degree of previous use, and thus damages cannot be precisely predicted further than the extension of present trends. In some vehicle path segments no lasting traces of ORV use were observed between highly degraded visible segments; for example, on open dry meadows between wetter lowlands. In other areas negative impacts may be severe and long-lasting, as on open wetlands. Where landscape transitions are abrupt, highly impacted areas can be adjacent to areas of little or no impact. Recovery times can likewise be disparate between closely adjacent areas.

3.3.6 Current ORV Impacts to Vegetation and Their Extent

<u>Existing Vegetation Damages</u>

Existing ORV travel areas and routes in the TUA were comprehensively inventoried and mapped in 2005, and a comprehensive report of impacts and their extent was compiled and mapped (Liebermann and Roland, 2006). Current ORV use in the TUA is primarily on a set of informal, unmarked trails of the area; these often have some peripheral branching side-trails and exploratory passes. A smaller area and number of impacts have been documented from dispersed travel on areas of the Cantwell Creek floodplain, and several single-event incursions across undisturbed land (Figure 3.1).

Extent of Impacts on ORV Travel Areas

Vegetation damage is limited to the vehicle travel path area on single-width travel passes (about 6 feet wide). Additionally, most of the trails have multiple areas that are wider than single-vehicle width, to 15 feet or, in extreme cases, 30 or more feet wide. The most extreme examples of trail widening are on the areas west of Cantwell Creek. In some cases these result from simultaneous or offset travel of two or more vehicles on discrete parallel routes; in others from drivers taking multiple discrete or overlapping passes around obstructions or trail degradations ("braiding"), and some are areas where the actual vehicle wheel path is unclear because of wide areas of damaged soils or vegetation on the trail surface; in a few cases impacts are not readily visible (e.g., the Cantwell Airstrip trail, on the rock outcrop area, as well as some sedge meadows). In these cases it is not possible to determine previous wheel placement, resulting in multiple, superimposed impacts over the area. Erosion has also spread beyond the vehicle path in some areas and impacted vegetation by removal or deposition of eroded soil.

Types of ORV Impacts

Vegetation damage or removal along the wheel paths is common on all but the least traveled ORV use areas surveyed in the TUA, and ranges from breakage of woody plant parts and compaction of herbaceous plants to soil removal and compaction, organic mat stripping, and destruction of revegetation. Heavily used and saturated areas usually have wider vegetation stripping across the vehicle path, with bare soil exposed, and in more severe cases vegetation stripping extends beyond the wheel tracks to part or all of the total trail width.

Shrub breakage and removal is the most visible type of vegetation impact resulting from ORV use in the TUA. Of the two main shrub types encountered on ORV use areas in the TUA (dwarf birch and willow), there is a difference between the nature and duration of response from ORV impacts. Willow shrublands cover much of the TUA, and all existing trails and most single-use passes cross at least some willow areas. Willows are generally larger and have more and thicker branches and thus sustain more visible morphological damage after a vehicle pass. Willows are adapted to herbivory (such as by moose), however, and thus tend to recover some vegetative form sooner than dwarf birch. Dwarf birch are generally smaller and less robustly branched than willow, and after an initial vehicle pass dwarf birch show less branch breakage than willow. However, a year or more later they show a much more visible and persistent decrease in number of branches, leafiness, and upright form across the vehicle travel path and, in particular, on the wheel contact tracks (Liebermann and Roland 2006, Sinnott 1990).

Some vegetation and plant species composition change has been observed on existing use areas in the TUA. The most prominent of these is replacement of shrub growth by herbaceous vegetation where shrubs have been impacted. On open areas of saturated soils some species changes were noted, such as higher frequency of some species, related to several factors including impacts to original vegetation and microenvironmental changes such as compression and rutting of soils and related soil moisture changes.

Visual impacts to vegetation results from a combination of vegetation and soil impacts, and were recorded in 2005 in most areas in the TUA with ORV use. The most common visual impacts are from a combination of wheel ruts into saturated soil and vegetation damage and in shrub morphology damage to willow and dwarf birch.

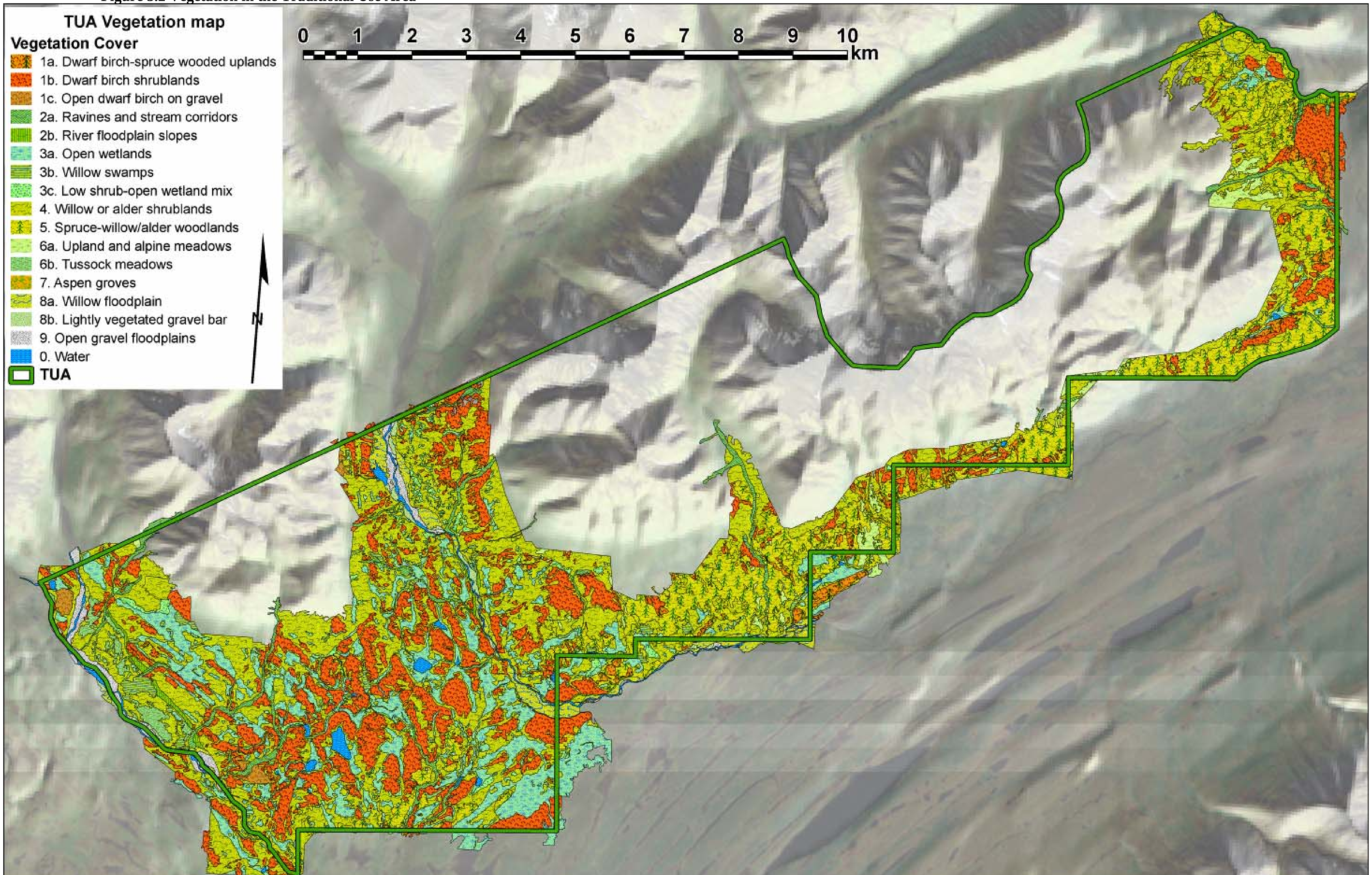
Hydrological impacts to wetlands documented in 2005 included those confined to the general vehicle path area, such as the creation of wet muddy depressions, water-filled track ruts, and extensive trail-wide water-filled "ponded" depressions. Impacts to larger areas were also found, including drainage capture of streams or overland drainage by wheel ruts or trail depressions, drainage stream widening and deepening at ORV crossing areas, and newly created drainage channels from wetlands. All of these can affect vegetation by direct removal, drowning, sedimentation, or diverting water away from areas. Hydrological changes can also affect species composition by favoring different species from the original.

In some cases access to an area created by ORV use can **facilitate non-vehicle impacts** from increased non-ORV use, such as disruption or fire rings from camps or burned areas like that observed near the Cantwell Creek West-Southeast trail (on State land). Some evidence of saw-cutting of shrub branches to facilitate vehicle access was observed in 2005 mapping on two trails. In general, these kinds of impacts were rarely observed in 2005 surveys and are thus very difficult to predict.

Table 3.2 Relative susceptibility of some common vegetation types in TUA to various forms of impacts, based on observations of existing impacts made in the 2005 TUA ORV impact field inventory.

Vegetation landscape type	mudholes and muddiness	rutting	braiding	ponding	erosion	organic mat perforation	wide trail width	vegetation stripping	rapid vegetation damage	persistent vegetation damage
	Relative susceptibility of damages by vegetation landscape type. 1: moderate, 2: likely, 3: very likely									
1a, 1b. Dwarf birch uplands	1	2	1	1	3	2	1	2	3	3
2a. Ravines & stream corridors	2	2	2	2	3	2	2	2	2	2
3a, 3c, 8a. Wetlands & wet floodplains	3	3	3	3	1	3	3	3	3	2
3b. Willow swamps	2	2	2	3	1	2	2	1	2	1
4. Mesic willow and/or alder shrublands	2	1	1	1	2	2	2	2	2	2
4, 8a. Wet willow and/or alder shrublands	2	2	2	3	1	3	3	3	3	2
5. Spruce-willow/alder woodlands	2	2	2	3	1	2	2	2	2	2
6a. Upland meadows	2	1	1	1	2	2	1	2	1	1
8b. Lightly vegetated floodplains	2	2	3	1	1	2	3	3	3	1

Figure 3.2 Vegetation in the Traditional Use Area



Extent and Distribution of Impacts

The combined linear distance of all ORV trails and passes in the TUA totaled about 22.8 miles, and the combined "footprint" area of all ORV-related impacts totaled 36.5 acres. There are also substantial additional impacted areas on State of Alaska lands immediately adjacent to the TUA. Appendix 8 provides the linear and area impacts documented by vegetation type, and Figure 3.1 shows the extent of impacts in the TUA.

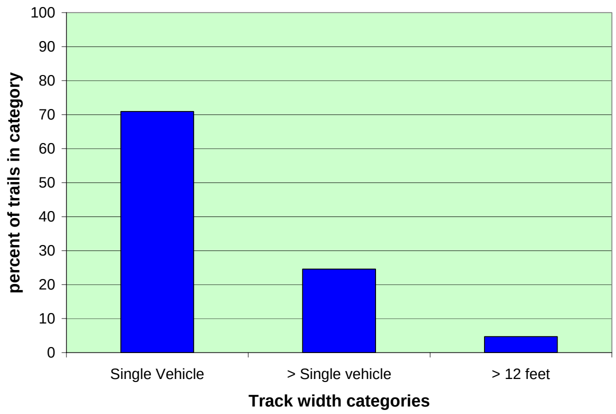


Figure 3.3. Percentages of the total linear distance of trail mapped in 2005 by trail width categories. Note that approximately 29% of all track segments mapped were wider than a single track width (wider than 6 ft.).

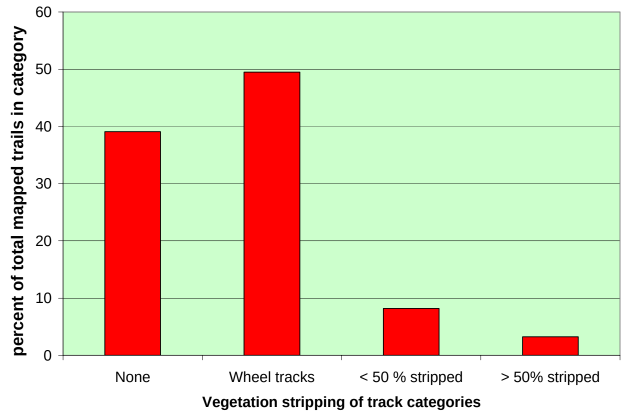


Figure 3.5. Percentages of the total linear distance of trail mapped in 2005 by vegetation stripping categories across the trail width. Note that over 60% of all trail segments mapped showed removal of vegetation from the trail.

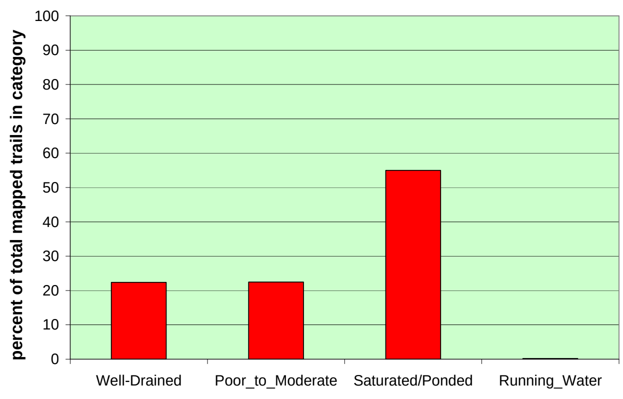


Figure 3.4. Percentages of the total linear distance of trail mapped in 2005 by drainage characteristics. Note that over 50 percent of trail length traversed areas of saturated or ponded soils, and less than a quarter of the total trail mapped was in the well-drained category. 0.6% had running water (active erosion) flowing in the trail.

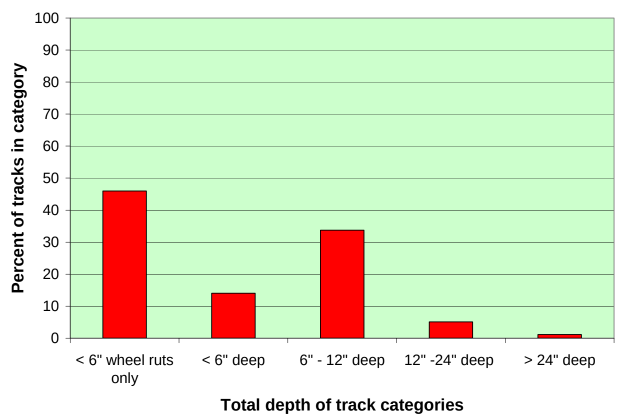


Figure 3.6. Percentages of the total linear distance of trail mapped in 2005 by total trail depth categories. Total trail depth is a measure of the total depression of the trail surface compared to the adjacent surface due to compaction, displacement, and/or erosion of soils and vegetation on the trail bed.

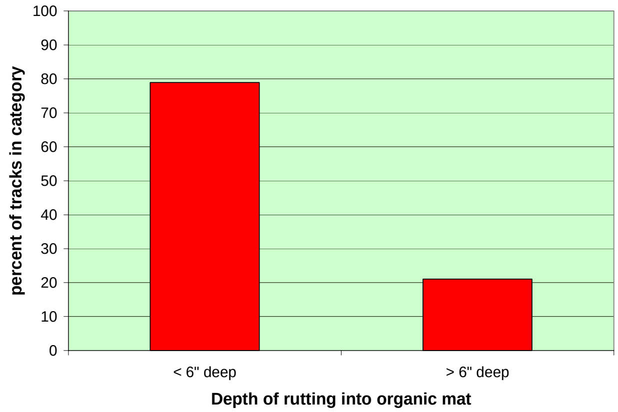


Figure 3.7. Percentages of the total linear distance of trail mapped in 2005 by soil rutting depth categories. Depth of rutting is a measure of the depth *below* the organic mat layer that the track had damaged due to organic mat perforation. In areas damaged less than 6 inches there *may* be enough remaining root and other soil matter to retain part of the organic mat's protective properties; in areas of more than 6 inches organic mat perforation is complete and the subsurface is vulnerable to increased damage.

Figures 3.3 through 3.7 include data from the 2005 survey (Liebermann and Roland 2006) from some characteristic impact indicators. These figures include trails on State lands adjacent to the TUA with similar impact and landscape characteristics, adding approximately 20% to the length of trails, though overall proportions of damages are similar to those of the TUA alone.

The most severe and widespread damages found in 2005 in the TUA were those to wetter areas, such as open and shrubby wetlands, willow and alder swamps, and river floodplain areas.

Many steeper slopes had erosion, particularly the transition slopes leaving the Cantwell Creek and Bull River floodplains, and long subalpine shrub slopes. On uplands of mineral soils and dwarf birch, the more durable ground results in trails that sustain fewer damage and remain as well-defined single passes. However, dwarf birch uplands are usually intermittent at best, though they are the common type on the Windy Creek Bowl trail and that trail is in the best condition of those surveyed.

Use of Wetlands by ORVs in TUA

There is a tendency for ORV use in the TUA and elsewhere in Alaska to gravitate to wetlands and wetland edges when those features are present on the landscape, even where no established trails exist (NPS 2004c, Liebermann and Roland 2006, Sinnott 1990). For example, the Cantwell Creek North and Cantwell Creek West areas have had intensive wetland and wetland edge paths documented across their areas, with some of the most severe rutting and similar degradations found in the 2005 survey.

Paths are often along the edges of open wetlands, where the ground is somewhat more durable but shrub growth is not as dense as further upland. Such areas are often nearly as susceptible to impacts as the wetlands themselves, however, because of the fragile herbaceous vegetation and wet to saturated soils, and many of the severe impacts were found in these areas. Impacts to wetlands vary by soil type, moisture, and vegetation cover, but in general wet areas tend to sustain much greater soil impacts and vegetation damage than drier areas (Liebermann and Roland 2006, NPS 2004c, Sparrow and Wooding 1978, NPS 1990, NPS 1998).

The 2005 survey of ORV impacts in the TUA documented that of the 22.8 miles of linear ORV impacts documented in the TUA, 12.2 miles of the total(53% of the total length) were on open wetlands and willow swamps (types 3a, 3b, and 3c as described on the vegetation map and related table in this section), and an additional 5.3 miles (23% by length) were in vegetation types that contain a high percentage of saturated areas (types 2, 4, 5, and 8a). If a conservative figure of 25% of the second group is taken as the total of saturated soil wetlands in that group, the total is 13.5 miles or 59% of the length of impacts in the TUA was on wetlands. The percentages by impacted area are similar; 19.7 acres of the first group above (54% of area) and 9.9 acres (25%) in the second group; 22 acres total wetlands impact (assuming the same 25% of wetlands in the total of the second group as above), or about 61% of the total 36.5 acres of impacts were on wetlands. These numbers are not precise as no concerted effort was made to quantify the second group into saturated/non-saturated areas; however it is likely that the 25% estimated is on the low side of the actual proportion judging from observations made during the 2005 survey.

Table 3.3: Measured and approximate wetland ORV impact areas in the TUA.

	Acres of impacted wetlands	Percentage of total impacted area in TUA	Linear miles of impacted wetlands	Percentage of total impacted length in TUA
Open wetlands and willow swamps (types 3a, 3b, and 3c)	19.7 ac	54%	12.2 mi	53%
Partial saturated areas (types 2, 4, 5, and 8a), total area	9.9 ac	27%	5.3 mi	23%
Approximate total wetland impacts (combined first and 25% of second categories)	22 ac	61%	13.5 mi	59%

Where ORV passes followed wetland edges, impacts were generally, but not exclusively, less intensive than were those when travel was closer to the center of wetlands. Many wetland transitions in the TUA are rather abrupt, and there is often very little "middle ground" between saturated or inundated areas of the wetland and heavily shrubbed more upland areas. Wetlands are thus susceptible to impact disproportionately by ORVs compared to adjacent shrublands. In many areas, extensive wetland edge passes were documented in areas even where other, more heavily used, routes were present.

Duration of Impacts

Because of the single-season nature of the ORV impact survey, without the benefit of a similar previous inventory, it is often difficult to correlate the impacts documented with a timeline of occurrence or persistence. The impacts documented in 2005 were sometimes of obvious recent creation, but more often were modified over multiple seasons. Thus determinations of the age or persistence of impacts, the number or temporal arrangement of ORV passes, driving behavior, or type of ORVs are often rough estimates.

Some previous studies on ORV impacts in Alaska, such as Ahlstrand & Racine (NPS 1990) and Sparrow, Wooding, & Whiting (1978), have attempted to document the severity and persistence of impacts based on use intensity and temporal arrangement of impact creation, though their studies investigated the impacts to tundra shrub vegetation types that only somewhat resemble those found in the TUA. Other studies in Alaska have documented the longer-term persistence of ORVs, primarily on more northern ecosystems and from larger vehicles than the 4-wheeled ORVs used in the TUA.

With the caveat above, some general ideas can nonetheless be made of the persistence of ORV impacts documented in the TUA in 2005. The general character of woody vegetation (morphology, growth on clearing edge, etc.) alongside a vehicle path can give indications of how long it has been since the initial pass was made, such as on the Windy Creek North and Cantwell Creek North trails. Most of the trails mapped in the 2005 study have been used for multiple seasons and thus the age of impacts was difficult to ascertain.

However, the severity of some types of impacts (e.g., large mudholes or multiple, wide braids) indicates that they have increased in severity over several seasons of intensive use, as ORV users have avoided difficult areas or, when hemmed in, have persistently churned through mobile soils. Areas of wide trail impacts can take longer to recover their natural vegetation after use has ceased because of the greater total area of impacts (thus often more severe) and distance to the existing unaffected vegetation, organic mat, or soil edges. A 2005 resurvey of a 2003 off-trail incursion in the Dunkle Hills area, immediately west of the TUA, showed that impacts from several intense ORV passes within a single day had readily visible lasting impacts to willow swamp, wet sedge meadow, dwarf birch shrublands, and other similar types found in the TUA.

Observations of some areas of impact in the TUA during the 2005 study indicated that vegetation and soil damages created during a few multiple passes persisted several years beyond the event; the most dramatic of these were on dwarf birch shrublands on the Windy Creek Southwest trails and the deep ruts created on wetlands of the Cantwell Creek North and Cantwell Creek West areas. Other areas, such as abandoned trail segments that had been superseded by a more recent braid, did give some insight into the persistence of severe impacts after use had ceased. The Windy Creek North trail, for example, had several abandoned braided sections in wet willow-spruce vegetation that appeared to have quite obviously persisted for five years or more. The Cantwell Creek West-Southeast trail area, which had apparently been intensively traveled in past seasons but much less so in recent years, showed some vegetation recovery on more durable wetland edges (Liebermann & Roland 2006). There is one unusually old segment of trail, perhaps several decades old based on the growth of willow and dwarf birch vegetation that still clearly shows the presence of a trail in the Cantwell Creek West-Central area.

Effects of Climate Change on TUA Vegetation

Unknown ecological consequences are expected to result from the effects of climate change on the native ecosystems of the TUA. It is possible, or perhaps likely, that interactions between the "acute" disturbances related to ORV use and the more "chronic" stresses on the vegetation that may occur with climate change may interact in ways that impact these ecosystems synergistically. This is particularly true in the case of the potential for exotic plant introductions, which will only increase with a warmer climate, and larger numbers of users.

3.4 WILDLIFE

3.4.1 Mammals

Moose

Moose are abundant throughout the year within and near the drainages in the Traditional Use Area (TUA). They inhabit the entire vegetated TUA except tall alder shrubs, forest, and slopes greater than 20%.. Typically, moose occur in the headwaters of the draws in the TUA in August and early part of September and occur closer to the lower corridors later in September and October. Moose concentrations vary seasonally and, during winter, correlate with snow depth and timing (ADFG 1992b). Most calving takes place from late May through June. During calving, cows tend to seek areas within their home range that provide low predator densities (islands in rivers) or improved visibility (open muskeg areas) (ADFG 1996a). Post-calving moose generally move to higher elevations. Fall rutting and post-rutting concentrations occur in subalpine habitats, with moose moving down from these areas in winter as snow depths increase (ADFG 1992a). Riparian willow stands provide a large part of winter forage and upland coniferous forests provide thermal cover and shallower snow depths (ADNR 1991).

Concentrations of moose are often seen mid and late winter in the Windy Creek area above Cantwell and where Ohio Creek emerges from the mountains (NPS unpublished data). Mean density of moose during late winter (late March) ranged from 0.7 to 3.2 moose per square mile on the south side of the Alaska Range (ADFG 1990b). In the most recent NPS survey in November 2005, the entire TUA was surveyed, and 102 moose were seen. Moose were seen throughout the TUA with most of the moose seen near Cantwell Creek and 21 near Windy. This represents a mean density of 1.9 moose per square mile in the area surveyed. The bull/cow ratios show signs of stress to the population. In 200S5 there were 65 cows and 29 bulls, a 45:100 ratio, with 8 calves (NPS 2005b). NPS wildlife biologists have concluded that these numbers generally do not show an excess population that can be harvested.

A large rutting concentration roughly coincides with caribou calving grounds in the higher country north of Broad Pass between Windy Creek and the Bull River (ADNR 1985; ADFG 1985a). The drainages in the area of the old Dunkle Mine – the upper Bull River, Costello and

Cantwell creeks, and the West Fork of the Chulitna – are identified as prime early-winter moose range (NPS 1984; ADNR 1985).

Since 1992 the National Park Service conducted four moose surveys that encompassed the TUA. The following table shows estimates of moose per square mile, and calf/cow and bull/cow ratios. These surveys covered a 215 square mile area from Windy Creek to the West Fork of the Chulitna River.

Year	Calves per 100 Cows	Bulls per 100 Cows	Density per Square Mile
1992	29.5	29.5	1.4
1993	28.1	31.3	0.7
1995	23.6	27.6	0.9
2005	19.5	47.4	1.2

Caribou

Caribou are migratory herd animals that use varying habitats for wintering, calving (late May to early June), summer range, and rutting (September and October). The Denali caribou herd currently numbers approximately 2,000 caribou and ranges over approximately 3,900 mi^2, including most of Denali National Park and Preserve north of the Alaska Range, and areas south of the range and east of Mount McKinley. Researchers have conducted intensive studies on the dynamics of the Denali Herd since 1984 (Adams et al. 1995a; Adams 1996; Adams and Dale 1998). They found high losses of calves to predation are an important factor in limiting the growth of this caribou population. The Broad Pass area is used as winter range by the Denali herd because of good habitat and because the hill tops are wind-blown and cleared of snow.

Caribou habitat includes all land within the TUA. The Denali herd has been known to use the TUA when cow caribou drop their calves. Historically, 10–90% of the herd crossed to the Cantwell calving grounds each year for calving or immediately after calving. In the past these calving grounds may have been the most significant in terms of the percentage of the herd using them and of overall calf survival (NPS 1982; Kline et al 1983; Kline and Boertje 1984). Now, however, studies indicate the Cantwell grounds have recently been used less extensively for calving by the Denali herd than two northern areas (NPS 1989). For the last decade, approximately half of the cows in the Denali herd have calved in the foothills of Mount McKinley from the Muldrow Glacier to the Straightaway Glacier. The other half of the cows do not congregate on calving grounds but disperse throughout the range of the herd (Adams et al. 1995b). The proportion of cows on the calving grounds increases in years with low spring snowpacks and decreases when the mountains are blanketed in snow.

Following calving, caribou predominantly move to higher mountainous areas greater than 5,000 feet in elevation for the first half of the summer. These high altitude areas provide relief from insect harassment as well as nutritious, newly growing forage (Boertje 1985). By mid-summer, when insect harassment is reduced by cooler temperatures and increased rainfall, caribou disperse widely throughout the mountains and foothills of the park to forage.

With the onset of the breeding season in mid-September, caribou aggregate into rutting herds. These rutting groups can be found throughout the TUA.

In addition to caribou from the Denali herd, small numbers of caribou from the Nelchina herd venture into the TUA. The Nelchina herd, which reached about 45,500 animals in the early 1990s (ADFG 1993a), has recently declined to 36,677 animals (ADFG 2004).

Bear

Brown bears range throughout the park and preserve, but generally prefer high-elevation tall shrub, low shrub, and alpine tundra communities. Brown bear densities are poorly known for most of Denali, but recent work on the south side of the park indicates that densities there vary from 0.03–0.10 bears per square mile (ADFG 1990a, ADFG 1993b; ADFG 1996a).

Little is known about the density of black bears in Denali. In the Susitna River area, southeast of the park, black bear densities reach about 0.2 bears per square mile (Miller, et al.1987). Overall concentrations of black bears on the south side are thought to be decreasing (ADFG 1995). In contrast to brown bears, black bears prefer upland forest and floodplain forest communities below 2,000 feet in elevation (ADFG 1978a).

Gray Wolf

The size of the park's wolf population is primarily dependent on the abundance and vulnerability of ungulate prey species. During periods of low winter snowfall, when prey are in particularly good nutritional condition, wolf numbers tend to be low because of low pup production and survival and high dispersal and mortality of older wolves (Adams and Mech 1995c, Mech et al. 1998). When winters are severe, making prey more vulnerable, the wolf population can quickly increase by higher pup production and reduced dispersal of young adults. Wolves occur throughout all areas of the park that support ungulate prey (i.e., areas less than 6,000 feet elevation).

Smaller Carnivores, Rodents, Lagomorphs, and Insectivores

The TUA supports a large suite of smaller carnivores (coyote, red fox, lynx, river otter, wolverine, marten, ermine, least weasel and mink), rodents (hoary marmot, arctic ground squirrel, red squirrel, northern flying squirrel, beaver, voles, brown lemming, and porcupine), two lagomorphs (snowshoe hare and collared pika), insectivores (shrews), and at least one species of bat (little brown bat). These species inhabit a variety of habitats across Denali and form integral links in Denali's food web. Many of the rodents are prey sources for many larger omnivores and carnivores.

3.4.2 Birds

As of August 2001, 164 bird species were documented in Denali (NPS 2001). Of these, at least 106 species breed in Denali, including at least 25 resident species. The distribution of avian species in Denali is a function of habitat and elevation; however, studies of avifaunal communities are just beginning in Denali. In most cases, the available information is limited to presence and few data are available on relative abundance of species and habitat relationships.

The TUA provides habitat for many of the 164 bird species, including: migratory waterfowl such as trumpeter swans, harlequin ducks, and Tule greater white-fronted geese; raptors such as bald and golden eagles, falcons, merlins, kestrels, accipiters, northern harriers, and owls; all three species of ptarmigan; grouse; and shorebirds such as whimbrel, upland sandpiper, surfbird, semipalmated plover, yellowlegs, common snipe, solitary sandpiper, wandering tattler. The numerous lakes and ponds at lower elevations provide important summer breeding grounds for two species that winter at sea, arctic tern and long-tailed jaeger.

3.5 WATER RESOURCES

3.5.1 Water Quality

The surface waters of Denali National Park and Preserve generally appear to be of good quality, with indications of some localized impacts from human activities (Edwards and Tranel 1998). Potential sources of contaminants are principally associated with mining claims or glacial streams that drain high-altitude mountainous areas and carry high sediment loads (NPS 1995b). Most surface waters in the backcountry receive little recreational use because of difficult access, challenging boating conditions, or lack of fisheries.

Glaciers have a profound effect on water quality and can contribute large amounts of sediments to receiving streams, significantly increasing their turbidity. Streams and rivers in which glacial melt water contributes to streamflow are referred to as glacial waters. Studies done throughout most of Denali National Park and Preserve (though not specifically in the TUA), have shown that glacial waters within DENA contain suspended sediment concentrations ranging from means of 100 to 1,400 milligrams per liter (mg/L) and turbidity ranging from means of 77 to 363 Nephelometric Turbidity Units (NTUs) (Edwards and Tranel 1998). Most of the sediment load is carried during the summer months. In non-glacial streams, streams that are not influenced by glacial melt water, suspended sediment and turbidity can vary tremendously. DENA’s non-glacial streams contain suspended sediment concentrations ranging from means of 2 to 48 mg/L and turbidity ranging from means of 2 to 29 NTUs (Edwards and Tranel, 1998). The NPS does not have any information on existing contamination of water from ORV-related pollutants in Denali National Park.

3.5.2 Stream Morphology

Rivers and streams at DENA can be broadly categorized as either glacially fed or non-glacially fed. The contribution of glaciers to runoff in Alaska is considerable, and even modest contributions of glacial runoff to stream flow markedly affect the channel dynamics and flow regimes of streams and rivers (Oswood 1997). Streams of glacial origin like Cantwell Creek and Bull River are often characterized by shallow, swift flows over gravel beds, and are silty, braided, and have wide gravel floodplains filling mountain valleys. Glacier-fed rivers generally have pronounced daily and seasonal stream flow fluctuations, with large year-to-year fluctuations in flow. Typical glacial stream and river discharge in winter is very low to absent, then flows begin to rise in early May with increased solar radiation and reach a summer peak at maximum glacier melt. In contrast, non-glacial streams such as Windy Creek rise rapidly following ice breakup in early May, reaching a peak flow during breakup snowmelt by late May. An additional peak is often observed in these streams as a result of late summer storms (Milner and Petts 1994; Milner et al. 1997).

3.5.3 Benthic Macroinvertebrates

Conn (1998) identified 26 taxa of benthic macroinvertebrates in Denali National Park, including 6 families of Diptera, 6 genera of mayflies, 7 stonefly genera, and 6 Trichoptera genera. The only non-insects found were Oligochatae worms. Overall, the benthic macroinvertebrate studies in Denali have revealed that species diversity is low while the population density is high, particularly in more stable non-glacial streams (Conn 1998). Abundance of benthic macroinvertebrates varies from year to year and certain taxa may not be found at all in some streams in all years. Such variability in macroinvertebrate abundance is likely due to channel stability, flow variability, and climatic conditions, such as snowfall. Generally, however, undisturbed streams show less variability in macroinvertebrate communities over time than streams with unstable channels.

3.5.4 Fish-supporting water bodies in the Cantwell TUA

Within the Cantwell TUA, the fisheries affected environment includes three main watercourses: Bull River, Cantwell Creek, and Windy Creek. These streams are located in two distinct river basins: the watersheds of the Susitna River and the Yukon River, respectively. Bull River is tributary to the Chulitna River, which flows into the Sustina River, and ultimately into Cook Inlet northwest of Anchorage. Cantwell and Windy creeks are both tributary to the Nenana River, which discharges into the Tenana River. The Tenana flows into the Yukon River, which empties into the Bering Sea at the Yukon-Kuskokwim Delta.

During years of high water flows, the Division of Sport Fish of the Alaska Department of Fish and Game (ADFG) reports that small numbers of returning coho salmon (*Oncorhynchus kisutch* (Walbaum)) may reach the Bull River. The river may also support some stunted Dolly Varden (*Salvelinus malma*) as well. The Bull River is glacially occluded, that is, characterized by high turbidity from suspended glacial silt and dissolved minerals. ADFG is unaware of any sport fishery that takes place on this system (Rutz, 2007).

In a recent ADFG study documenting movements of radiotagged arctic grayling (*Thymallus arcticus* (Pallus)) in the upper part of the Nenana drainage, researchers found grayling in Windy Creek throughout the summer (Gryska, 2006).

Cantwell Creek is a turbid (glacial) system and there might be some transient movement of fish species through it, but it is not expected to support any seasonal grayling residents. However, historic ADFG survey documents (1969 and 1989) indicate that there are some small lakes located within the floodplain of Cantwell Creek that contain burbot (*Lota lota*) and whitefish (as well as grayling), so it is likely those species continue to exist in the Cantwell Creek drainage today (Brase, 2007a). Specifically, these survey reports indicate that lake trout, arctic grayling, humpback whitefish, round whitefish, burbot, and sculpin were found in small numbers in five small lakes within the Cantwell Creek drainage – Duck Lake, Edes Lake, Mirror Lake, Summit Lake, and an unnamed lake – which are located 1-2 miles from Cantwell Creek itself (Brase, 2007b). Table 3.5 describes the major features of these lakes related to their fisheries.

Dolly Varden are believed to occur in lakes in the nearby Jack River, but ADFG is unaware of any documentation of their presence in either Windy or Cantwell creeks (Brase, 2007a).

There is no evidence that any of the other species of Pacific salmon – pink or humpback (*Oncorhynchus gorbuscha*), chinook or king (*Oncorhynchus tshawytscha*), chum or dog (*Oncorhynchus keta*), sockeye or red (*Oncorhynchus nerka*), and rainbow trout (*Oncorhynchus mykiss*) – occurs in the Bull River, Windy Creek or Cantwell Creek, or other water bodies (e.g. tributaries, ponds, lakes) within their watersheds.

3.5.5 Fish species potentially present in the Cantwell TUA

Arctic Grayling

The arctic grayling is a “cousin” of the trout. This freshwater fish has a prominent sail-like dorsal fin dotted with large iridescent red or purple spots. Anglers consider it one of the most unusual and beautiful sport fish of Alaska, a symbol of the clear, cold streams of the northern wilderness. Grayling are distributed throughout the Arctic as far west as the Kara and Ob rivers of Siberia and east to the western shores of Hudson Bay in Canada. Once common as far south as Michigan and Montana, they have almost disappeared from the northern U.S. because of overfishing, competition from introduced species, and habitat loss. Grayling are naturally widespread throughout Alaska, except for the Aleutians, Kodiak Island, and Southeast Alaska, where they have been artificially stocked in a few lakes (Holmes, 1994a).

Table 3.4. Features of Fish-Supporting Lakes that Drain into Cantwell Creek

Lake	Surface area (acres)	Maximum depth (ft.)	Fish species documented	Accessibility	Fishing history
Duck	35	5	GR	¼ mile S. of Alaska Hwy.	None; too shallow for realistic management
Edes	115	7	GR, WF	½ mile hike from Summit Lake	Residents from Summit and Cantwell occasionally fish for grayling
Mirror	80	35	B, GR, LT, SC, WF	1/8 mile hike from road at Summit airstrip	Summer angling for grayling and lake trout; winter angling for whitefish and burbot
Summit	400	34	GR, LT, SC, WF	1¾ mile road from Summit airstrip	Extensively ice fished for lake trout and burbot in past years; locals claim LT population has declined
Unnamed	80	14	GR	¾ mile hike from Rte. 3	unknown

B = Burbot; GR = Arctic Grayling; LT = Lake Trout; SC = Sculpin; WF = Whitefish;
Sources: ADFG (1969a); ADFG (1969b); ADFG (1969c); ADFG (1969d); ADFG (1969e); ADFG (1989a); ADFG (1989b)

Grayling have evolved a number of strategies in adapting to what are often harsh and uncertain environments. They can be highly migratory within a given watershed, using different streams for spawning, juvenile rearing, summer feeding, and overwintering. In yet other areas, they can complete their entire life without having to leave a short reach of stream or lake. Grayling usually overwinter in lakes or the lower reaches and deeper pools of medium-sized rivers, or in large glacial rivers like the Tanana, Susitna, and Yukon. They are quite tolerant of low dissolved oxygen levels, enhancing their ability to survive long winters in settings that would kill other salmonids (Holmes, 1994a).

Table 3.5 summarizes what is known about fishery resources within the Cantwell TUA:

Table 3.5. Summary of Information on Fishery Resources within the Cantwell TUA

Species	Bull River	Cantwell Creek	Windy Creek
Arctic grayling	Not believed to occur	Documented presence in lakes within watershed	Documented presence throughout the summer
Burbot	Not believed to occur	Documented presence in lakes within watershed	NA
Coho salmon	Small numbers possible during high years	Not believed to occur	Not believed to occur
Dolly Varden	May support marginal population	NA	Not believed to occur
Lake trout	Not believed to occur	Documented presence in lakes within watershed	NA
Sculpin	NA	Documented presence in lakes within watershed	NA
Whitefish (humpback and round)	Not believed to occur	Documented presence in lakes within watershed	NA

NA – No Available information but could potentially occur in low numbers

In spring, grayling migrate upstream to spawning grounds. Like salmon, this species faithfully returns every year to the same spawning and feeding areas. They spawn for the first time at 4-5 years of age and a length of about 11 to 12 inches. After spawning, they migrate once again to summer feeding areas up to 100 miles away. By the middle of summer, grayling stocks segregate themselves according to age and maturity – older adults in the upper reaches of river and stream systems, the sub-adults in the middle, and the juveniles in the lower ends. Grayling fry hatch about three weeks after spawning, and tend to occupy the quieter waters close to where they hatched. In early autumn, grayling again migrate leisurely to their overwintering areas (Holmes, 1994a).

Grayling are generalists in their food habits. Drifting aquatic insects – especially mayflies, stone flies, and caddis flies – are their primary food items. They also feed on the eggs of spawning salmon, outmigrating salmon smolts, terrestrial insects that have fallen into the water, or even an occasional vole or shrew (Holmes, 1994a).

Anglers prize grayling because any fishing technique, including bait, lures, and flies, may work at one time or another. They are especially popular because of their willingness to rise to a dry fly. Within Alaska, the largest grayling fisheries occur along the road system in the Interior.

Burbot

The burbot is the only member of the cod (Gadidae) family in fresh water in North America, and like its saltwater relatives, has mild-tasting white flesh. Burbot are distributed in fresh waters throughout North America and Eurasia southward to about 40 degrees north latitude, and occupy most large clear and glacial rivers and many lakes throughout Alaska (Holmes, 1994b).

This species has a thin, elongated body that tapers to a point near the tail. Its major distinguishing characteristics are a "chin whisker" or barbel, and dorsal and anal fins that run from the middle of the body almost to the tail. Its mouth is quite large and contains numerous rows of small, backward-slanting teeth. Burbot have mottled olive-black or brown skin interspersed with yellow patches; they appear scaleless but actually have small, almost microscopic scales. Anglers often disparage burbot as ugly, but in spite of its less than elegant appearance, it is a valuable food and recreational fish (Holmes, 1994b).

Burbot are relatively long-lived and slow-growing. It takes them about six or seven years to reach about 18 inches, the size at which most Alaska burbot spawn for the first time. They spawn under the ice in late winter (February to March) and have been observed to congregate in a large writhing ball while spawning. Their eggs are very small, and an individual female may deposit over a million of them (Holmes, 1994b).

Juveniles feed mainly on insects and other invertebrates, but by the age of five, burbot feed almost exclusively on other fish. While adult burbot may appear sluggish, they are voracious nocturnal predators. The burbot’s large mouth, strong jaw, and large number of inward slanting teeth explain its efficiency as a predator. Whitefish, sculpins, lampreys, and other burbot are common food items, though small rodents or shrews may occasionally occur in the diet (Holmes, 1994b).

The most popular fishing areas for burbot in Interior Alaska are large, glacial rivers such as the Yukon and Tanana rivers. Burbot can be caught both in the summer as well as through the ice in the winter. In some areas anglers use set-lines or "trot-lines.”

<u>Coho Salmon</u>

Also known as silver salmon, this anadromous fish is found in coastal waters of Alaska from Southeast to the Chukchi Sea and in the Yukon River to the Alaska-Yukon border. Coho are extremely adaptable and occur in nearly all accessible bodies of freshwater, from large trans-boundary watersheds to small tributaries (Elliott, 1994).

Adult cohos usually weigh 8-12 pounds and are 24-30 inches long, but individuals weighing up to 31 pounds have been caught. Adults in the ocean or recently arrived in fresh water are bright silver with small black spots on the back and on the upper lobe of the caudal fin. Spawning adults of both sexes have dark backs and heads with maroon to reddish sides; these features are more pronounced in the male. Males also develop a prominent hooked snout with large teeth called a kype. Juvenile coho salmon have 8 to 12 parr marks evenly distributed above and below the lateral line with the parr marks narrower than the interspaces (Elliott, 1994).

Coho salmon enter spawning streams from July into November, usually during periods of high runoff. The timing of the run has evolved to reflect the requirements of specific stocks. In large rivers, adults must arrive early, as they need several weeks or months to reach headwater spawning grounds. Run timing is also regulated by the water temperature at spawning grounds: where temperatures are low and eggs develop slowly, spawners have evolved early run timing to compensate; conversely, where temperatures are warm, adults are late spawners. Adults hold in pools until they ripen, then move onto spawning grounds; spawning generally occurs at night (Elliott, 1994).

The female coho digs a nest, called a redd, and deposits 2,400 to 4,500 eggs. As she deposits the eggs, the male alongside fertilizes them with milt (sperm). Eggs develop during the winter and hatch in early spring; embryos remain in the gravel utilizing the egg yolk until they emerge in May or June. The emergent fry occupy shallow stream margins, and, as they grow, establish territories which they defend from other salmonids. During the next year or more, the fry live in ponds, lakes, pools, sloughs, and backwaters of streams and rivers, usually among submerged woody debris or submerged or emergent aquatic vegetation. From these quiet areas with little or no current, juvenile cohos dart out to seize drifting insects (Elliott, 1994).

Some coho leave fresh water in the spring and rear in brackish estuarine ponds and then migrate back into fresh water in the fall. They spend one to three winters in streams and may spend up to five winters in lakes before migrating to the sea as smolt. Time at sea varies, but most coho stay 18 months before returning as full size adults (Elliott, 1994); in that year and a half in the productive North Pacific, Gulf of Alaska, and Bering Sea, their weight may increase 100-fold.

The coho salmon supports lucrative and important commercial and sport fisheries. It is a premier sport fish and is taken in fresh and salt water from July to September. Coho are esteemed as spectacular fighters and the most acrobatic of the Pacific salmon (Elliott, 1994).

Dolly Varden

The Dolly Varden, like its close relative the eastern brook trout, belongs to a group of fish called char within the family Salmonidae. The light spots on their sides distinguish them from other salmonids like trout and salmon, which are usually black spotted or speckled. Dolly Varden are locally abundant in all coastal waters of Alaska. Anadromous and freshwater resident varieties exist, with lake, river, and dwarf populations being found among the freshwater residents. Little is known of the habits of Alaskan non-migratory Dolly Varden (Hubartt, 1994).

Dolly Varden spawn in streams, usually during the fall from mid-August to November. The female, depending on her size, may deposit from 600 to 6,000 eggs (2,500 to 10,000 in the northern form) in depressions (redds), which she excavates in the streambed gravel by digging with her tail fin. The male typically does not help with nest building but spends most of his time fighting and chasing other males. When the female is ready to deposit her eggs, the male moves to her side and spawning begins. Sperm and eggs are released simultaneously into the redd (Hubartt, 1994).

The eggs develop slowly in the cold water; hatching may occur in March, four to five months after fertilization. Dolly Varden fry rear in streams before beginning their first migration to sea. During this rearing period, their growth is slow, a fact which may be attributed to their somewhat inactive habits. Young Dolly Varden often remain on the bottom, hidden from view under stones and logs, or in undercut areas along the stream bank, and appear to select most of their food from the stream bottom (Hubartt, 1994).

Most Dolly Varden migrate to sea as smolt in their third or fourth year, but some wait as long as their sixth year, when they are about five inches long. This migration usually occurs in May or June, although significant but smaller numbers have been recorded migrating to sea in September and October. After their first seaward migration, Dolly Varden usually spend the rest of their lives wintering in and migrating to and from fresh water. At maturity, Dolly Varden return to spawn in the stream from which they originated. The fish possesses the ability to find their “home” stream without randomly searching, as was the case in their original search for a wintering area (Hubartt, 1994).

Most southern form Dolly Varden reach maturity at age 5 or 6. At this age they may be 12-16 inches long and may weigh from 1/2 to 1 pound. Dolly Varden are one of Alaska's most coveted sport fish (Hubartt, 1994).

Lake Trout

The lake trout (*Salvelinus namaycush*) is Alaska's largest freshwater fish. It is also the largest representative of the group of salmonids called char, and is closely related to Dolly Varden, eastern brook trout, and Arctic char. Lake trout have a body shape resembling that of trout and salmon. They generally have small, light, irregular shaped spots on a silvery-to-dark background; but color can vary considerably. Males and females are similar, with males having a slightly longer, more pointed snout (Bendock, 1994).

In Alaska, lake trout inhabit the deeper lowland lakes along the central Arctic coastal plain, as well as waters in the Brooks Range and Alaska Range. Lake trout inhabit clear, mountain lakes in northern Alaska as well as turbid glacial lakes on the north side of the Chugach Range and Kenai Peninsula.

Lake trout typically spend their entire lives in large, deep, cold lakes. They spawn on clean, rocky lake bottoms from September through November. Males reach the spawning sites several days before the females and use their snouts and fins to clean the substrate. Spawning occurs at night with peak activity occurring after dusk. Eggs hatch early the following spring. Little is known about the early life history of lake trout; they are believed to be reclusive while feeding on plankton as young fry. Spawning occurs for the first time at 7-8 years of age. Lake trout spawn every other year or less frequently in northern Alaska, while some southern populations may spawn annually. Lake trout growth varies depending on diet, water temperature, altitude, and genetics. The maximum size attained in some Alaskan populations probably exceeds 50 pounds, and 8-10 pound fish can be taken in many of the state's fisheries (Bendock, 1994).

The diet of lake trout varies with the age and size of the fish, locality, and the type of food available. Typical food items include zooplankton, insect larvae, small crustaceans, clams, snails, leeches, several kinds of fish, mice, shrews, and even occasional young birds. Lake trout feed extensively on other fish such as whitefish, grayling, sticklebacks, and sculpins, when available.

Most successful lake trout anglers use bright spinners or spoons while fishing from shore or near inlet and outlet streams. Natural mortality is low in most lake trout populations; however, slow growth, alternate year spawning, and older ages at maturity combine to make lake trout populations susceptible to overharvest by commercial and recreational fisheries (Bendock, 1994).

Sculpin

The slimy sculpin (*Cottus cognatus*), a bottom-dwelling fish, is found throughout most of northern United States, Canada and Alaska. It occurs in both streams and lakes, and is sometimes mistaken for a baby burbot. It is a small fish that averages about three inches in length with eyes on top of its head. It has a broad, flat head with an upper lip that protrudes past the lower lip with fine teeth on both jaws (Mansfield, 2004).

Sculpin move to shallower waters during the spawning season, which is in the spring. Males select a nesting spot under a rock or log and clean the area by fanning fine sediment and removing small pebbles with their mouths; they are territorial and can be aggressive towards other males. A male courts a female until she deposits her eggs, which are yellow to pink, on the underside of the rock or log. The female leaves after egg deposition. Once the eggs are fertilized, the male guards his nest until the young fish are ready to leave. During this time the male fans the eggs to remove silt and provide oxygen and keeps the nest clean. The eggs hatch about 30 days after being fertilized. The sac-fry stay in the nest, usually resting on the bottom, where they remain for about a week while the yolk is absorbed. Slimy sculpin reach sexual maturity at about two years and typically live about five years (Mansfield, 2004).

The slimy sculpin is found in areas with rocky or gravel bottoms. It is nocturnal and usually spends most of its time on the stream bottom and seeks shelter under rocks and logs. It is an ambush predator, feeding primarily on insects, but also eats crustaceans, fish eggs, and small fish. Although the sculpin itself is not sought by anglers, its small size and poor swimming ability makes it a important prey item for larger fish (Mansfield, 2004).

<u>Whitefish</u>

As a major food item for many predatory fish, the various species of whitefish are important in the aquatic food chain. While they have potential as a sport fish, and a few small commercial fishing operations exist, their greatest use in Alaska is as a subsistence food for Natives and their dogs (Alt, 1994).

Two species of whitefish have been logged by ADFG surveys in the small lakes within the Cantwell Creek watershed: the round and the humpback whitefish (*Prosopium cylindraceum* and *Coregonus oidschian*, respectively).

Round whitefish have rounded, cigar-like bodies with tiny, pointed snouts and single nasal flaps. The upper jaw extends out over the lower. Round whitefish in most Alaskan streams rarely exceed 16 inches in length.

The humpback whitefish is referred to as a “true whitefish.” Its diet consists mainly of small clams, snails, aquatic insects, larvae, and freshwater shrimp. Its head is small and the body deep or wide from stomach to backbone (Alt, 1994).

3.6 VISITOR EXPERIENCE

In the summer months, the TUA is used for recreation and other purposes by visitors to Denali National Park and Preserve. Hiking, backpacking and camping generally occurs on the Windy Creek Access Trail, on the higher elevation ridges, and along gravel bars. A backcountry permit is not required for the TUA; however, some backcountry users pass through the TUA to access adjacent units for which a permit is required. Based on the number of backcountry permits issued each year for units adjacent to the TUA, and patrol reports by rangers, park managers estimate that very few people recreate in the TUA during the summer and fall seasons (no more than two groups per week).

The availability of the opportunity to recreate in the TUA, and the quality of the visitor experience, are described in the following sections.

3.6.1 Availability of Visitor Opportunity

The TUA is located within backcountry unit 70. Hikers and backpackers typically access the TUA from Cantwell via the Windy Creek Access Trail and either exit the same way they entered or exit the unit via Windy or Foggy Pass. Most summer recreational use in the TUA is focused in the eastern part of the unit near Cantwell.

While there are currently no limits on the number of people who can recreate in the TUA, use during all seasons is subject to guidance in the 2006 *Final Backcountry Management Plan*.

The TUA is zoned by the Backcountry Plan as Management Area B, which is described by the following standards:

- Visitors notice few if any signs of social trails, campsites, or cut or broken vegetation.
- Visitors have at most one encounter per trip with modern equipment or a landscape modification (landscape modification do not include permitted modifications for subsistence use such as cabins or trapline trails).
- There are no visible landscape mitigations for visitor use.
- No more than 5% of visitors encounter human waste, toilet paper, or litter in the backcountry.
- Natural sounds predominate in this area, but there are infrequent motorized intrusions, a few of which may be loud. Motorized noise may be audible up to 15% of any hour, and there may be as many as 10 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 40 dBA.
- Visitors occasionally encounter other parties in these areas, but are almost always alone. They generally encounter 2 or fewer parties per day. One or two of the parties encountered may have more than 6 people.
- Visitors are always able to camp out of sight and sound of others.
- Administrative presence is generally limited to emergency activities and occasional patrols, with research and resource monitoring projects in some areas.

Based on conversations with visitors and field observations by park staff, the following conditions are assumed to exist. Natural sounds predominate in the TUA during the summer season, except during hunting season when ORVs are being used for subsistence. During the winter season natural sounds predominate in the TUA, except on a busy weekend in winter when snowmachine use is higher than normal. Visitors have at most one encounter per trip with modern equipment except during hunting season when users may encounter multiple ORVs that are being used for subsistence purposes, and during busy weekends in winter when snowmachine use is higher than normal. Visitors occasionally encounter other parties in this area but they are almost always alone, except during hunting season when they may encounter multiple parties and during busy winter weekends. Visitors are always able to camp out of sight and sound of others. Visitors typically do not encounter human waste, toilet paper, or litter.

Summer visitors notice ORV trails in the vicinity of Windy Creek, Cantwell Creek, and Bull River. The most severe ORV damage, including rutting and cut or broken vegetation from ORV use, occurs in the wetland areas that are less attractive to hikers. The level of ORV impacts varies throughout the TUA.

This is one of the more accessible areas of the park, and one that has relatively low visitation – a unique combination. Visits to this unit require self-reliance and can require a significant time commitment and specialized backcountry travel skills.

3.6.2 Soundscape

Researchers at Denali National Park and Preserve used sound level meters and digital media storage devices both to record sound level measurements in decibels (dB) and to collect digital sound recordings. Decibel levels are generally described using an A-weighted scale (dBA) to better approximate human hearing sensitivities. The sound recording stations have been used at 11 locations; the Dunkle Hills site is closest to the TUA.

Studies show that the natural soundscape of Denali National Park and Preserve varies depending on the acoustical attributes of the location. Season, animal life, vegetation, climatic conditions, topography, and proximity to water all influence the production and propagation of sounds. The TUA falls primarily in two acoustical zones (those areas with similar soundscapes): sub-alpine, and scrub/forest zones. The natural soundscape in each of these zones relies on the interplay of sound generation and attenuation (attenuation is the reduction in amplitude and intensity of a signal with respect to distance traveled through a medium).

The sub-alpine acoustical zone in Denali is vegetated by low plants. Though the natural soundscape is dominated by wind, during non-winter months, flowing water and a diversity of birds, insects and mammals are often audible. Low vegetation absorbs sound propagation but is offset by wide-open spaces that allow long distance travel from distant sound sources. Jet, propeller, and helicopter aircraft are often audible, as well as road and rail traffic near these corridors. Human voices are audible near backpacking routes and other travel and recreation corridors. Winter soundscapes differ by having fewer animal and propeller planes sounds, and no flowing water. Human-generated sounds originate from snowmachines in the TUA when there is adequate snowcover. Sound often carries long distances in this zone because of the lack of sound attenuation from vegetation.

The dominant tree species in the scrub/forest acoustical zone in Denali is a mixture of deciduous and conifers on the south side, including the TUA. The natural soundscape is less dominated by wind in this zone due to the presence of trees and scrub that block and reduce the speed of wind. Compared to other zones, animal sounds are more frequently audible. A greater diversity of birds, insects, and mammals also is heard. With the exception of aircraft sounds, audible sounds are usually generated by nearby sources rather than carried from far distances. Human-generated sounds originate from developed areas and from travel corridors near roads and railways. Aircraft are often heard overhead throughout this zone. Again, the distinction between the natural soundscapes of the acoustical zones becomes blurred during the winter months when flowing water sounds either have stopped or are muffled by snowcover and animal sounds are reduced in diversity and number.

3.7 WILDERNESS

ANILCA designated most of the former Mt. McKinley National Park as the Denali Wilderness. ANILCA also identified the protection of "wilderness resource values" and the provision of associated "wilderness recreational opportunities" to be important purposes of the park additions and preserves. A wilderness suitability review conducted as part of the 1986 General Management Plan concluded that 3.73 million acres of the park additions, including those lands within the TUA, were also suitable for wilderness designation. The conditions present in the TUA suggested that it could provide outstanding opportunities for wilderness recreation. It was also recognized that it could become a very important area for wilderness recreation within the park in the future because its proximity to major transportation corridors and the Dunkle Hills road made it relatively accessible to the public in comparison to many other areas of the park and preserve.

NPS Management Policies direct the NPS to "take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed." Working from the definitions given in the Wilderness Act, the provisions of ANILCA, and the tradition of wilderness preservation at Denali, the following "wilderness resource values" were identified for Denali National Park and Preserve in the 2005 Backcountry Management Plan.

- Perpetuation of natural ecological relationships and processes and the continued existence of native wildlife populations in largely natural condition
- Absence of permanent human structures, including buildings, roads, trails, dams and communications facilities
- Opportunities for solitude including:
    - Freedom from the reminders of society
    - Privacy and isolation
    - Absence of distractions such as large groups, mechanization, unnatural noise, and other signs of modern human presence

  Opportunities for primitive and unconfined recreation, which have the following characteristics;
    - Self-sufficiency, absence of support facilities or motorized transportation
    - Direct experience of weather, terrain and wildlife with minimal shelter or assistance from devices of modern civilization
    - Lack of restriction on movement; freedom to explore in the way that is desirable given conditions of weather, terrain, and personal ability; ability to be spontaneous
    - Minimal formal regulatory requirements

At the present time, these wilderness resource values are primarily affected by the extensive ORV impact that has developed away from the trail corridors that were present in the area in 1986. Snowmobile use is also a major contributor to the amount of unnatural sounds in the area, particularly on weekends during the late winter and spring. The presence of unnatural sounds from the nearby ground and air transportation corridors is also a contributing factor. The TUA remains largely free from visible presence of permanent human structures, including buildings, roads, constructed trails, and communication facilities.

Vegetation and soil damage in the form of trails from past ORV use was present when the lands within the TUA were determined to be suitable for wilderness designation in 1986. The area of the Cantwell TUA was considered to be suitable for designation in 1986 because the resource damage was largely confined to a few narrow trail corridors primarily at the northeastern edge of the TUA area. The damage associated with these trail corridors was not considered to be incompatible with possible wilderness designation in the future given the presence of trail corridors created from past use that had been incorporated into other wilderness areas. Where traditionally employed, ORV use for subsistence purposes could also occur within wilderness provided the use would not cause, or would not be likely to cause, adverse impacts to park purposes.

Subsequent ORV incursions have created widespread impacts, particularly in the open wetland areas between Cantwell Creek and the Bull River. This expansion of tracked areas since 1986 has diminished the suitability of the TUA for wilderness designation.

3.8 SUBSISTENCE OPPORTUNITIES

3.8.1 Background

One of the purposes of ANILCA is to provide the opportunity for local, rural residents engaged in a subsistence way of life to continue to do so. Accordingly, Congress provided for traditional subsistence uses by qualified local rural residents within the ANILCA additions to Denali National Park and Preserve, including the TUA. Local rural residents engage in, and depend upon, resources from the park and preserve for personal consumption, cultural identity, and to maintain a subsistence way of life.

In addition to describing the specific purposes for which Denali National Park and Preserve is to be managed, Section 202(3)(a) of ANILCA provided that "subsistence uses by local residents shall be permitted in the additions to the park where such uses are traditional in accordance with the provisions in title VIII." Under Title VIII of ANILCA, Section 811(a) states that "rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public lands." Subsistence access is further addressed in section 811(b) where it states that "the Secretary [of the Interior] shall permit on the public lands appropriate use for subsistence purposes of snowmobiles, motorboats and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulation."

In authorizing subsistence uses within Denali National Park and Preserve additions, Congress intended that traditional National Park Service management policies be maintained which strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals as part of their ecosystem, while recognizing that subsistence use by local rural residents have been, and are now, a natural part of the ecosystem serving as a primary consumer in the food chain. In addition to providing for traditional subsistence opportunities, Congress directed the NPS to take appropriate steps when necessary to insure that consumptive uses of resources within the park and preserve not be allowed to adversely disrupt the natural balance which has been maintained for thousands of years (Senate Report p. 171, top para.).

The continuation of traditional subsistence activities depends directly on the availability of healthy and diverse wildlife, plant and fish populations. The natural diversity and abundance of resources important to subsistence activities is, in turn, directly dependent upon intact and healthy ecosystems.

On July 1, 1990 the Federal Government assumed responsibility for the management of subsistence taking of fish and wildlife on Federal public lands in Alaska. The Federal Subsistence Board (FSB) was established to oversee the Federal Subsistence Program and is the decision making body that makes rural/non-rural determinations, customary and traditional use determinations which define what communities and areas have subsistence use of wildlife populations, which species and populations are subject to harvest, when seasons open and close, how many animals may be harvested, and the method and means by which an animal may be taken. The subsistence harvest of wildlife in Denali National Park and Preserve by NPS qualified subsistence users is subject to Federal subsistence management regulations. Annually any person, agency or group may submit proposals to change Federal subsistence regulations. The Federal

Subsistence Board uses the Emergency Action process if immediate action is needed to resolve fish and wildlife issues. Emergency Actions are authorized and in accordance with 50 CFR 100.19(d) and 36 CFR 242.19(d).

The purpose of the Denali Subsistence Resource Commission (SRC) is to devise and recommend to the Secretary of the Interior and the Governor of Alaska a program for subsistence hunting within Denali National Park, and to annually recommend changes to the program. The Regional Advisory Councils review and make recommendations to the Federal Subsistence Board on proposals for regulations, policies, management plans, and other subsistence related issues on Federal public lands within the region; develop proposals pertaining to the subsistence harvest of fish and wildlife; review proposals others submit; encourage and promote local participation in the decision making process affecting subsistence harvests on Federal public lands; make recommendations on customary and traditional use determinations of subsistence resources; and appoint members to national park subsistence resource commissions.

3.8.2 Cantwell Traditional Use Area

The NPS determines eligible local rural subsistence users through the use of resident zone communities and issuance of subsistence use permits. The community of Cantwell is identified as a subsistence resident zone community containing a significant concentration of residents who have customarily and traditionally used Denali National Park lands for subsistence purposes. In 1981 after consultation with Denali's Subsistence Resource Commission (SRC), boundaries for this resident zone community were established. Resident zones authorize all permanent residents within these zones to participate in subsistence activities on NPS lands without a subsistence use permit. Individuals who reside outside of the resident zone communities, who have customarily and traditionally used park subsistence resources, may apply to the Superintendent for a subsistence use permit. Approximately 100 households qualify for subsistence use activities within the Cantwell TUA.

The number of federal registration permits issued in Cantwell in recent years (NPS 2005c):

Year	**2003**	**2004**	**2005**	**2006**
Caribou (two per applicant)	47x2	77x2	68x2	38x2
Moose (one per household)	78	88	82	36

In 1991, a decision was made that Native select lands were not federal public lands and were, therefore, closed to federal subsistence use. This closed significant portions of Cantwell Creek and Windy Creek. In 1999, fisheries regulations passed and these lands again were open to federal subsistence use. ANILCA Section 811(b) states that "...the Secretary shall permit on the public lands..." Section 102(3) defines "public lands" as Federal Lands in Alaska, to exclude validly selected State and Native Corporation lands. Thus, Section 811 did not authorize the use of ORVs on selected lands, even where found to be "traditionally employed," for subsistence purposes. It also appears that 811(a) did not authorize subsistence uses at all on those selected lands (Title II authorizations always refer to the "provisions of Title VIII"). The 1991 changeover from State to Federal management of subsistence hunting on Conservation System Units should not have changed anything. When subsistence fishing was added to federal management in 1999, the new regulations setting up the Federal Subsistence Board amended the ANILCA definition of

"Public Lands" under the authority of ANILCA Section 906(o)(2), and made the change in 50 CFR 100.4 Definition of Public Lands (2).

The State and AHTNA selected lands comprise about 70% of the TUA between Cantwell Creek and the northeast border of the TUA and less than 3% of the TUA between Cantwell Creek and the Bull River. State and Native Corporation selected lands have not been surveyed, patented or interim conveyed, and because of over-selections, they may never get transferred out of federal ownership.

The NPS determined in the 1986 Denali General Management Plan (GMP) that ORVs had not been regularly used for subsistence purposes and were not considered a traditional means of subsistence access. However, in the 1990's, eight Cantwell subsistence users and the Denali Subsistence Resource Commission (SRC) requested that the Superintendent review and reconsider the 1986 GMP determination in light of new information provided by Cantwell residents regarding their traditional use of ORVs for access to subsistence resources. In response to these requests, and in compliance with ANILCA and NPS regulations and policies, the NPS undertook a project to compile and review traditional access information for the Cantwell area. The scope of this review and report was limited to the Cantwell area because the request was specific to that community and adjacent Denali National Park lands regarding traditional subsistence ORV access for the Cantwell area.

Based on the information in the review, the National Park Service made its final Cantwell Subsistence Traditionally Employed ORV Determination (hereby incorporated by reference), in July 2005, which opened the entire Cantwell traditional ORV use area to the use of ORVs for subsistence purposes. On August 1, 2005 the National Park Service implemented a temporary 120-day closure to protect park resources in the area where Cantwell residents traditionally employed ORVs for subsistence purposes that was identified in the Determination. Three existing trails (Windy Creek Access Trail, Cantwell Airstrip Trail, Upper Cantwell Creek Floodplain Route) were exempted from this closure. The closure allowed reasonable access to subsistence resources for residents of Cantwell while protecting park resources and providing time for the National Park Service to complete the necessary field work and environmental documentation evaluating ORV effects on park resources and values. In 2006, the National Park Service implemented an identical closure.

Subsistence activities are dynamic and diverse with moose and caribou hunting usually occurring in August and September. Cantwell subsistence hunters typically look closest to home first, using Windy Creek, Cantwell Creek, then farther south in the TUA. If unsuccessful, they hunt along the Denali Highway and then Kantishna (NPS 2006c). Stricter state regulations for moose hunts on state lands, decreased moose populations on state lands, and increased competition with other hunters encourage subsistence hunters to use park lands.

Federal subsistence moose season is open August 1 – September 20, and caribou season is open August 10- September 30 and October 21 – March 31. Both hunts require a Federal registration permit. One moose permit will be issued per household. The harvest limit for moose is one antlered bull moose, and the harvest limit for caribou is two bulls. There are currently no quotas for annual unit-wide harvests of moose or caribou.

Retrieval of game occurs on foot or by ORVs used on trails that are open for such use. Most harvests are likely supported by ORV use (NPS 2005). The 2005 Cantwell Subsistence Traditionally Employed ORV Determination indicates there were a variety of corridors and routes available for mechanized access by businesses as well as local residents for subsistence into areas that are now included within the ANILCA park additions. Information contained in the 1992 affidavits, 1993 ATV interviews and mapping, and the 2005 oral history project demonstrates there has been evolution of mechanized equipment used over time by Cantwell NPS qualified subsistence users along the primary routes along Windy and Cantwell Creek corridors, and into adjacent areas for subsistence harvests. Sections of intermittent ORV trails leading from the southwest side of Cantwell Creek into the Bull River drainage were also observed on park additions during the 1981 aerial survey.

In 2000, about 50% of the nearly 100 subsistence-eligible households in Cantwell attempted to harvest moose, with about 25% successful. Because there are so many factors involved with a successful hunt, it would be difficult to correlate ORV use with harvest levels. There is little evidence that horses have been used to retrieve game from the TUA.

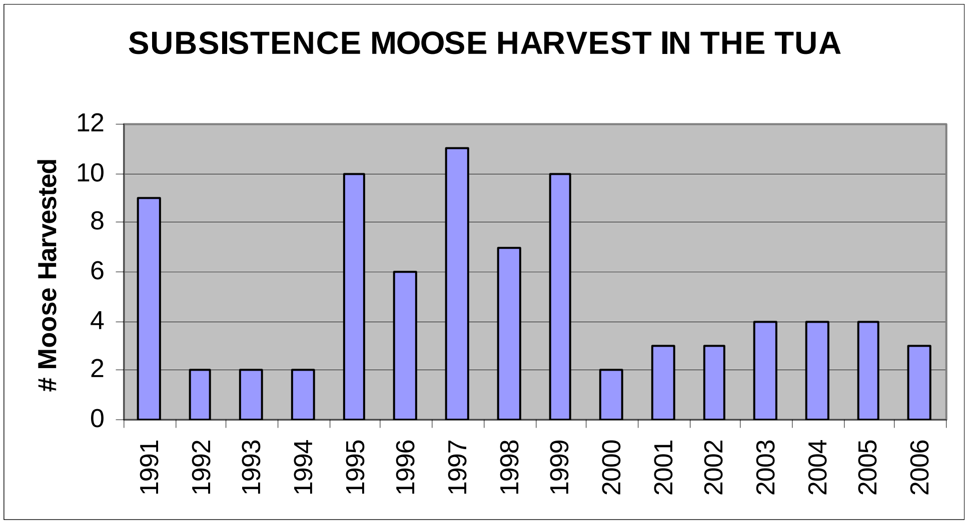
Winter hunting opportunities exist for caribou and many other furbearers and small game species. However, in recent formal and informal public meetings, eligible Cantwell residents have generally not talked about winter hunting, particularly for moose and caribou, as an important part of traditional ways.

There are traditions, among Natives and other hunters, that meat is not good in some seasons, e.g. caribou during the rut. Caribou and moose on poorer range lose fat and meat quality in late winter. But based on the widespread acceptance of the state's winter hunts for both species, and personal experience, McNay (ADFG 2006d) believes that winter meat quality is not a problem. The customary hunting practices of the late 20th century were based in part on the state's fall hunting seasons, which were in turn based on the ease of water access, ease of hunting animals during the rut, and general hunting traditions. Prehistorically, McNay (ADFG 2006d) suspects that there was a pulse of hunting activity in the fall based on water access and another in the winter based on snow travel. The state's December-January moose and caribou hunts, which are scattered around the state, are widely popular, including a winter subsistence hunt within the north side of Denali National Park in Unit 20C. In remote areas without electricity, people have often asked for hunting seasons to be moved later in the year to solve the problem of keeping meat cold (ADFG 2006d).

Figure 3.8 shows moose harvests in the Cantwell TUA from 1991 – 2006 (NPS 2006c, USFW 2007b, ADFG 2007). This information comes from NPS records maintained by the Subsistence Program Manager for Denali National Park and Preserve as well as Federal Subsistence Registration data provided by the Office of Subsistence Management at the U.S. Fish and Wildlife Service. Although Cantwell residents generally comply with reporting requirements, harvest counts could be off by as much as 15% due to underreporting or other sources of error (NPS 2006c).

Figure 3.8 shows that there has been an average of 5.1 moose harvested per year in the TUA. Harvest levels in current years have been near, or slightly above or below, sustainable levels. This can be seen by looking at total moose population in the area and bull/cow ratios. The bull/cow ratios show signs of stress to the population. In 2005 there were 65 cows and 29 bulls, a 45:100 ratio, with 8 calves (NPS 2005b). NPS wildlife biologists have concluded that these numbers generally do not show an excess population that can be harvested.

Figure 3.8. Subsistence Moose Harvests in Denali National Park: 1991 – 2006.



The ADF&G does not provide a caribou hunting season in GMU 20C, which includes most of the range of the Denali herd. However, a variable percentage of the Denali herd crosses back and forth over the Alaska Range. This means some of the Denali herd winters in GMU 13E, where they can be legally harvested on state and private lands by all hunters, and on ANILCA park lands -- including the TUA -- by qualified subsistence hunters.

Another subsistence activity is trapping, but this is conducted during winter by snowmachine and therefore would not be affected by the different ORV management provisions being proposed.

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