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Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions

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Potential Natural Vegetation (PNV) Name: Tussock Tundra 1

Fire regime group: V
Geographic Area: Interior Alaska, Seward Peninsula, Nulato Hills region of western Alaska, and Alaska Range transition region.

Physical Stetting Description:
Tussock Tundra 1 PNV sites occur in arctic and alpine landscapes beyond latitudinal and altitudinal treeline as well as on subarctic lowlands where they exist within a mosaic of spruce type PNVs. Tussock Tundra 1 sites on the Seward Peninsula and western Alaska are widespread and common on flats and gentle slopes with gradients up to 10 percent (Viereck et at 1992). Permafrost is usually present at depths of 30-50 cm. Soils are generally poorly drained, gleyed, and often with a poorly decomposed organic horizon at the surface, which may constitute most of the active layer. Frost scars are common. Tussock bog communities occur on 1) lowlands of interior and southcentral Alaska on filled-in sloughs on flood plains and 2) on cold, poorly drained slopes and terraces. These sites are underlain by wet, silty mineral soils with a surface peat layer 10 to 40 cm thick surrounding the tussocks (Viereck et al 1992).

Biophysical Classification:
The Tussock Tundra 1 PNV occurs in the following ecoregions described by Nowacki et al (2001):

- Intermontane Boreal
- Bering Tundra
- Bering Taiga – Nulato Hills (P2)
- Alaska Range Transition

The following community types described by Viereck et al (1992) are included in Tussock Tundra Interior PNV group:

IIB1a – Closed Tall Willow Shrub (in tundra regions may succeed to tussock tundra as permafrost table rises)
IIB2a – Open Tall Willow Shrub (sere on tussock tundra sites)
IIB2d – Open Tall Alder-Willow Shrub (sere on tussock tundra sites)

IC2a – Open Low Mixed Shrub-Sedge Tussock Tundra

IIC1a – Closed Low Shrub Birch Shrub (sere on river terraces)

IIC2a – Open Low Mixed Shrub-Sedge Tussock Tundra
IIC2b – Open Low Mixed Shrub-Sedge Tussock Bog
IIC2l - Open Low Alder Shrub (successional relations unknown – likely sere in shrub-tussock tundra type)

IIIA2a – Bluejoint Meadow (sere in tussock tundra sequence on some sites on Seward Peninsula)
IIIA2d – Tussock Tundra (climax on poorly drained flats, plateaus, benches, and gentle slopes in northern and western Alaska)

IIIA3a – Wet Sedge Meadow Tundra (complex successional relations – may succeed to or from Tussock Tundra)

Identification of Key Characteristics of the PNV and Confuser PNVs:
The Tussock Tundra 1 PNV is dominated by sedges in a tussock growth form. *Eriophorum vaginatum* (cottongrass) is the primary tussock-former in most stands. Other indicator species include *Carex bigelowii* (Bigelow sedge), *Carex spp.* (sedges), *Betula nana* (Dwarf white birch), *Ledum decumbens* (Labrador Tea), *Vaccinium vitis-idaea* (Mountain Cranberry), *V. uliginosum* (Bog Blueberry), and *Empetrum nigrum* (crowberry). Grasses, including *Calamagrostis canadensis* and *Arctagrostis* spp. may also be present. On wet sites in interior and southcentral Alaska, mosses (*Sphagnum* spp., *Pleurozium schreberi*, *Hylocomium splendens*) may form a nearly continuous mat between tussocks. On the drier Tussock Tundra 1 sites on the Seward Peninsula and western Alaska, *Sphagnum* may be absent or a minor constituent. Conversely, lichens are scarce (with the possible exception of *Peltigera canina*) on the interior and southcentral sites, and may be abundant on the Seward Peninsula and western Alaska sites. Here, lichens may include *Cetraria cucullata*, *C. islandica*, *Cladonia* spp., *Cladina rangiferina* (reindeer lichen), and *Thamnolia subuliformis*.

The Tussock Tundra 1 PNV is very similar to the Tussock Tundra 2 PNV, which occurs in Alaska's arctic, Yukon-Kuskokwim Delta, and Bristol Bay regions, and which has a longer mean fire return interval (MFI). Geographic location is the best determinant between these two PNVs. The Tussock Tundra 1 PNV is also similar to the Dwarf Shrub Tundra PNV which shares many of the same species and occurs in much the same region but lacks the tussock growth form.

Natural Fire Regime Description:
The fuel layer in sedge-shrub tussock tundra is dense and continuous and leads to large, fast spreading fires (Duchesne and Hawkes 2000, Racine et al 1987). Racine (1979) found much variation in burn intensity on a landscape scale on the Seward Peninsula, from completely unburned to intensely burned. These patterns are related to variations in topography and the composition, moisture content and soil organic accumulations of the plant communities. Fires in *Eriophorum* tussock tundra types tend to be light because of the wet soil profile (Wein 1971). Burns in this type usually consume all aerial woody and herbaceous plant material and litter; regeneration is vigorous via rhizomes and root sprouts. Racine (1979) found that burning was generally less severe in the tussock-shrub and sedge-shrub tundras than in the birch and ericaceous shrub tundra of the Seward Peninsula. He found that tundra burns were patchy, with unburned communities and unburned patches within burned communities.

More fires occur near the forest-tundra ecotone and spread further if trees are present (Heinselman 1981). Wein (1976) reports that July and August are the most common months for lightning fires in tundra ecosystems, while Racine et al (1983) found that distinct fire seasons occur in both June and July in the Noatak River watershed. Subsidence and thermal erosion following fire is usually minimal in tundra ecosystems (Walker 1996).

In most areas of tussock-shrub tundra on the Seward Peninsula, less than one half of accumulated organic soil layer was removed by fire (Racine 1979). Thaw depths increased to reach into the mineral soils, but were not greatly increased except where organics were removed. Frost features were made more conspicuous, and soil nutrient concentrations (K and P) increased locally.

Mean fire return interval estimates for tussock tundra ecosystems include:

- 50-300 years (personal communication FRCC experts' workshop March 2004)
- 180-1,460 years in forest shrubzone and 9,320 years in shrub subzone in northern Quebec; shorter cycle west of Hudson's Bay/in interior zone (Payette et al 1989)
- 612 years for Noatak River watershed (all vegetation types) (Racine et al 1983)
- Fire interval yet to be determined (Racine et al 1987)
- Rapid recovery following fire makes fire frequency difficult to determine (Wein 1971)
- The fire regime of tundra systems are likely quite variable from one region to another making generalizations difficult (Viereck and Schandelmeier 1980)

Other Natural Disturbance Description:
On interior and southcentral Alaska Tussock Tundra 1 sites the thaw pond cycle (disturbance leads to thawing of permafrost and ponding) and paludification (Sphagnum layer buildup and saturation) are important disturbances. On the Seward Peninsula and western Alaska, frost action creates polygonal ground and other periglacial features and is a widespread, small-scale and continuous disturbance.

Change in the arctic and subarctic climate is another source of disturbance that is currently affecting tundra ecosystems.

Natural Landscape Vegetation-Fuel Class Composition:
The natural vegetation structure is a mosaic of the seral stages described below.

Natural Scale of Landscape Vegetation-Fuel Class Composition and Fire Regime:
Tundra vegetation types cover vast expanses of the landscape on the Seward Peninsula and Nulato Hills regions. Typical landscapes in these regions include the Tussock Tundra 1 PNV within a mosaic of other tundra types, including sedge dwarf shrub and wet sedge-grass meadow types. Tundra types exist in a more patchy distribution in interior and southcentral Alaska within a mosaic that includes forested types and wetlands.

Wien (1976) reports many tundra fires in the 1 to 100 ha size range and few large (thousands of ha) fires. Racine (1979) reports that in 1977, lightning-caused fires burned 35,480 ha on the Seward Peninsula, with one fire burning 9,440 ha. Jandt and Meyers (2000) report that large fires (>200,000 ha) occur about every 10 years in the Buckland Valley and surrounding highlands of the Seward Peninsula. Racine et al (1983) found that 40 fires burned 100,000 ha (1000 km^2) in the 30,000 km^2 watershed of the Noatak River between 1956 and 1981. Forty-three percent of wildland fires occurring in interior Alaska occur in treeless areas, primarily tundra bogs and fens (Viereck 1975).

Uncharacteristic Vegetation-Fuel Classes and Disturbance:
Uncharacteristic vegetation-fuel classes and disturbances result in different percentages of seral classes than those listed below for the Tussock Tundra 1 model.

PNV Model Classes and Descriptions:
Vegetation communities in the Tussock Tundra 1 PNV typically follow one of two alternate successional pathways; one which develops tussocks with shrubs following disturbance, and one which further develops a significant lichen component.

Class	**Modeled Percent of Landscape**	**Description** (After: Walker 1996, Racine et al 1983, Wein 1971, Auclair 1983, personal communication FRCC experts' workshop March 2004, Jandt and Meyers 2000)
A: 0-15 years Post disturbance cottongrass/sedge	5%	First year following fire *Eriophorum* (cottongrass) and *Carex* spp. (sedges) regrow via rhizomes, most vascular species begin to recover, shrubs sprout from rootstock. Sedges often capture site 6-10 years post fire. Grasses (*Calamagrostis* and *Arctagrostis*) are locally important following fire.
B: 10-250 years Tussock/shrub tundra	70%	Tussocks dominated by *Eriophorum* (cottongrass), *Carex* spp. (sedges) Lichens begin to re-establish but do not reach former abundance until 50-120 years following fire. Fire is difficult to detect even in the early stages of this class, however the proportions of species differs from the pre-burn community, with very few lichens, fewer shrubs and more sedges, grasses and cottongrass. Former abundances of all species are typically reached 50-120 years post fire. Lichens, if present, have < 25% cover.
C: 80-300 years Lichen/tussock/ shrub	25%	Tussocks are dominated by shrubs and lichens. Species composition is similar to that in Class B, but lichen cover is >25%.
Total:	100%	

Modeled Fire Frequency and Severity:

	Mean Probability	Mean Fire Frequency (years) (inverse of probability)	Description
Replacement fire	0.0047	210 years	Based on literature and expert input
Mosaic fire	0.0005	2000 years	Based on literature and expert input
All Fire	0.0052	195 years	Based on literature and expert input
Other disturbances			

Modeled Fire Severity Composition:

	Percent All Fires	Description
Replacement fire	90%	Based on literature and expert input
Non-replacement fire	10%	Based on literature and expert input
All Fire	100%	

Further Analysis:

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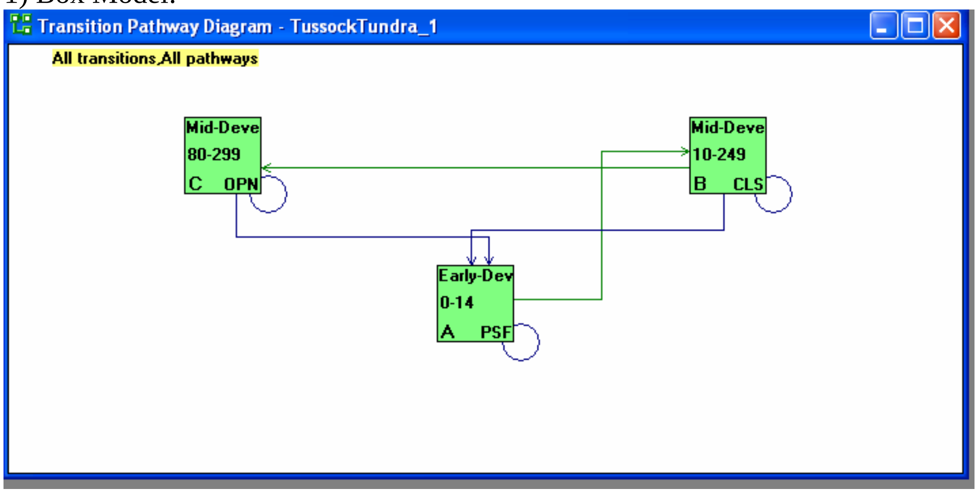
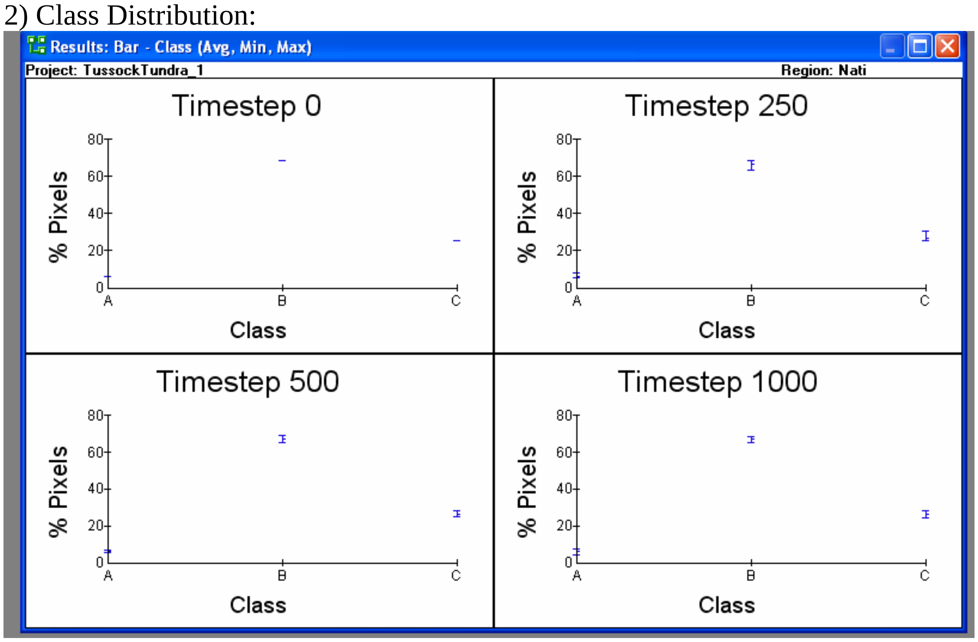
VDDT model diagrams

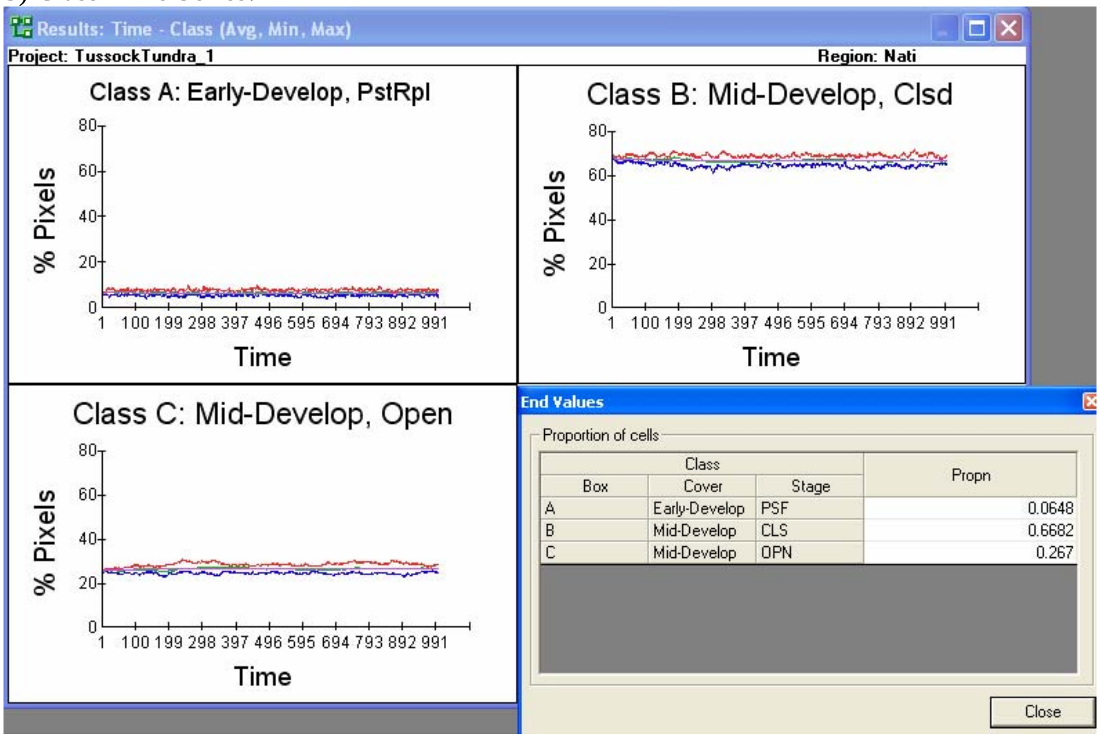
1) Box Model:



2) Class Distribution:



3) Class Time Series:



4) Fire Disturbance Time Series: