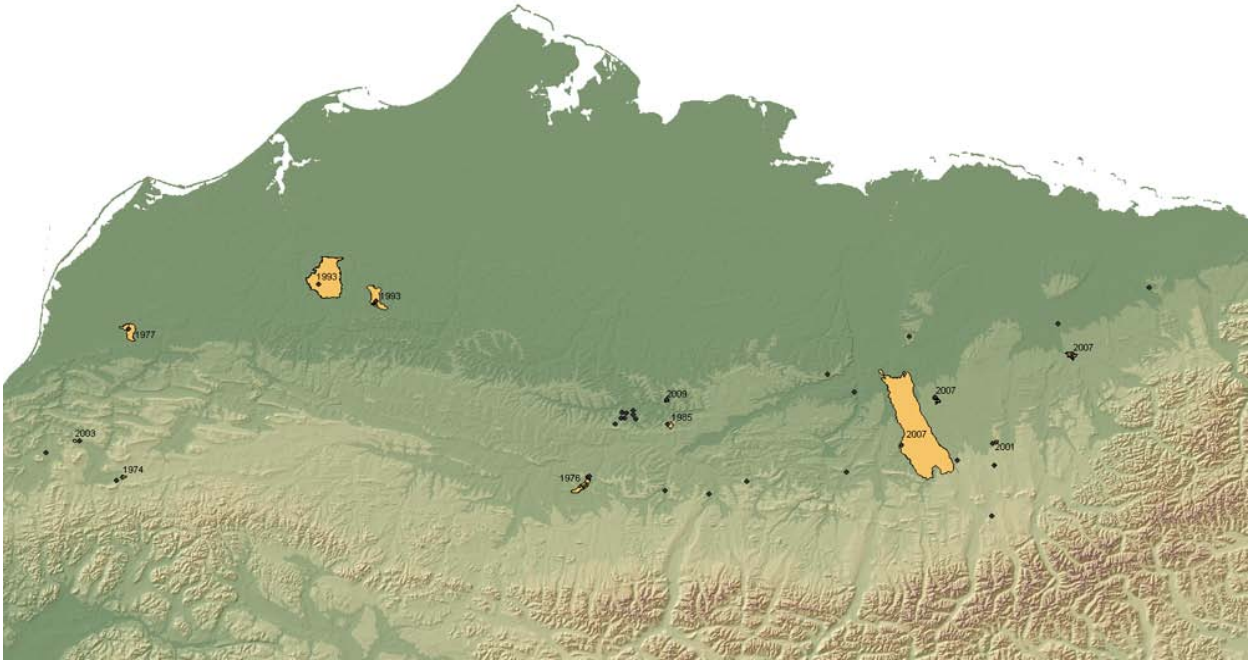
Basic Statistics on North Slope Tundra Fires in Alaska

Eric Miller, 21 June 2010

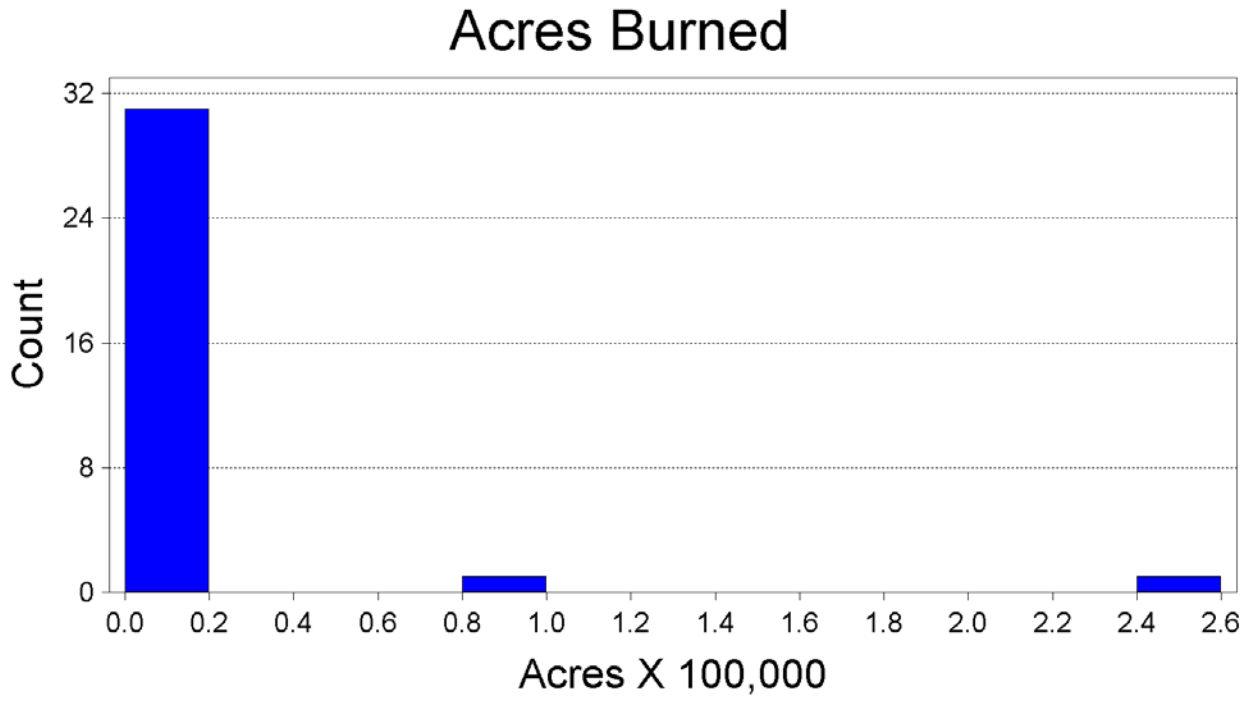
Summary:
To date in 2010, eleven fires have been detected on the North Slope. There has been some interest in the fire activity and whether it is abnormal. Here I provide some basic statistics on North Slope fires since 1969 to provide some context. There have been 34 recorded fires on the north slope. Early season fires tend to be smaller and burn for only a single burn period. Mid-season fires have potential to burn longer and to a greater area if conditions allow fire to penetrate and hold overnight in the duff. Fires are carried by the accumulation of cured, dead sedge foliage. The mean and median fire size is 60-80 acres. The lightning season is mid-June to late July. Strike density decrease exponentially from the foothills of the Brooks Range out to the coastal plain. Although fire frequency has increased in the last 40 years, the size of the fires detected has simultaneously decreased which suggests it may be explained by increased aircraft traffic and by better remote sensing technology.

Detailed Discussion:
The North Slope is defined for this analysis as north of the Brooks Range, including the foothills. It includes all fires between the Chukchi Sea to the west and the Beaufort Sea to the northeast.

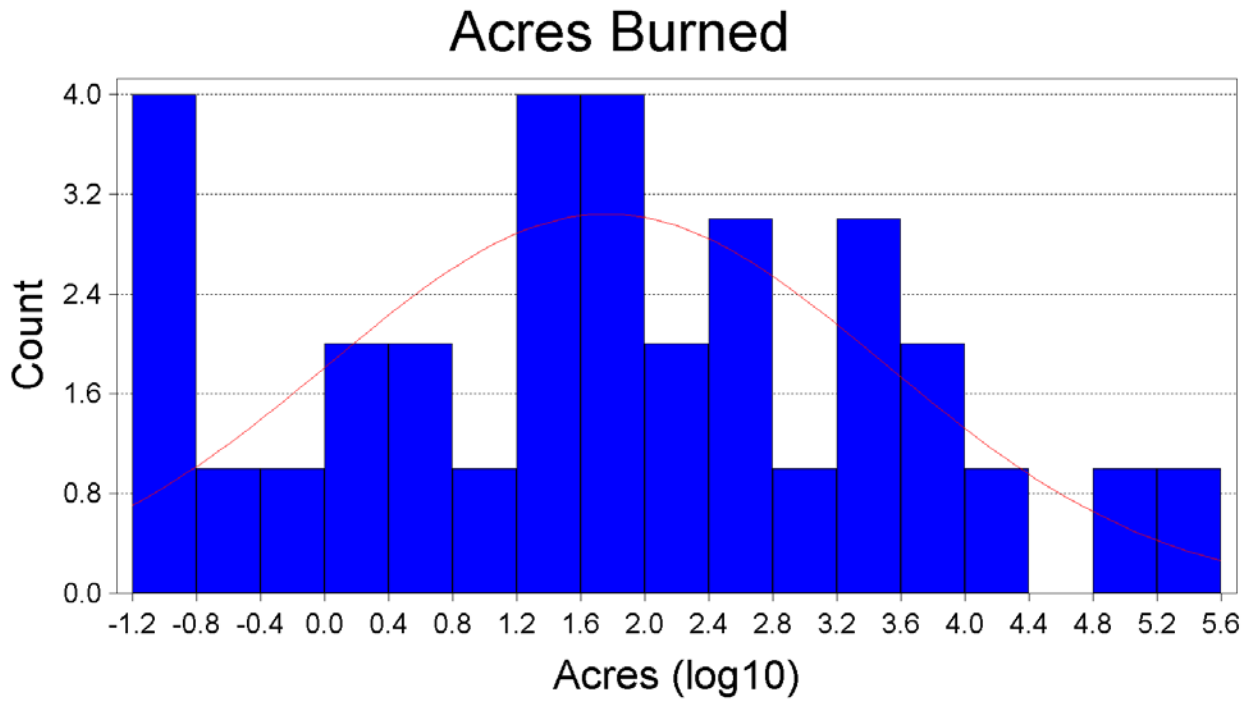


Earliest known fire:	6/21/1969
Number of fires as of 6/21/2010:	34
Median fire size:	80 acres
Mean fire size (log transformed):	58 acres
Largest fire:	Anaktuvuk River, 7/16/2007, 256,734 acres.

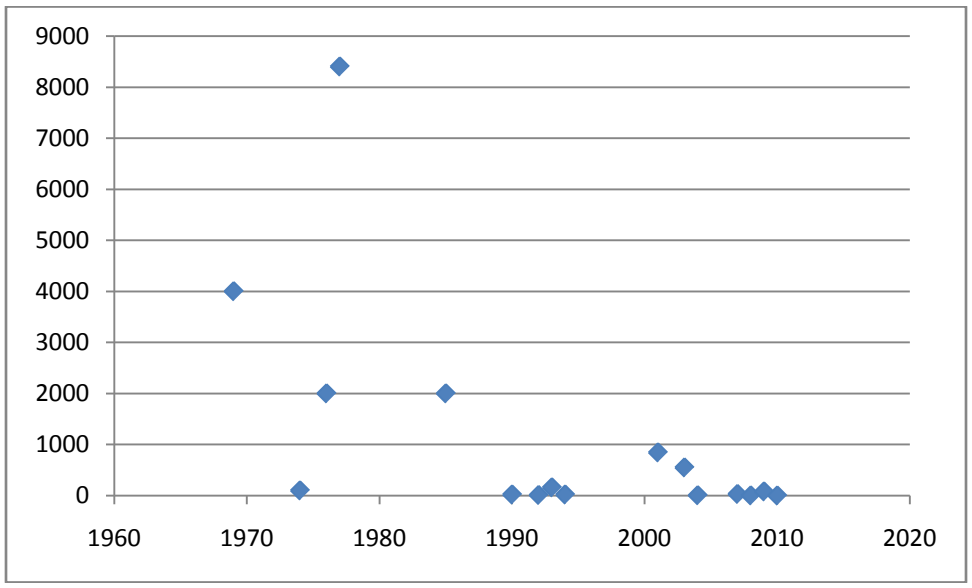
Fire size is not normally distributed. The majority of fires are small with a few very large fires. Attempts to find the mean or median fire size are suspect because the minimum detected fire size has decreased over the years since 1969. That is, more smaller fires are being detected in recent years owing to more aviation activities or better remote sensing. Given the information available the mean and median fire size is roughly 60-80 acres.



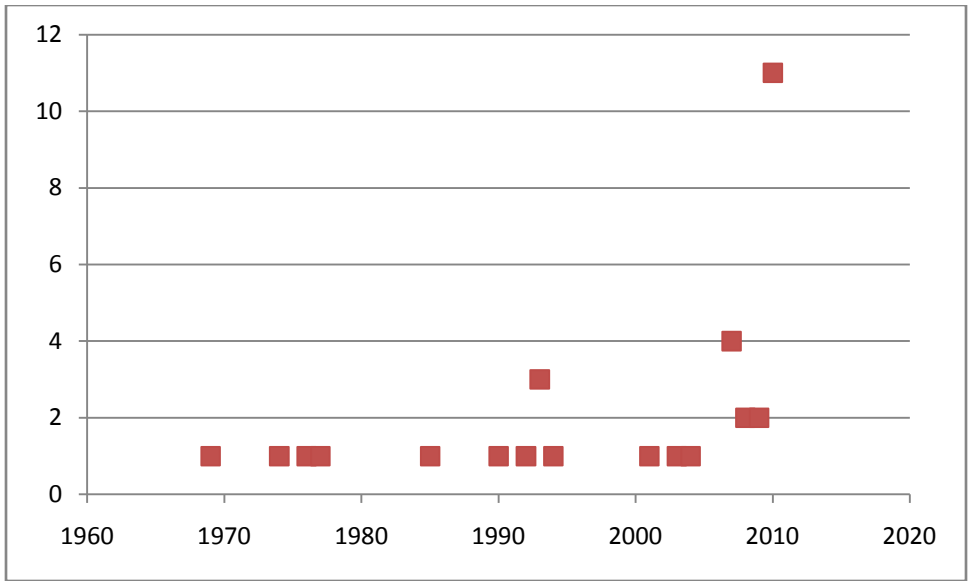
Fire size histogram. Most fires are small with a few extremely large fires. A log scale on the X axis is more appropriate.



Fire size (Log 10 scale on the X axis). Mean log-10 fire size is 1.76 which is equivalent to 58 acres.

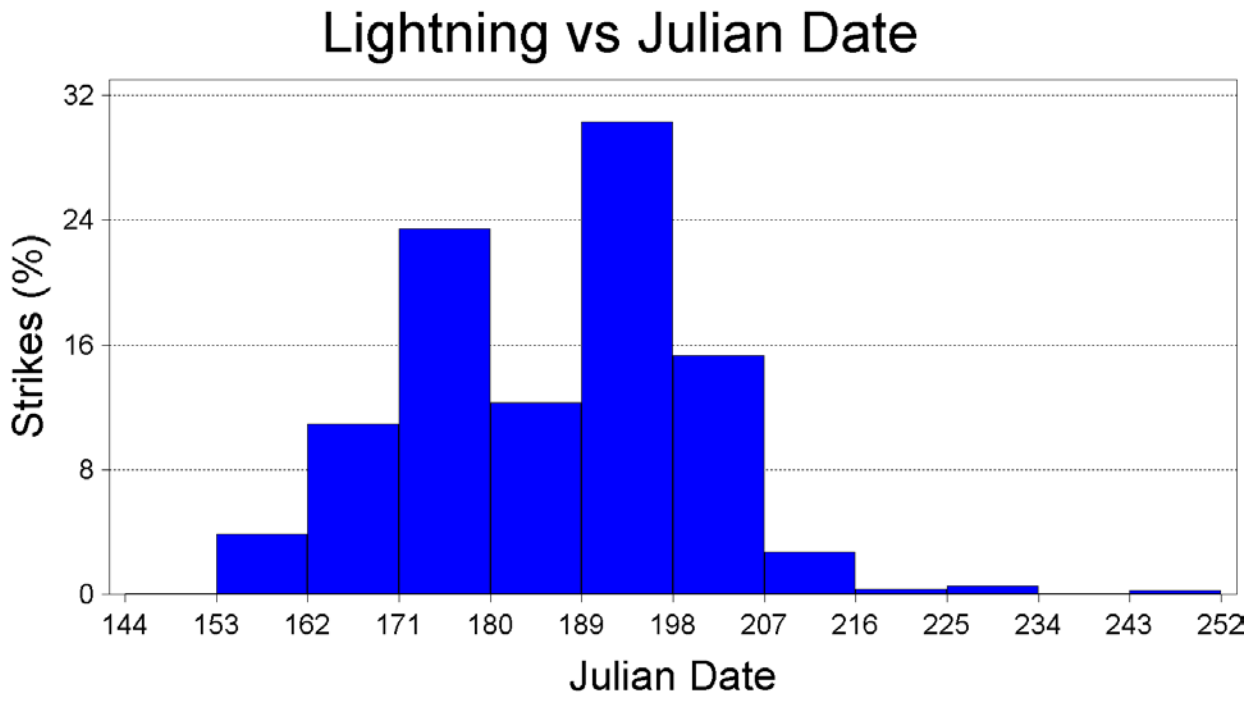


Minimum fire size (the smallest fire detected in a given year) versus time. The size of fires being detected in recent years is decreasing, probably due to more flights and better remote sensing.



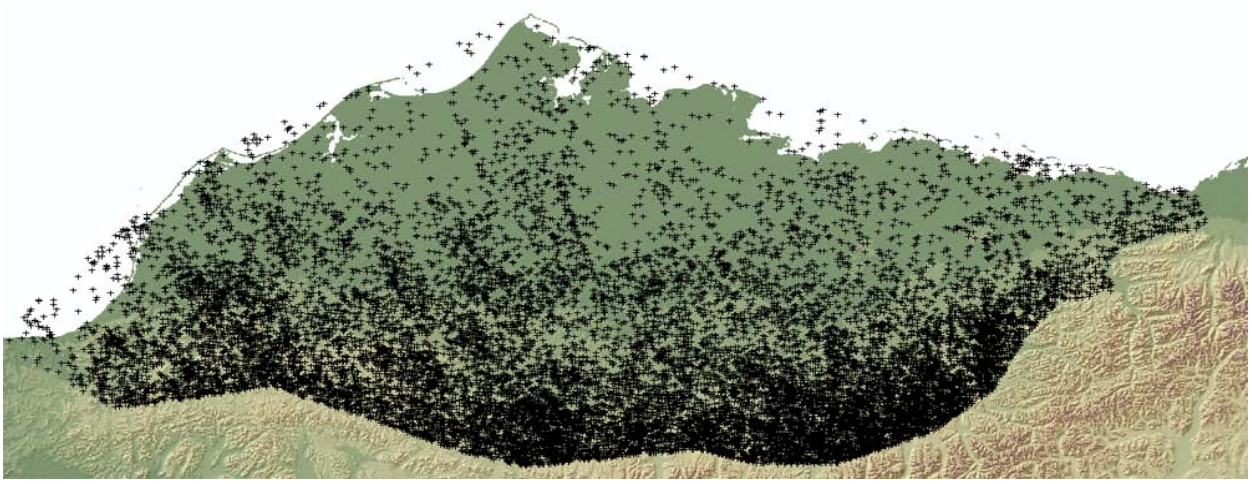
Number of fires detected per year versus time. Increasingly more fires are being detected.

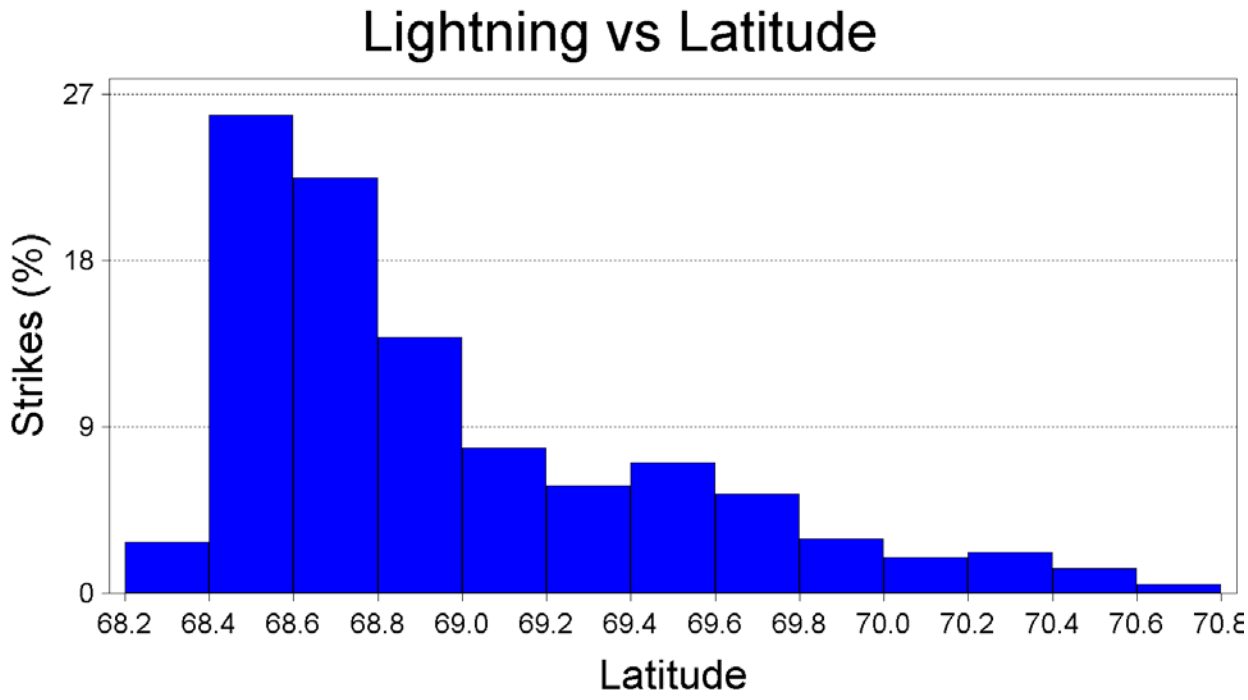
Is there a pattern to the timing and location of North Slope fires? No doubt ignitions are tied to patterns of lightning. The earliest detected lightning strike between 1986-2009 was 25 May and the latest was 9 September. Ninety percent of lightning strikes occur between 13 June and 25 July with a peak at 7 July.



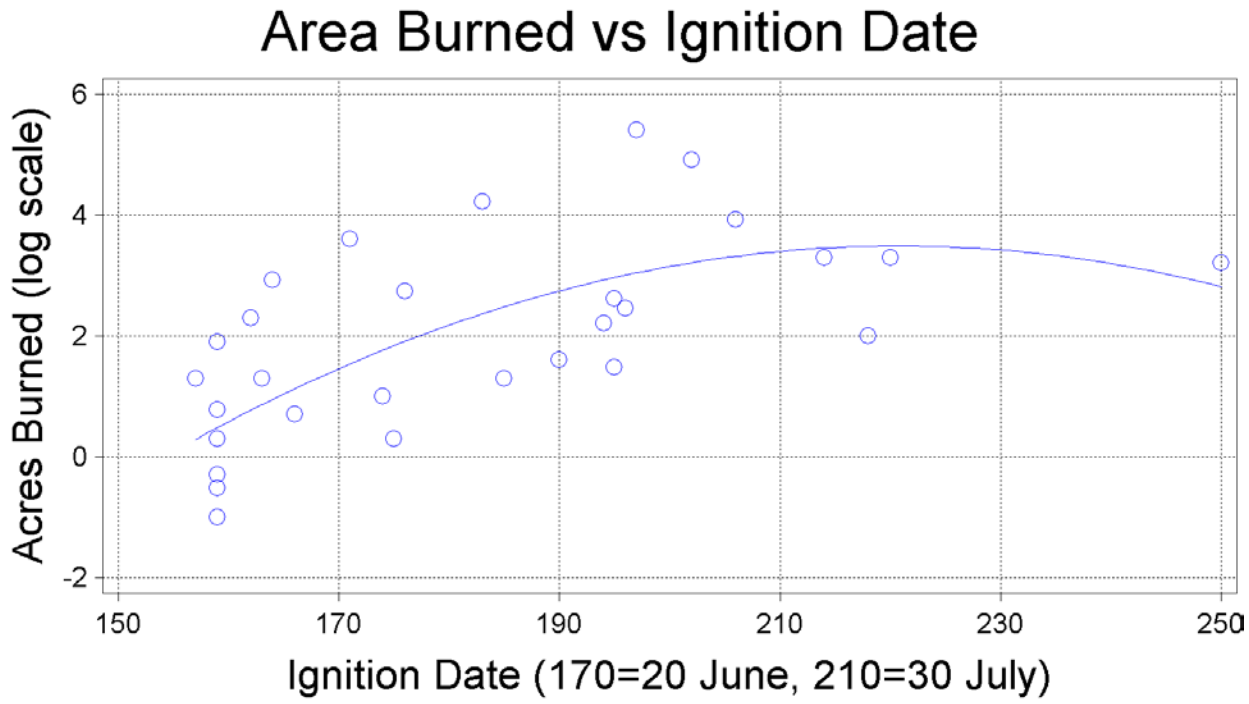
Percentage of lightning strikes vesus Julian date (170=20 June, 210=30 July).

Lightning is also much more likely in the foothills of the Brooks Range than it is out on the coastal plain. For this reason it is hard to say whether the factor limiting fire ignition potential is lightning, the receptivity of the plant communities, or the fuel moisture conditions.





Percentage of lightning strives versus latitude. Lightning strike potential is greatest in the foothills of the Brooks range and decreases exponentially north to the coastal plain.



Fire size (logarithmic) as a polynomial function of Julian date. Early fires tend to remain small and extinguish early. Mid-season fires have more potential to hold heat until favorable burning conditions allow them to grow large. Fire size declines for ignitions after ~9 August (Julian 220) probably due to decreasing day length and unfavorable weather conditions.

North Slope fires are generally of short duration, burning for only a single burn period. The tundra lacks large diameter fuels that hold heat through the night. Fires tend to burn through the flashy dead, accumulated sedge (tussock) foliage. High humidity at the end of the burn period limits further spread, unless heat can penetrate and hold in the duff. For this reason, later season fires have the potential to be larger and of longer duration as the moist duff dries and becomes potentially available to burn. Fires have the greatest potential to hold and spread during abnormally dry and warm weather in late summer as seen at the 2007 Anaktuvuk River fire. This fire was ignited on 16 July but major growth did not occur until 9-10 September during unusually warm, dry, and windy conditions. Frost curing may increase the loading of available grasses and sedges. Not much is known about the effects of fuel conditions on fire behavior because firefighters are seldom on the ground observing tundra fires.

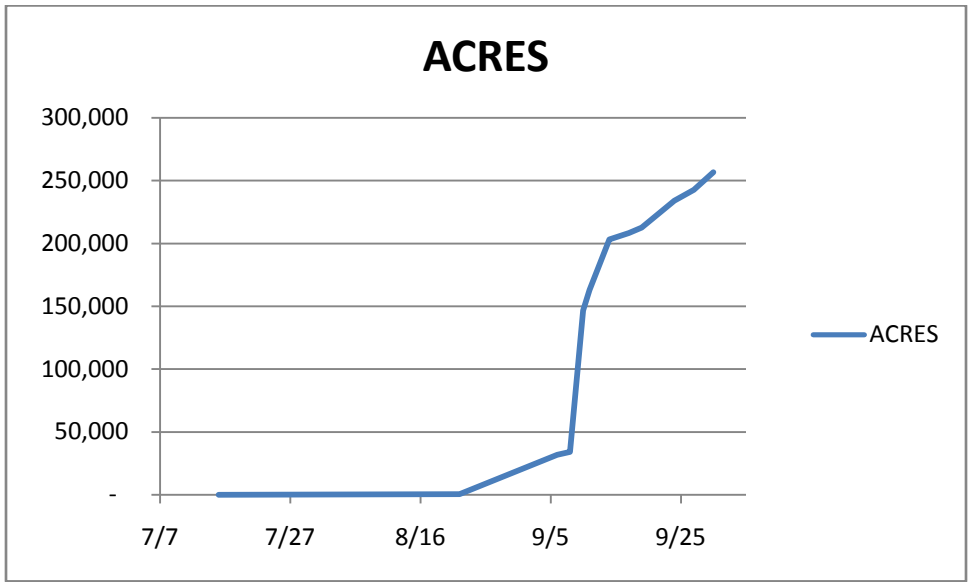
“Skirts” of dead, accumulated sedge foliage on tussock grass.

Tussock tundra: tussocks, dwarf birch, Labrador tea, and sphagnum moss.

Cross-section of a tussock.

Burned tussocks. The fire consumed the “skirts” of dead foliage but left the living parts of the tussocks unburned (and mostly unharmed).

Tussock tundra one year following the 2007 Anaktuvuk River Fire. Here the fire burned hot enough to consume the duff down to mineral soil under the tape. The majority of tussocks readily recovered.



Anaktuvuk River Fire acreage gain versus date. This fire ignited on 16 July but did not grow significantly until late August. Most growth occurred 9-10 September. Growth of tundra fires in late August and September is unusual.