Fire History of New York State, 1920-2010.

Working Paper

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Introduction

This note is an initial summary of key data on New York's twentieth century forest fire history. We reach back into history for several reasons. First, it is useful to see whether major fire years are synchronous across states or not, and if so to associate those with weather conditions to the extent we can. Second, the history can yield clues to important associations with weather that might not be evident from a short period of records. Analyzing this kind of information is subject to the usual caveats; especially for the older data, completeness and accuracy of coverage cannot always be assured. For example, it is easy to find in the literature widely differing estimates of the area for the same fire! Most importantly must take care in making casual extrapolations to the future. Ultimately we hope to analyze circumstances surrounding the very largest fires in the region, and hope to use the annual fire occurrence data to identify years when those occurred.

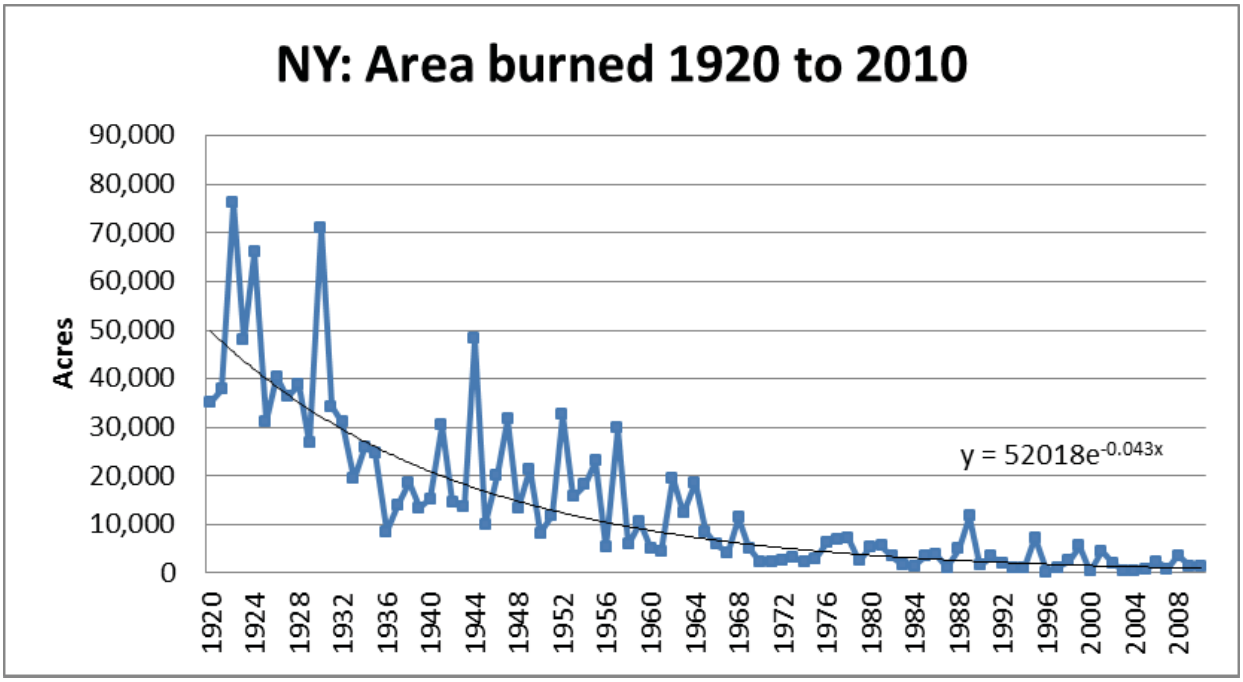
As a policy matter, the number of acres burned annually may not be a sensible way to discuss policy. A year is an arbitrary unit of time. Would it make more sense to think in terms of area burned per decade or even longer, given resource and property values involved? Also, in this research we are searching for general empirical regularities to the extent they can be observed, but our purpose is not to develop methods for prediction.

Our data source for forest fire history is records as supplied by the Fire protection division of NYSDEC, for 1903 to 2010. We received valuable assistance from the Forest History Society in filling in some of the older data. For certain details since 1984 we rely on standardized reports by the USFS.

Fire History

Other reports record high fire years early in the century, but our series here begins with 1920[1]. The volatility in fire occurrence is evident, but the overall trend describes a gradually descending curve to the present. Spikes in area burned in 1922, 1925, and 1930 gave new meaning to the phrase "Roaring Twenties". A wartime spike in 1944 was followed by a minor spike in 1947, concurrent with the regional outbreak of that year. Thereafter, area burned regularly spiked from almost 20,000 acres and higher until after the Great Drought of 1961-45, when the recent trend of very moderate fire activity set in.

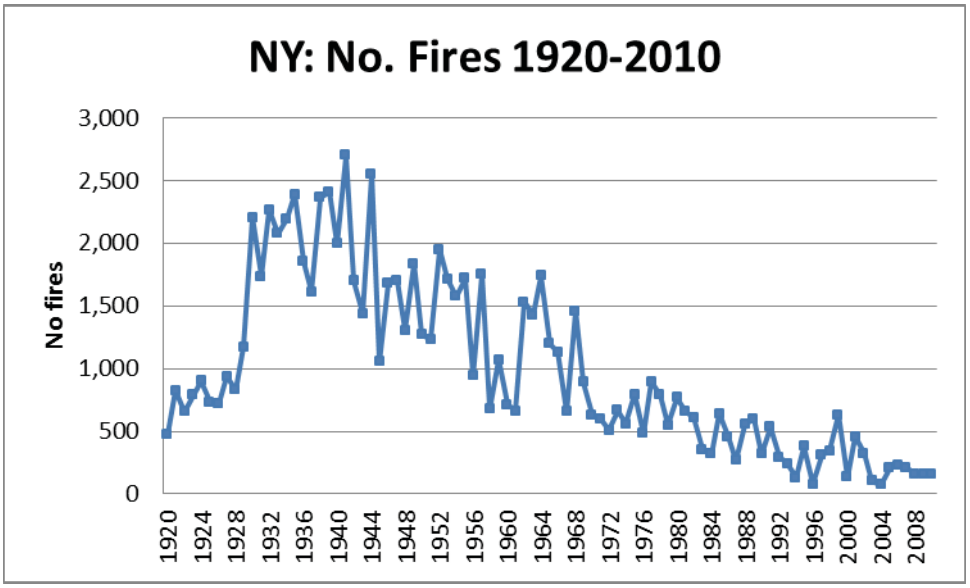
Fig. 1.



[1] May 24, 1903, New York Times, "Adirondack Forest fires burn over 1` million acres". A chronology issued by (Chilson n.d.) estimates the spring 1903 fires at 600,000 acres.

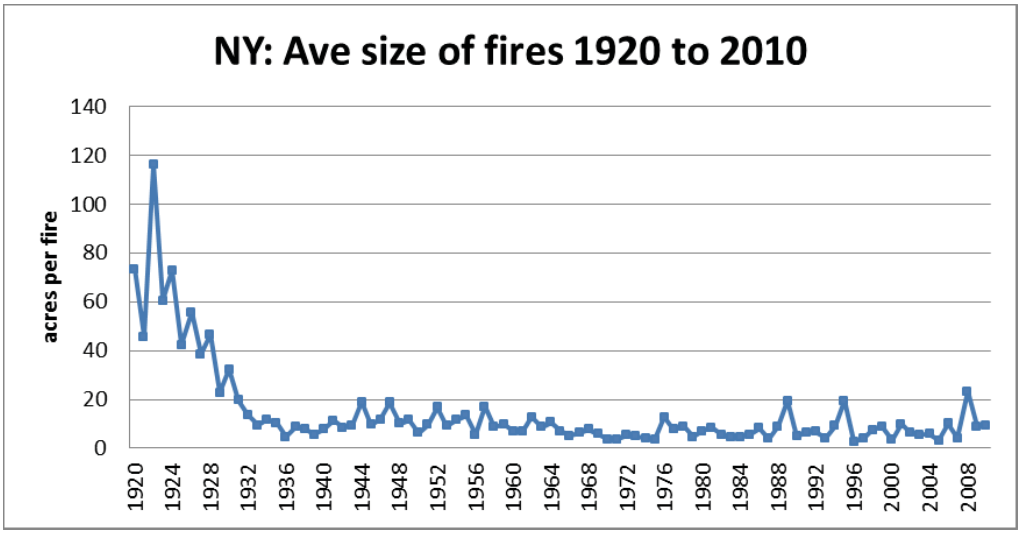
The number of fires reported does not match the smooth trend of area burned. Whether due to reporting changes or otherwise, reported fire numbers rose after the late 20s, before beginning a gradual but highly volatile decline after the rough year of 1944.

Fig 2.



Interestingly, average size of reported fires fell rapidly after 1923, so that by the mid 30's the average fire size remained at roughly the same level until the present. This suggests an early level of success in controlling fire sizes by the fire protection services.

Fig. 3.



Looking at decadal averages smooths out the picture (table 1). After the 60's affected by the Great Drought, area burned fell by more than half from the 80's to the 00's.

Table 1.

Table: New York Decadal Averages		
Year	Area Burned	No. Fires
	acres	
1911-1920	35176	479
1921-1930	47,234.9	979.4
1931-1940	20,524.7	2,091.1
1941-1950	21,149.0	1,724.8
1951-1960	15,823.3	1,336.8
1961-1970	9,233.9	1,133.7
1971-1980	4,171.5	662.1
1981-1990	3,891.7	479.2
1991-2000	2,497.6	307.5
2001-2010	1,793.1	208.4

Fires by season

New York has traditionally had a typical Northeastern bimodal fire season, but recently the fall has been more muted than in the past (Fig. 4). From 2000 to 2010, about half of the number of fires occurred in March, April and May. April has been far and away the peak month for number of fires per day (Fig 5).

Fig. 4

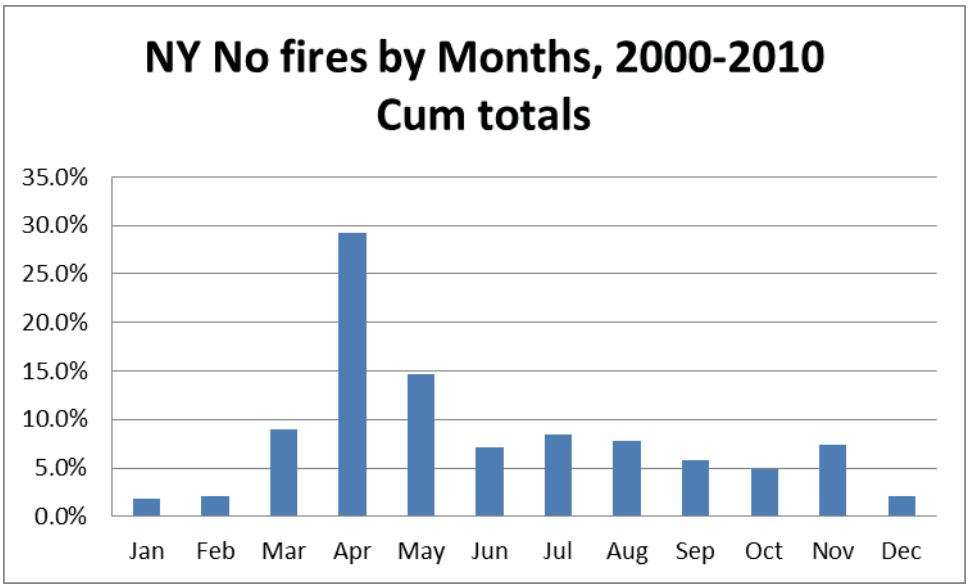
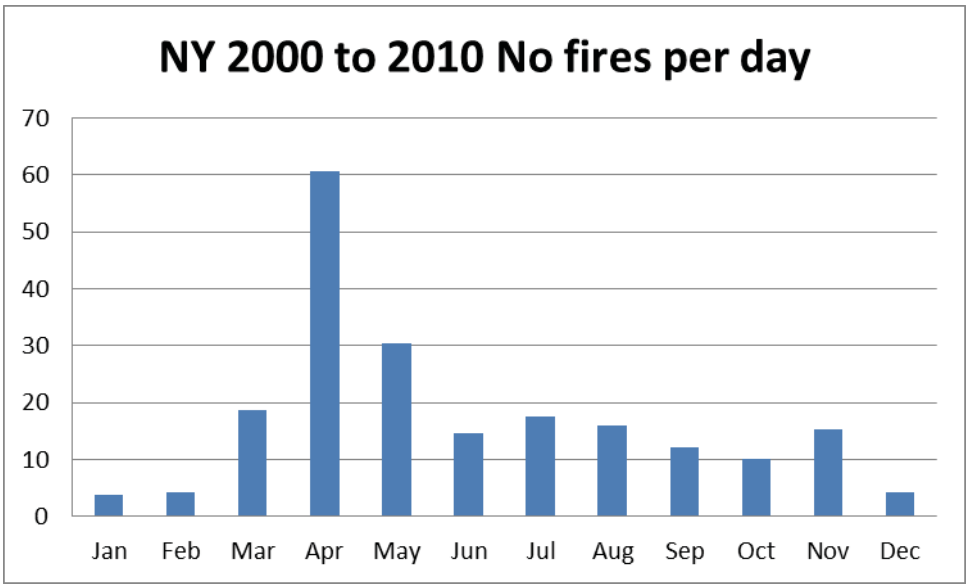

NY No fires by Months, 2000-2010
Cum totals
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

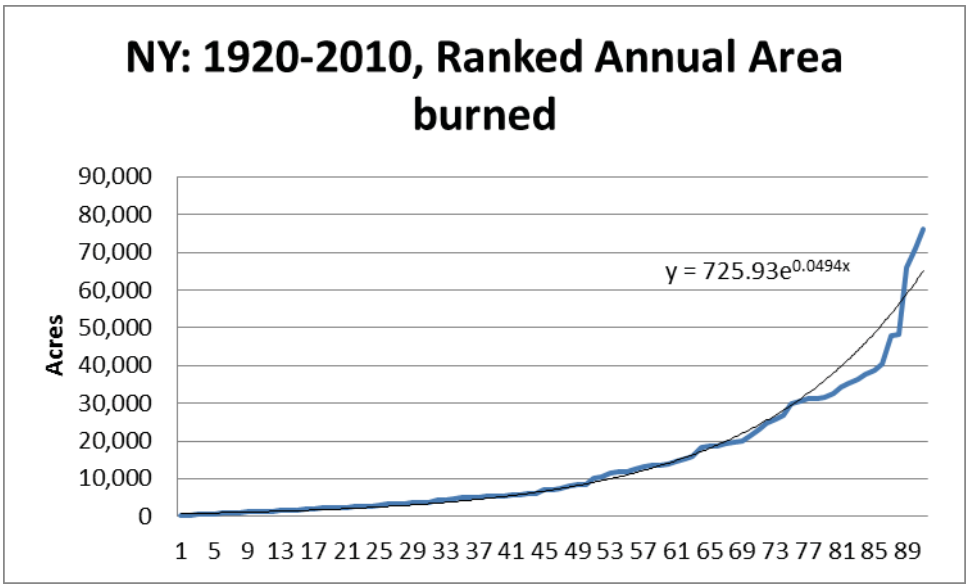
Fig 5.



Ranked Data and Return Periods

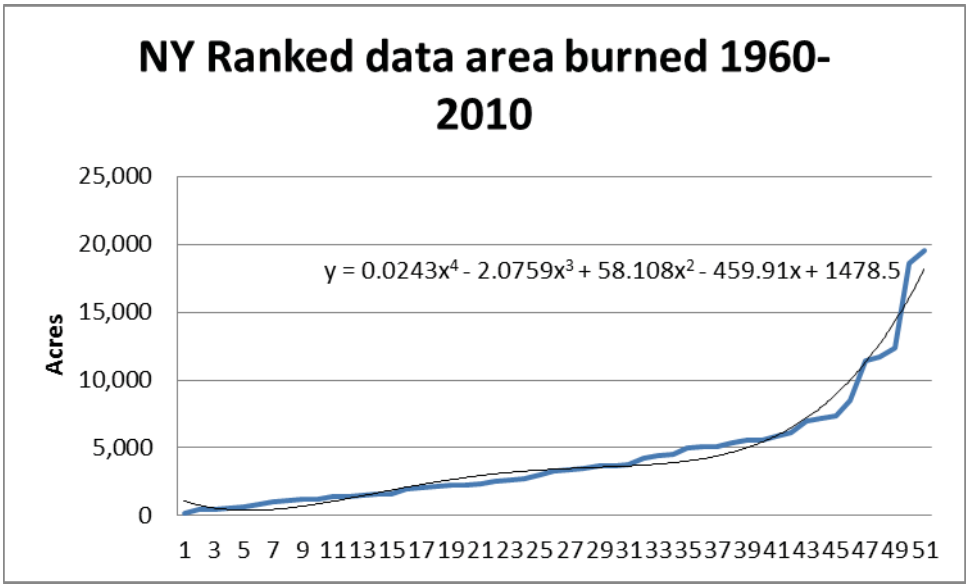
Using the annual data we can perform a simple extreme value analysis. This begins by simply ranking the years by area burned (Fig 6). When this is done, it is seen that the very highest years exceed their next lowest neighbors by large amounts. In contrast, most of the years move within a similar range. This is typical of northeastern fire year size distributions. Further, it is typical of major extreme weather Events like floods, tornadoes, and hurricanes as well. In such extreme weather situations, there is no reason why the next extreme event cannot be 10 or 20% more severe than the current record event.

Fig. 6.



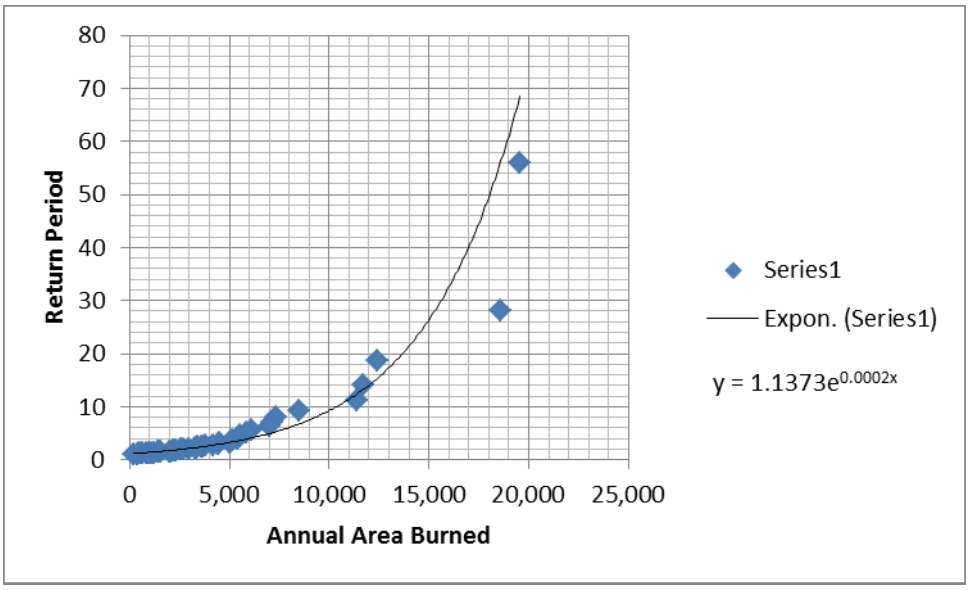
Given that forest conditions, ignition sources, fire control services, and weather were different in the past, we may feel more comfortable using a more recent period as a baseline. When we do this, we see that the shape of the chart does not really change – only the level does (Fig 7). This means that even in a lower fire environment such as we now have achieved, the potential for extreme events – relative to recent levels -- has not changed.

Fig. 7.



One way of addressing extreme value problems is by return period analysis, as is used to evaluate risks of extreme events such as hurricanes and floods. A return period analysis asks, "what is the magnitude of an event that would likely occur once in specified time interval?". For flood control works, we are accustomed to planning for and protecting against the "100-year flood". When this analysis is performed for annual area burned, the result is Figure. 8. This chart says that if we wish to plan for a 20-year return period, we should expect that sometime during that period one year will reach 13,000 acres of area burned. This is far higher than the average of the last 20 years area burned (see Table 1 above).

Figure 8. Return Period Analysis 1960-2010.



Large Fires

New York is one of the few states for which we have been able to obtain detailed data on large individual fires. This shows that despite the decline in overall area burned, fires larger than 2000 acres occur roughly once a decade (Fig 8). The leading cause of the large fires is arson, followed by campfires and smoking (Fig 9).

Fig. 8.

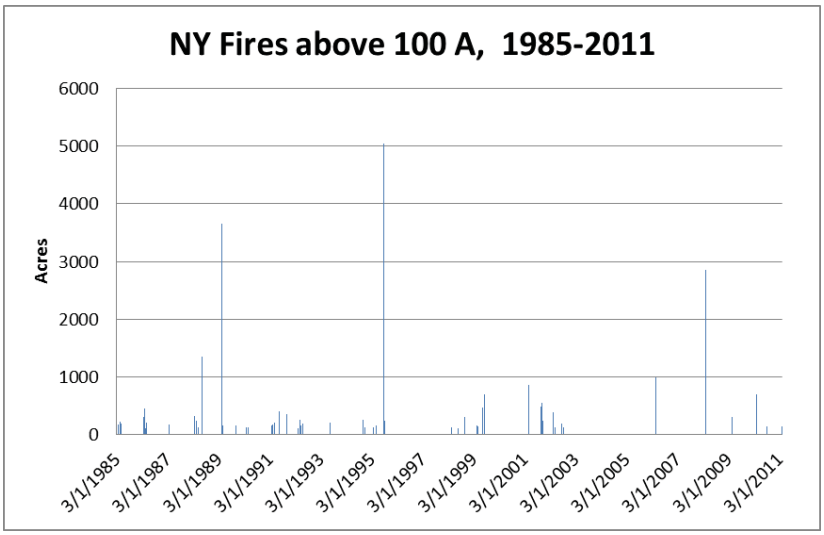
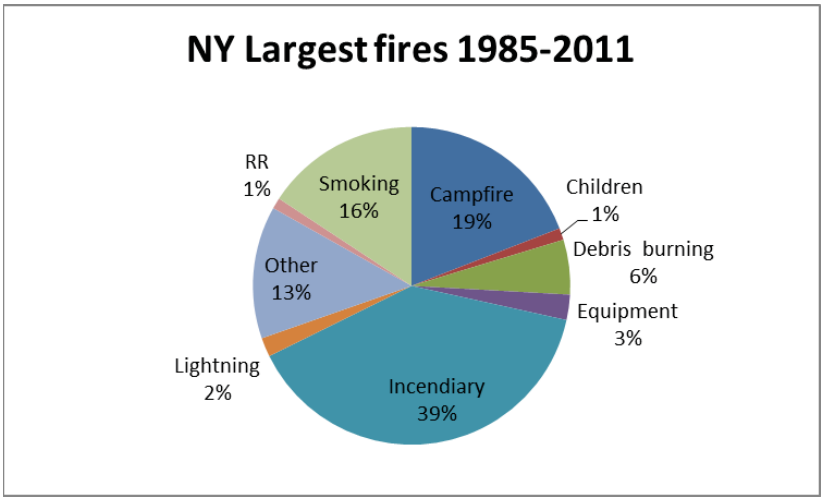
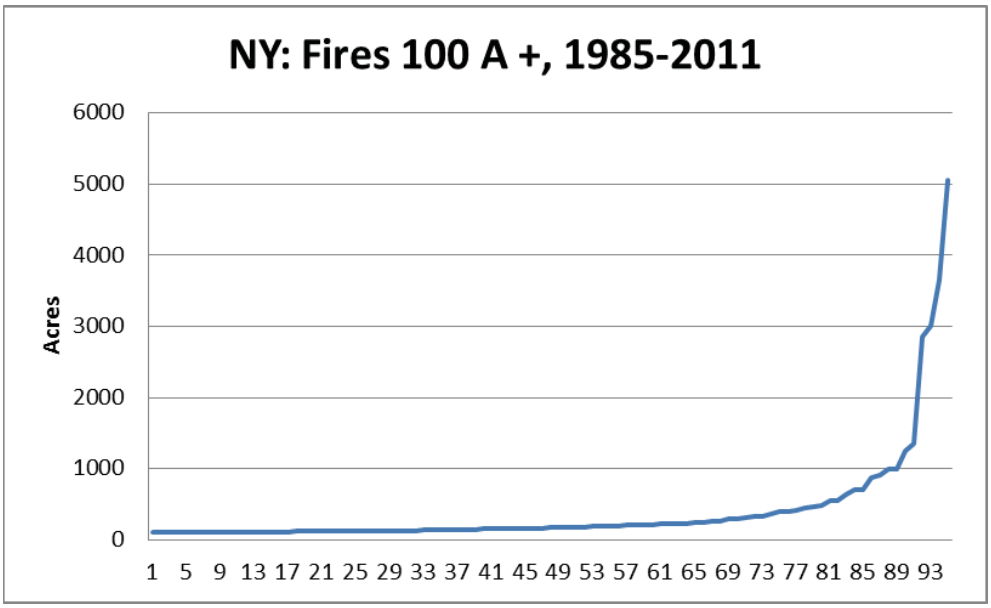


Fig. 9.



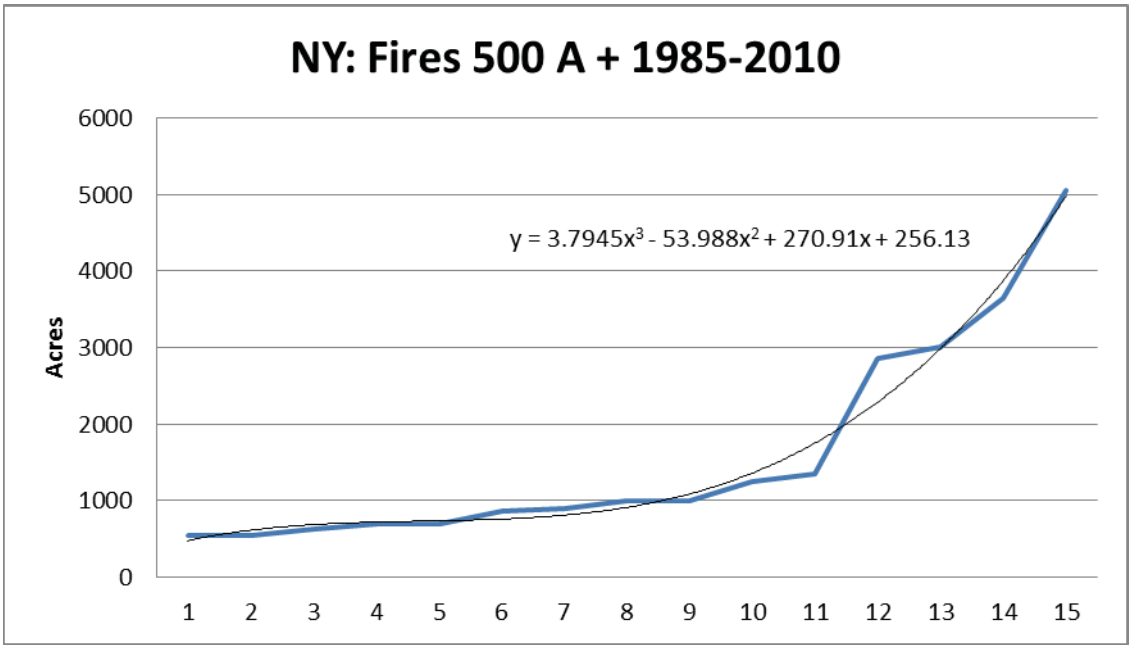
When we rank the the 95 fires larger than 100 acres since 1984, we see an extreme upslope that is even more extreme than the pattern for annual area burned (Fig. 10).

Fig. 10



Focusing in on the 15 largest of these, it takes a cubic expression to follow the upward curve for these fires (Fig. 11).

Fig. 11.


NY: Fires 500 A + 1985-2010
Acres
6000
5000
4000
3000
2000
1000
0
y = 3.7945x³ - 53.988x² + 270.91x + 256.13
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Detailed Analysis 1984-1020

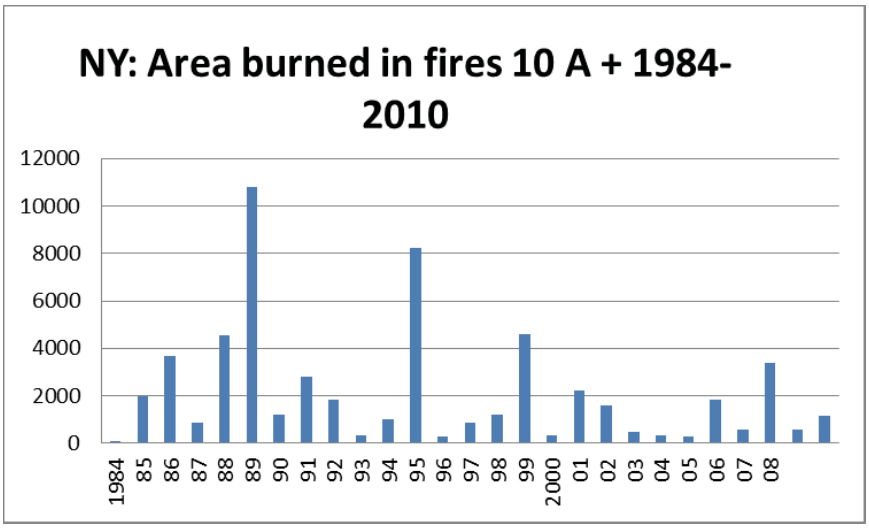
Here, we use annual compilations for more detailed data supplied by the USFS to study recent trends. Using the standard classification of fire sizes, over this period, a total of 894 patches of ten acres and larger were burned (Table 3) . This does not mean crown fires, but some influence by fire. The aggregate area affected by fire was 71,000 acres, of which 57,000, or 80%, was in patches larger than 10 acres.

Table 3.

NY					
NUM	Cum 1984				
	to 2010	PERCENT		In 27 seasons…	
Class A	2,584	29%		10 a & Larger	
Class B	5,505	61%			
Class C	806	9%		894	patches
Class D	65	1%			
Class E	16	0%			
Class F	6	0%			
Class G	1	0%			
TOTAL	8,983	100%			
ACRES					
Class A	333	0%			
Class B	13,697	19%			
Class C	21,037	30%		57187	acres
Class D	9,241	13%			
Class E	8,749	12%			
Class F	13,110	18%			
Class G	5,050	7%			
TOTAL	71,217	100%			

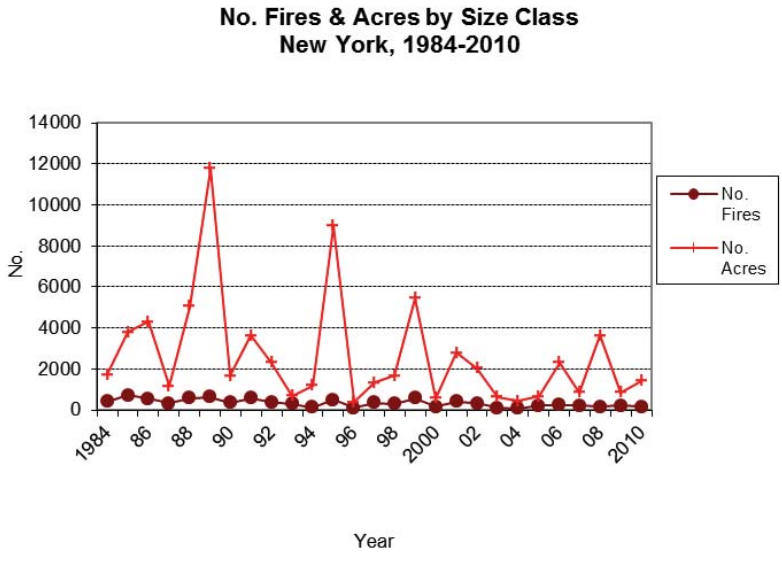
The extreme years for fire risk stand out when the 10 acre and larger fires are plotted for area burned (Fig 12).

Figure 12.



Total area burned and fire numbers for this period are reproduced for context in Fig. 13. According to the reported data, most of the variation in area burned seems to be due to differing fire sizes , not numbers of fires.

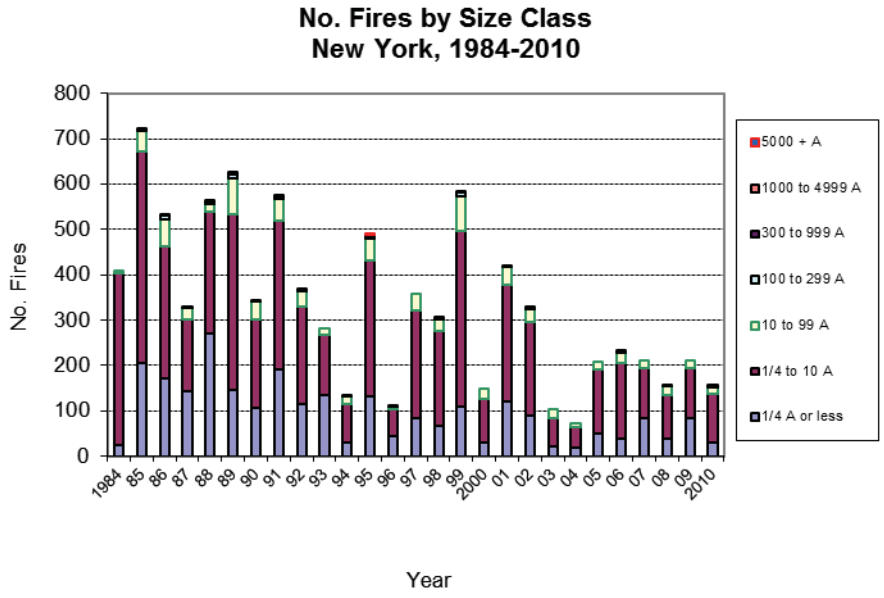
Figure 13:



The number of smallest fires continues to decrease, though in an irregular manner (Fig 14). Even in mild fire years, a few fires reach larger sizes. (do these reflect extreme wind or

fuel conditions, more remote locations, or something else?)

Figure 14.



Across all the annual variability in fires, one thing that seems striking in Figs 15 and 16 is that larger fires continue to account for the bulk of the area burned.

Figure 15

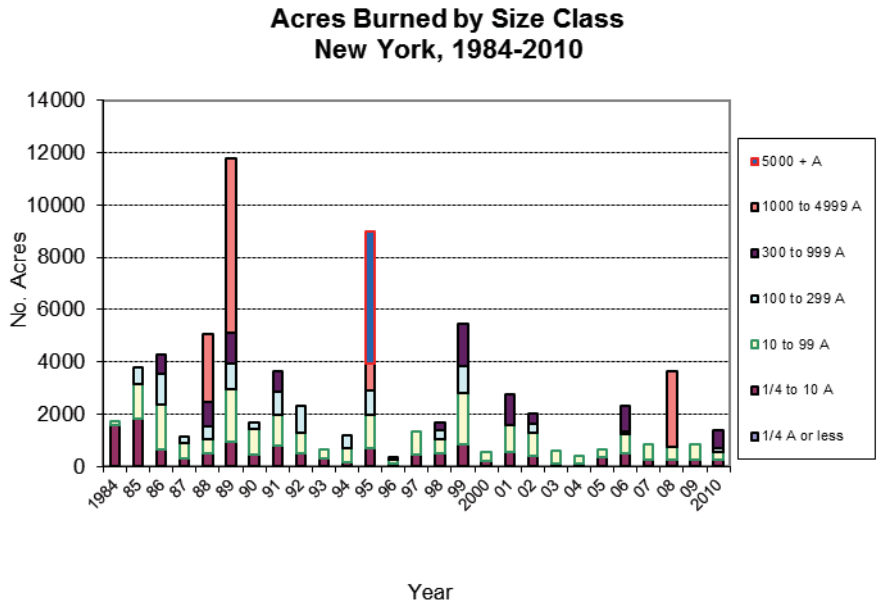
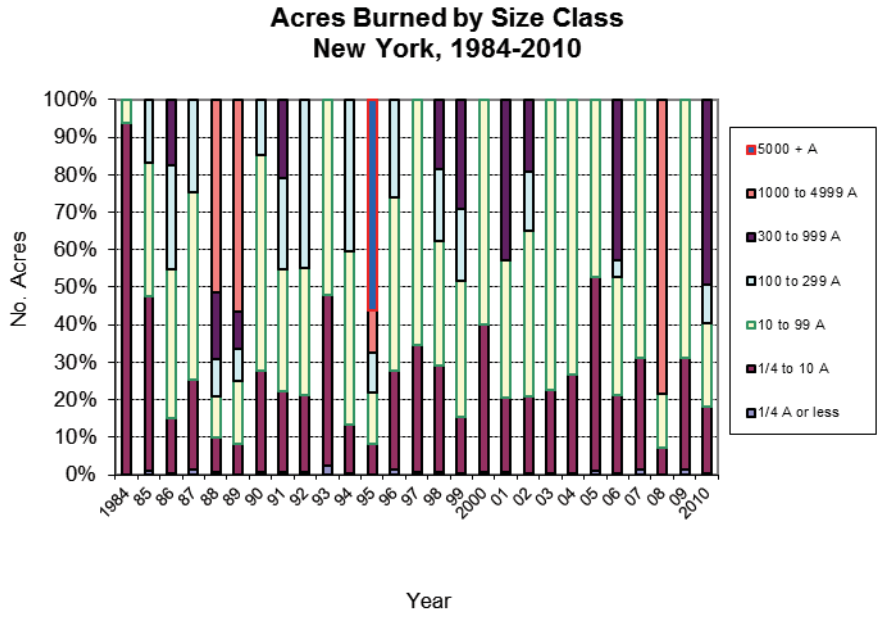


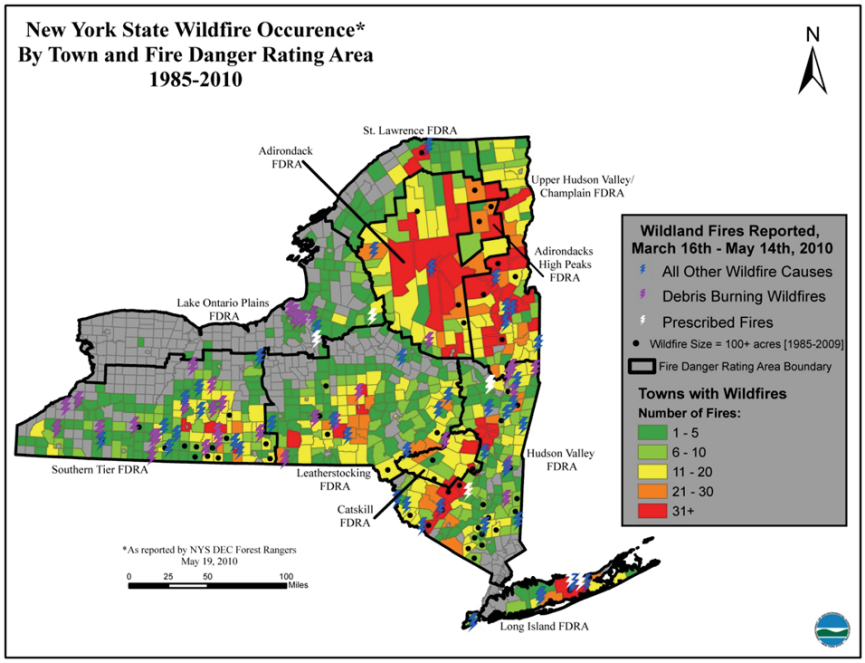
Figure 16

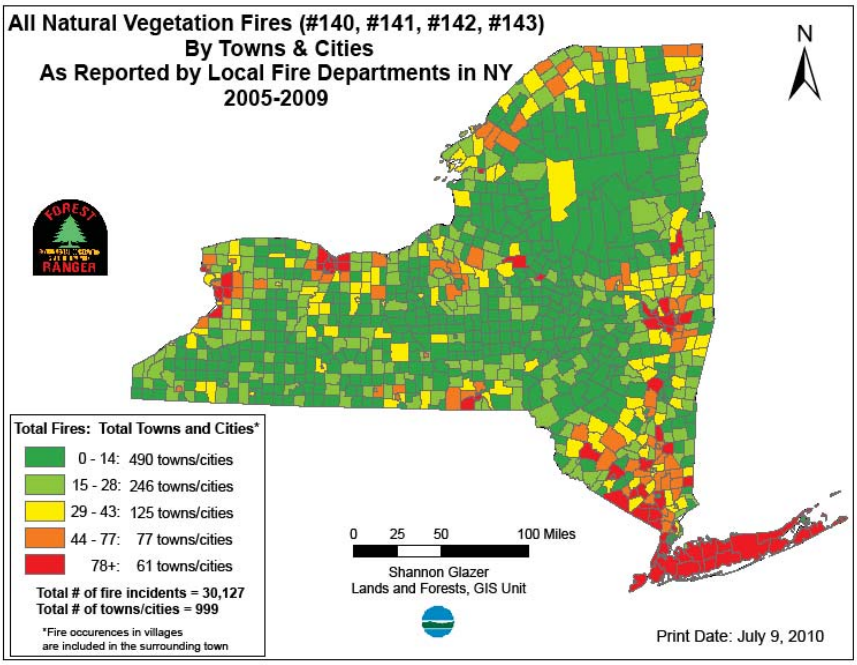


Fire Geography of New York State

The state's GIS provides maps showing recent fire distributions, both for ranger fires

and locally controlled fires. These vividly show the variability across the state in fire occurrences, and also indicate a significant concentration of fires in areas with fireprone ecosystems as well as high real estate values. (Figs 17 A & B)





Fire Occurrence and Weather

New York is a large and diverse state. NOAA identifies ten distinct climate zones for the State. For analyzing local phenomena such as forest fires, state averages are a weak measure. Without major resources for compiling geographically specific fire occurrence information, we will conduct this initial scan on a statewide basis.

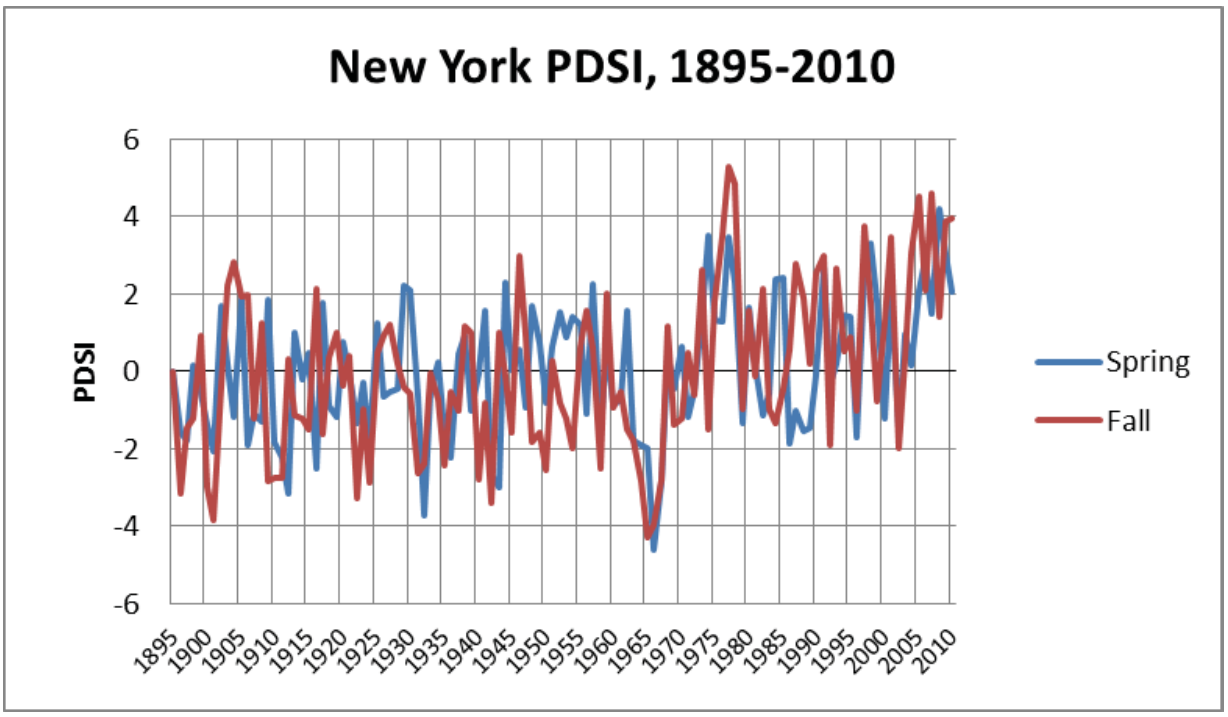
In summarizing statewide Palmer Drought Severity Index by decades for the period of record, we can see that from 1920 to 1970, there were frequent spring occurrences of drought index lower than minus 2, but none since then (Table 4). Further, since 1970, fall fire seasons have all been quite wet.

Table 4.

SUMMARY											
Apr May Jun	1901-1910	1911-1920	1921-1930	1931-1940	1941-1950	1951-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
lower than minus 2	1	2	0	2	2	0	2	0	0	0	0
minus 2 to zero	5	4	7	4	2	4	5	2	7	3	2
zero to plus 2	4	4	1	4	5	5	3	5	0	4	3
plus 2 or higher	0	0	2	0	1	1	0	3	3	3	5
Sep Oct											
lower than minus 2	3	0	3	3	2	1	4	0	0	0	0
minus 2 to zero	2	5	3	5	4	5	4	4	3	3	1
zero to plus 2	3	4	4	2	3	3	2	2	3	4	3
plus 2 or higher	2	1	0	0	1	1	0	4	4	3	6

Figure 18 shows the Great 1960's drought clearly. Since then, fire season weather conditions have been quite moist compared to pre-1960 decades. Should time and data permit, we may perform additional comparisons of weather variables and fire occurrences in more geographic detail. We have already done this for the 1947 fires, summarized in a separate paper.

Figure 18


New York PDSI, 1895-2010
PDSI
6
4
2
0
-2
-4
-6
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Spring
Fall

Tentative conclusions

1. Since the peak burning years of the "Roaring 20s", New York has steadily reduced annual area burned. This has been due to various causes, including strengthened protection services, changes in lumbering, changes in farming, and prevention programs.
2. Since the Great Sixties Drought, New York on average has seen a sustained period of unusually favorable weather during its fire seasons. Meteorologists expect a severe regional drought to be likely about once in half a century.
3. In terms of annual area burned, New York displays a typical pattern in which extreme values are usually significantly higher than the next lowest year. In practical terms this means that there is no reason why the highest fire year in recent decades (1990), could not see its 12,000 acre figure exceeded by 15 or 20%.
4. Based on annual data from 1960, a 20 year return interval for area burned would be about 13,000 acres.
5. Fires attributed to arson contribute a large share of the biggest fires.

References

Chilson, G. n.d. Adirondack Chronology. Pdf on Website.

www.protectadks.org

NYSDEC Fire data, various sources. Per Col. Andrew Jacob.

NYSDEC, Wildfire hazard profile 3.9 --excerpt from State Assmt?

USFS Fire Statistics

http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?