Observed Carbon and Biomass Trends Within the Long Term Tree Growth Plots of the Black Rock Forest

John A. Cannella
Pew Summer Fellowship 1998
Black Rock Forest, Cornwall, N.Y. USA

Introduction

During the early 1930's, a group of ambitious foresters at the Black Rock Forest in Cornwall, New York developed and initiated a long term forest growth study led by Henry H. Tryon. Driven by purely materialistic factors in the start, the research was aimed at understanding and implementing a successful forest thinning strategy in order to maximize merchantable tree stocking. At ten sites within the forest, Tryon established long term plots through "...the accepted lines of laying out, marking, witnessing, numbering, measuring, recording and photographing" (Tryon, 1939).

At each of the ten sites, two plots of comparable characteristics and equal area (either 0.10 or 0.25 acre) were established. One plot was manipulated and thinned, while the other plot was left untouched as a control. At some point between 1930 and 1998, six of the original ten sites and their respective plots have been manipulated in some way or another. Therefore, the four untouched sites and respective plots are examined herein. Those four sites and eight plots are named Arthur's Brook (plot 4a1, plot 4a1c), White Oak Trail (plot 4a2, plot 4a2c), Mount Misery (plot 5a4, plot 5a4c), and Bog Meadow (plot 9c1, plot 9c1c).

During the latter era of this long term tree growth research, the focus has shifted from merchantable tree stocking towards biomass trends and carbon sequestration. From the robust data sets on record since the beginning of this research, researchers have the opportunity to look at the past and make inferences into the future trends of the Black Rock Forest. In this report, I briefly describe the patterns of carbon storage and accumulation on and between all long term sites, as well as the species diversity and dynamics of one of the four remaining long term sites.

RESULTS

According to the long term data, the forest is indeed storing carbon, and doing so in a linear fashion. Table 1 and Figure 1 display the amounts of carbon (in grams) stored within the four long term sites and their corresponding experimental and control plots. Blank spaces within the table denote years in which a plot was not visited nor measured. Taking into account the two sizes of plots, the values of carbon used in both the table and graph have been converted to carbon per hectare.

As apparent in the table, the 1998 Arthur's Brook control plot (4a1) has the largest amount of carbon stored with an estimated 10,321,832 g/carbon/ha. The 1998 Arthur's Brook thinned plot (4a1c) is a close second in respect to total carbon storage with a value of 8,523,459 g/carbon/ha. In comparison, the 1998 White Oak Trail plots have the lowest amounts of carbon stored; the thinned plot (4a2) having 3,888,918 g/carbon/ha, and the control plot (4a2c) having only 2,941,523 g/carbon/ha. The total amounts of carbon stored within these plots in 1998 is partly a function of the amounts of carbon stored within them in 1931. Thus, it is not surprising that since Arthur's Brook had a large amount of carbon stored in the beginning of the study, it also had the largest amount of total carbon stored within it in 1998.

There is a marked difference between total carbon stored within the plots compared to the amounts of carbon stored between 1936 and 1998 (Figure 2). During this time period the Bog Meadow control plot (9c1c) sequestered almost 5.3 million grams of carbon. Arthur's Brook thinned plot (4a1) also stored a massive amount of carbon, 4.9 million grams of carbon. Carbon storage was the lowest at the White Oak Trail site where the thinned plot (4a2) and control plot (4a2c) sequestered 2.1 and 1.6 million grams of carbon.

Average annual carbon sequestered is presented in Figure 3, shows trends similar to Figure 2, as one would expect. The Bog Meadow site and Arthur's Brook site both have the highest averages of annual carbon storage nearly 80,000 g/ha/yr. Mount Misery plots are both intermediate at approximately 53,000 g/ha/yr, and the White Oak Trail plots have the lowest average annual storage of carbon just under 30,000 g/ha/year.

Figure 4 exhibits the rate of carbon storage during the 1936-1998 time interval expressed as a percentage of original carbon content. The Mount Misery thinned plot (5a4) has been storing carbon at the highest rate between all sites at nearly 350%. The Mount Misery control plot (5a4c) is also storing carbon at a fast pace, at an estimated 240%. The slowest rate of carbon storage is seen in the Arthur's Brook plots, specifically the control plot (4a1c) which has a carbon storage rate of 60%.

The entire raw data set and associated metadata are included as an appendix.

LITERATURE CITED

Tryon, H. H. 1939. Ten Year Progress Report 1928-1938. Bulletin No. 10. The Black Rock Forest, Cornwall-On-The-Hudson, New York, p. 65.

TABLE 1. Kilograms of carbon sequestered in tree biomass per hectare on each of the eight plots.

Year	4a1	4a1c	4a2	4a2c	5a4	5a4c	9c1	9c1c
1931	2968	5720	1721	1425	618	1017		
1936	3591	6466	1803	1375	1042	1247	2785	2331
1941	4101	7072	2110	1619			3676	3086
1942					1161	1484		
1946	4687	7535	2373	1771			4270	3715
1947					1649	1814		
1954	5042	8084	2659	1981	2094	2056	4604	4136
1961	5913	8900	2839	2283	2757	2552		
1964							5887	5068
1965	5707	9138	2994	2367	2982	2637		
1972							5950	4907
1973	6268	9237	3022	2539	3376	2866		
1976							6193	5550
1978			3317	2609				
1979	6873	9271			3902	3238		
1981							6867	6176
1983			3274	2555				
1984	7035	9008			3652	3529		
1986							6030	6362
1988			3520	2643				
1989	7428	9560			3860	3711		
1992	7810	9706					6643	6902
1994	7944	9915	3795	2753	4325	3933	7095	7250
1995	8036	9965	3858	2813	4402	4030	7274	7251
1996	8101	10159	3941	2885	4498	4146	7525	7439
1997	8340	10156	3804	2919	4567	4188	7569	7504
1998	8523	10322	3889	2942	4653	4205	7672	7628

FIGURE 1

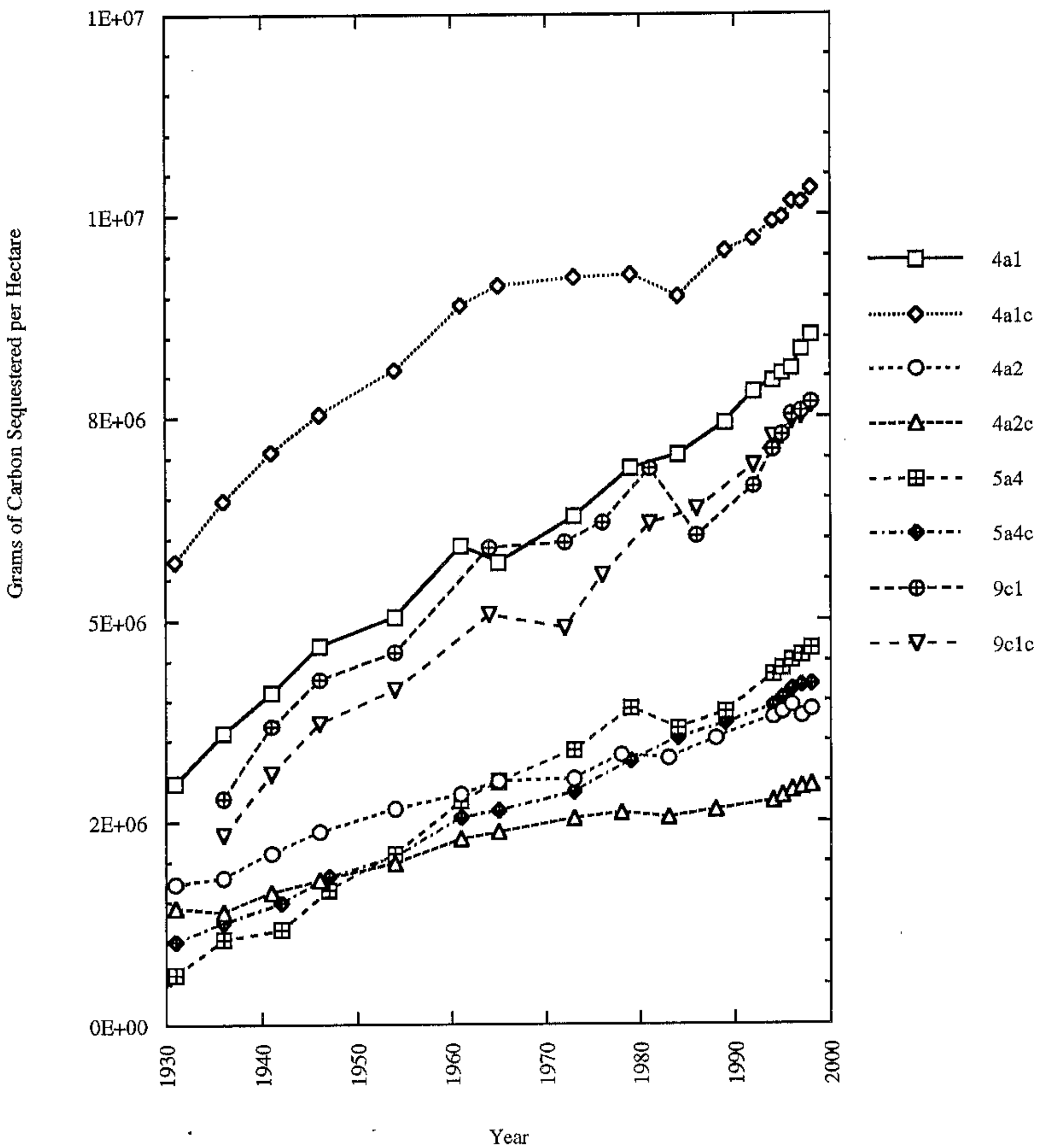

1E+07
1E+07
8E+06
5E+06
2E+06
0E+00
Grams of Carbon Sequestered per Hectare
1930
1940
1950
1960
1970
1980
1990
2000
Year
4a1
4a1c
4a2
4a2c
5a4
5a4c
9c1
9c1c

FIGURE 2

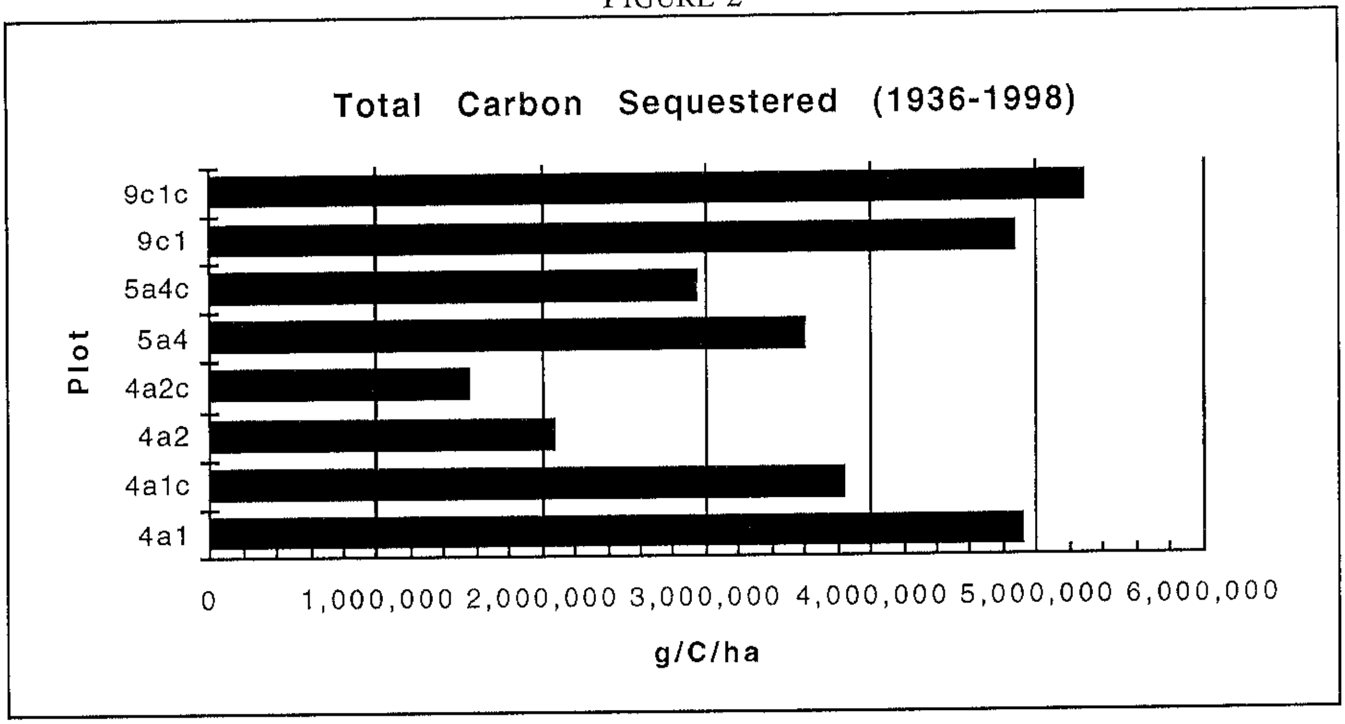


FIGURE 3

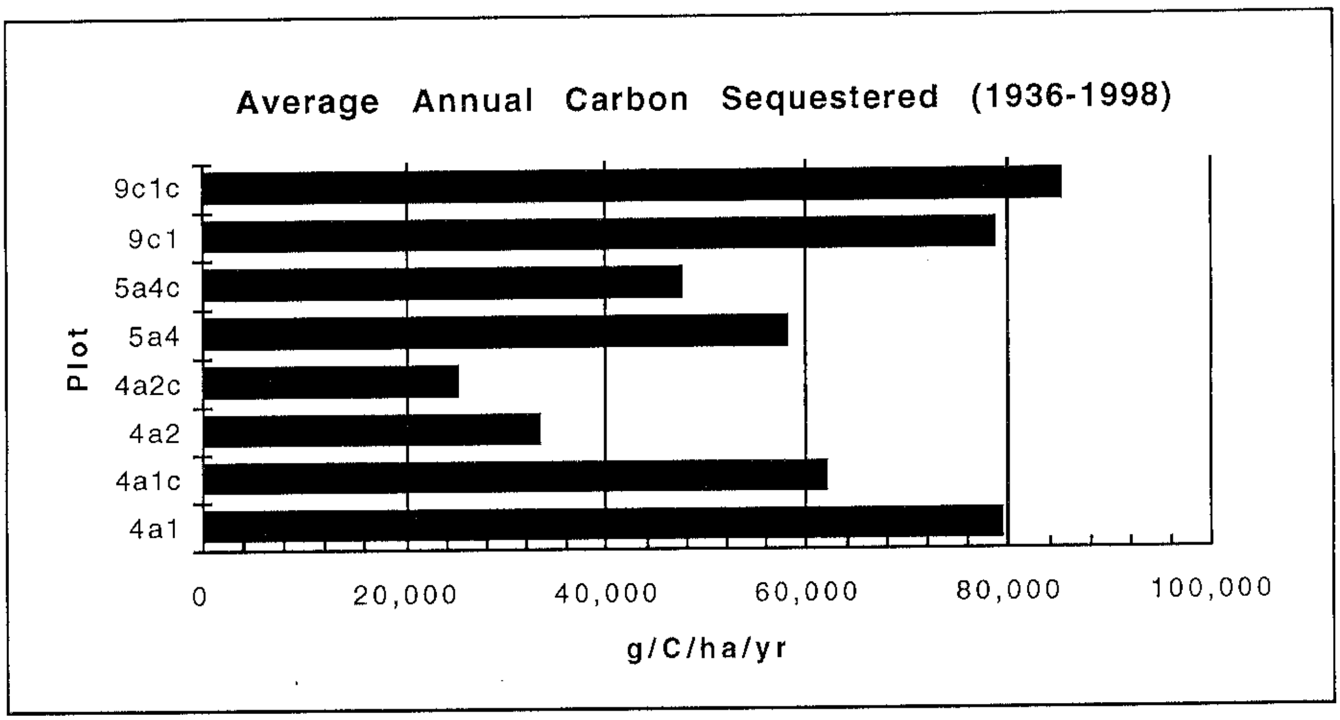
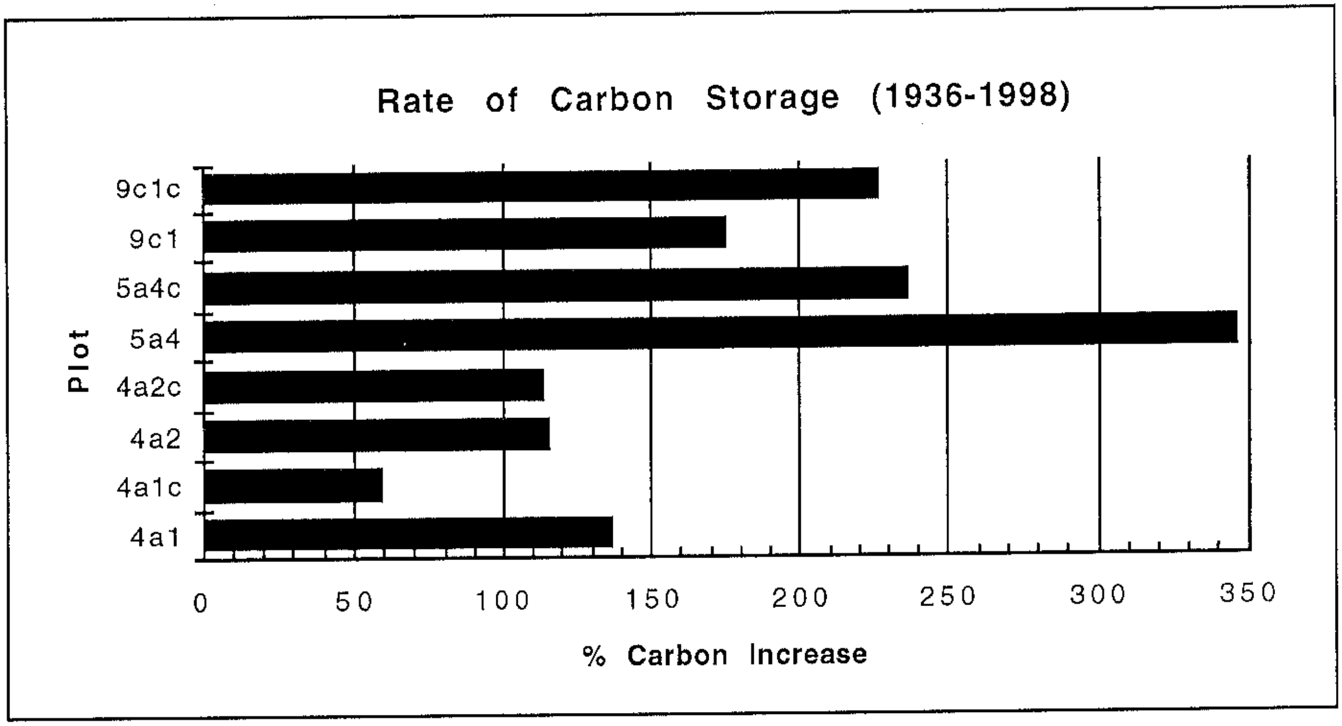


FIGURE 4


Rate of Carbon Storage (1936-1998)
Plot
9c1c
9c1
5a4c
5a4
4a2c
4a2
4a1c
4a1
0
50
100
150
200
250
300
350
% Carbon Increase