Greater Alpine FSC Chipping Projects:
Pile Volume Distribution and Chipping Efficiency

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Executive Summary

From the new data collected during its last two Chipper Days, the Greater Alpine Fire Safe Council has calculated (1) the histogram for the frequency of piles of a given size, (2) the total volume of piles of a given size, and (3) the chipping efficiency for equally spaced piles of a given size. Piles of less than about 300 cu ft are much more frequent than larger piles although the total volume of piles with volumes below about 600 cu ft is fairly constant. However, because of the time spent driving between equally spaced piles, the chipping efficiency decreases from near 100% for piles over 1200 cu ft to 80% for the most frequent 200 cu ft piles in this study. Since homeowners cut and stack brush at 44 cu ft per hr, they should spend at least16 hours producing their piles so that maximum chipping efficiency can be approached during Chipper Days.

Introduction

The Greater Alpine Fire Safe Council, a 501 (c) 3 corporation, was founded in 2006 to implement the Alpine Community Wildfire Protection Plan. A key part of this plan is to help homeowners in especially fire-prone areas to create defensible space around their homes by providing them with a free chipping service. Homeowners must clear all flammable brush, especially chamise and buckwheat, within 100ft of their homes and stack it in orderly piles. The Greater Alpine FSC chips these piles using grants from the federal government and insurance companies and each quarter reports on the volume of brush chipped and acreage cleared.

In an earlier study[1], the Greater Alpine Fire Safe Council has developed methods for (1) calculating the volume of brush cut by homeowners; (2) estimating the area cleared around their homes; (3) estimating the time homeowners spent cutting the brush; and (4) estimating the productivity of the crews. In this study, we calculate (1) the histogram for the frequency of piles of a given size, (2) the total volume of piles of a given size, and (3) the chipping efficiency for equally spaced piles of a given size using new data collected from chipping programs carried out in five different locations in Alpine, California. We hope that our results will prove useful to other Fire Safe Councils for maximizing the efficiency of their own chipping programs.

Analysis

We used the methodology described in our earlier study[1] to first measure the dimensions of the 72 piles then calculate their volumes. Figure 1 is the histogram for the frequency of piles of a given size. Interestingly, the frequency decreases monotonically as the volume increases rather than being normally distributed as might have been expected.

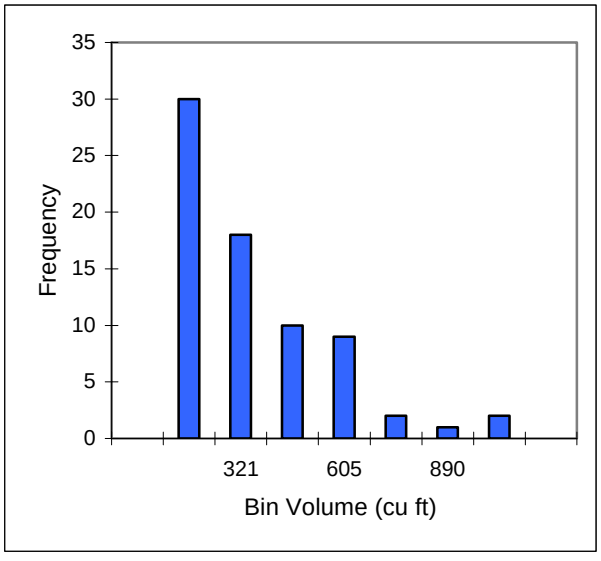

Figure 1: The frequency of piles of a given size

[1] Greater Alpine FSC Chipping Projects: Methodology and Analysis

While piles with volumes below 200 cu ft are substantially more frequent than bigger piles, Figure 2 shows that the total volume included in this bin is less than in the next three higher bins though the total volume in a bin drops dramatically when the pile volume is over 700 cu ft.

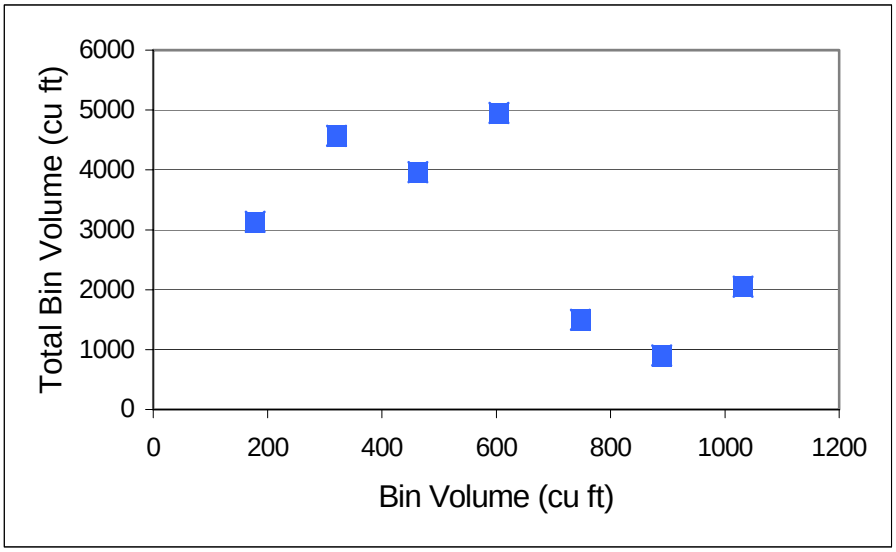

Figure 2: Total pile volume versus pile size

These results immediately suggest that the chipping strategy employed during a Chipping Day could have a substantial impact on the chipping efficiency achieved because of the time spent driving between piles. With the parameters described in the accompanying Table, we can write:

$E = E_0 / (1 + rdN / vV)$

We get a good approximation to the average separation between piles from:

$d = (A/N)^{0.5}$

so that

$E = E_0 / (1 + r (AN)^{0.5} / vV)$

Definitions

N Total number of piles
d Average separation between piles
A Area targeted for chipping
V Average bin volume
v Average speed driving between piles
r Chipping rate
E Chipping efficiency
E_0 Maximum chipping efficiency

Using the results from our earlier study[1] or parameters that characterize this latest Chipper Day, we have that $E_0 = 100$ %; r = 0.2 cu ft per sec; v = 20 ft per sec; A = 16 sq miles; and N = 72 and thus we get the results shown in Figure 3.

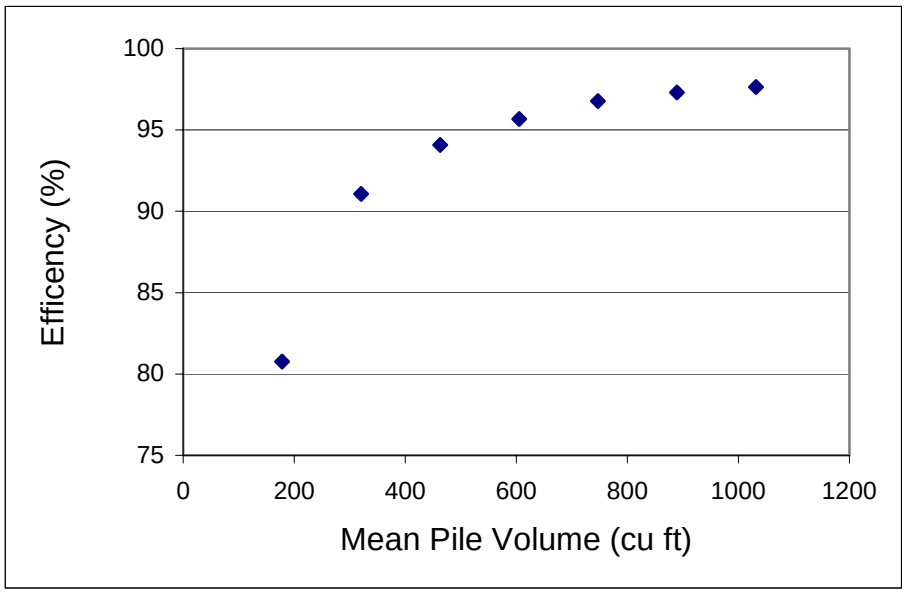

Figure 3: Efficiency versus mean pile volume

As expected the chipping efficiency falls rapidly when the pile volumes decrease and reaches 80% of maximum efficiency for our most frequent 200 cu ft piles.

Conclusions

In future Chipper Days, it will be highly advantageous to encourage homeowners to do more work, both for their own protection, and to make best use of government funding. Previously, we found that homeowners cut and stack brush at 44 cu ft per hour. Thus a homeowner needs16 hours of work to produce a 700 cu ft pile, the size at which our chipping efficiency approaches the maximum level. So homeowners should spend a weekend in the garden as essential preparation!

Another approach would be for homeowners to bring their brush to a central site where the chipping would occur. This would certainly maximize our chipping efficiency at the expense of potentially losing those homeowners who would not jump the additional hurdle required to take part in the program. We will analyze pros and cons of this second approach in a future paper.