MODIFIED 5TH YEAR SURVEYS USING DRONE IMAGERY

The process we are presenting differs from fixed area plots that are traditionally done on 5th year surveys. Normally a forester will place a grid of fixed radius plots across a unit. Each plot will be visited and the trees tallied by species and height (dbh is not important at this age) that occur within each plot. This requires the forest technician to traverse the entire unit determining in and out trees as well as recording species and height. The result is a tabular set of data that can be compiled to generate stand level information like trees per acre by species and height.

We propose flying the entire unit with a drone to generate an orthophoto with approximately 1” resolution. Advanced machine learning algorithms are then used against that imagery to produce a stem shapefile for all trees across the unit. As a quality check we randomly select 20 quarter acre cells and compare the automated tree count against what we can see on the image for each cell. Any difference is calculated as an adjustment factor and the trees per acre are adjusted accordingly. For example, if across 20 quarter acre cells there are a total of 1,600 trees counted by the algorithm and we find an additional 50 trees that were missed, then an adjustment of (1600+50)/(1600) = 1.03 is applied. A quarter acre grid is then superimposed on the shapefile in ArcMap to produce a fishnet map where each quarter acre cell can be classified by the trees per acre calculation inside each cell. Tree species and heights are gathered in the field by a forest tech using transects as opposed to plots. The process involves walking along transect lines while recording species and heights of trees very close to the line of travel. Since this traverse will not be used to calculate trees per acre it is not critical exactly how close each tree is to the transect line. This is a very efficient way to collect a lot of species and height pairs since data can be collected continuously, as opposed to only when on a plot. It is then easy to calculate the percentage of trees by species and height for a given unit based on the sample of trees collected. We multiply those percentages against the trees per acre generated from the stem map (adjusted for the quality check) to generate trees per acre by species and height. This information can then be fed into an inventory system and reported upon. The result is not only tabular data but a detailed map of the unit that shows every tree as well as color coding by trees per acre on a quarter acre basis.

Advantages of this new process:

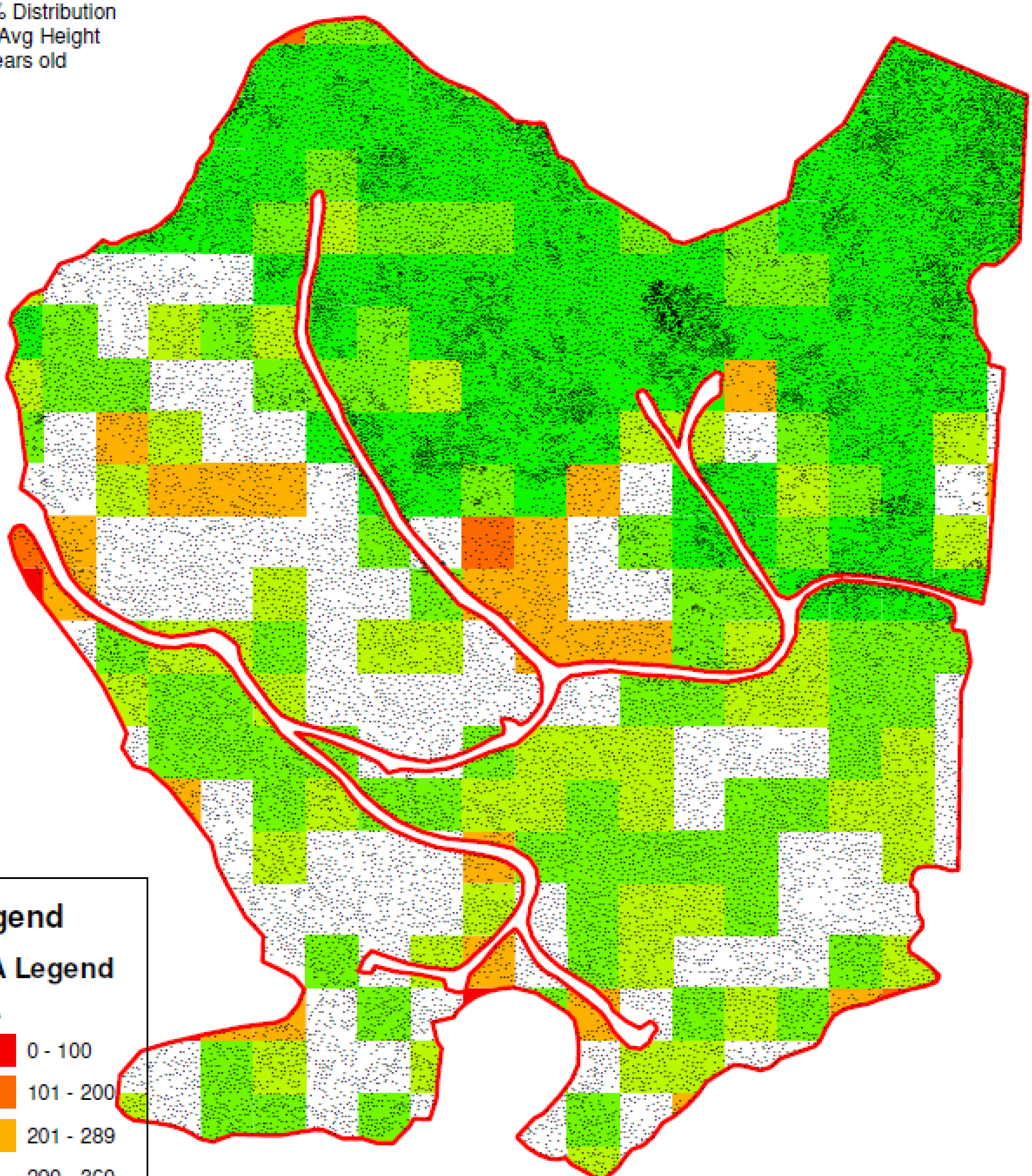
1. Productivity – It is much quicker to fly a drone and walk transects than it is to traverse a unit and put in plots. A forest tech could do 3-4 times as many unit acres in a day walking transects as opposed to doing plots.
2. Results – The 100% stem map is an extremely valuable addition that you can’t get with a traditional survey, and has actually never been possible before. It can be used to help the forester determine potential PCT areas in a stand as well as identify low stocked problem areas. The fishnet grid can be saved as a layer in the GIS so it is very accessible and easy to share with others. The orthophoto can be saved in the GIS as well and used to zoom in on overstocked or understocked areas.

Map Examples

I have included a few example maps we made for a client. In this case, the client identified their target TPA for 5th year surveys to be 290-360 trees per acre. Quarter acre cells that matched that range were given a white background, meaning all is well. Understocked areas are in shades of red and overstocked in shades of green. The actual stem mapped trees are symbolized as tiny black dots. This is useful to see how the trees are scattered across each quarter acre grid cell. Because the entire unit is surveyed (not just where fixed area plots happen to land) it is possible to generate a “% Distribution” statistic that is shown on the map. It is calculated by taking the coefficient of variation (CV) between all of the quarter acre cells, then subtracted from 100%. The CV is a measurement of variability from cell to cell in the grid. So, for example, if all cells had exactly 300 trees per acre (i.e. the trees are all spaced exactly the same), the CV would be 0%, so the distribution would be 100% (100-0). That is the highest possible score. The more varied the stocking level is between grid cells the lower the distribution score. The goal of the forester is to achieve the desired trees per acre with as uniform spacing as possible. This is just one example of the type of calculations that can be made with this kind of data.

Sample Unit 1

72 Acres
483 TPA
57% Distribution
8.9 Avg Height
5 years old



Legend

TPA Legend

TPA

- 0 - 100
- 101 - 200
- 201 - 289
- 290 - 360
- 361 - 400
- 401 - 500
- 501 - 9999

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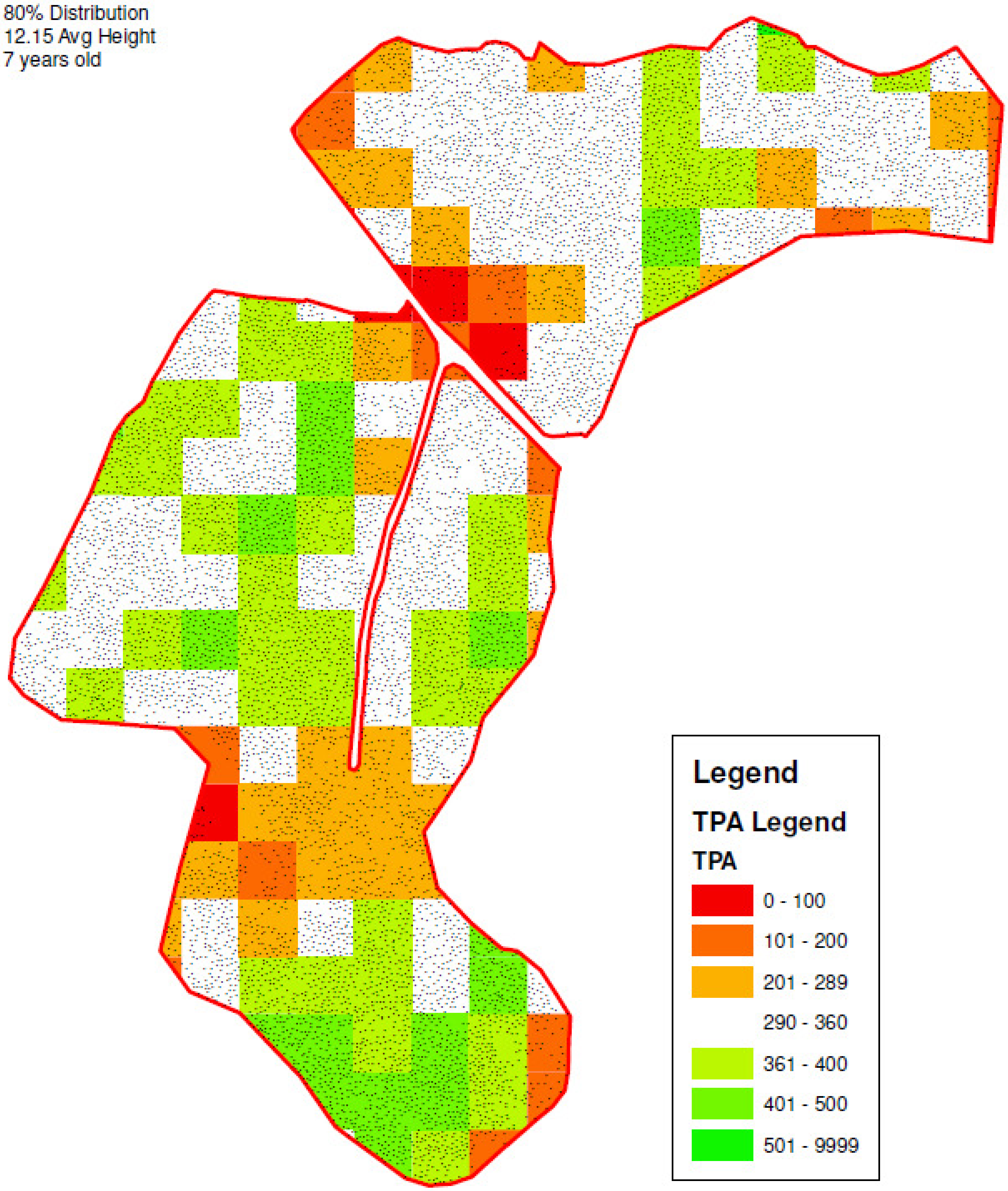
Sample Unit 2

35 Acres
322 TPA
80% Distribution
12.15 Avg Height
7 years old



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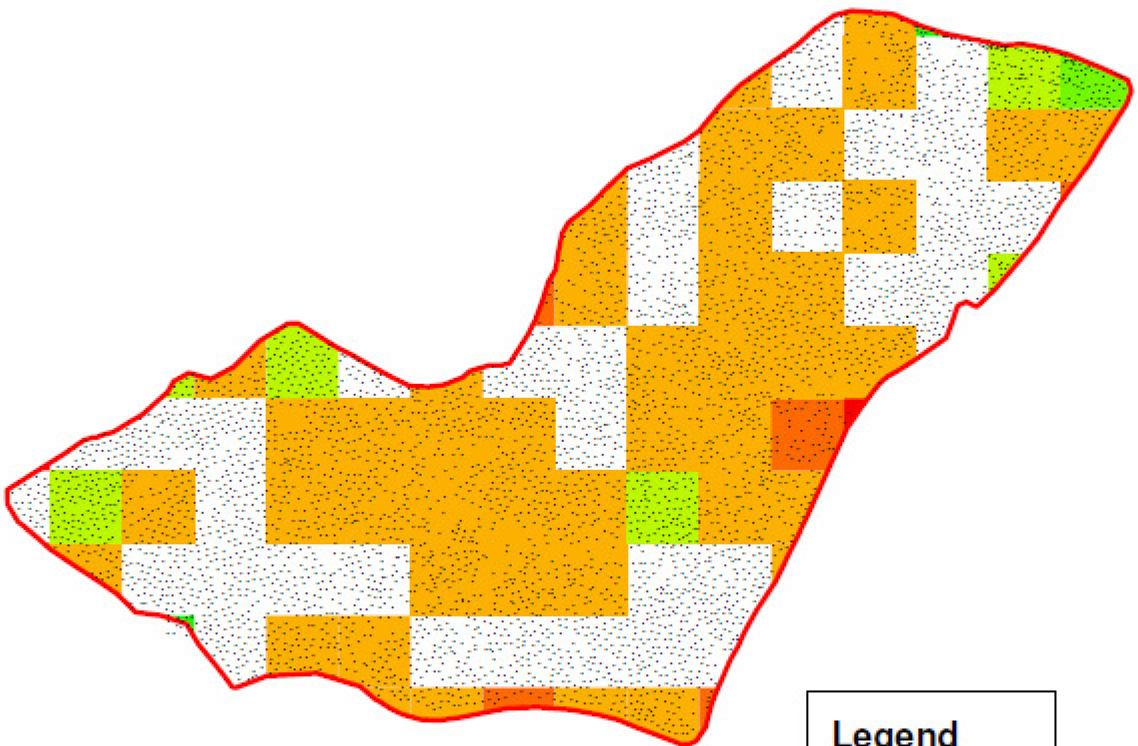
Sample Unit 3

18 Acres
294 TPA
84% Distribution
10.4 Avg Height
5 years old



Legend

TPA Legend

TPA

- 0 - 100
- 101 - 200
- 201 - 289
- 290 - 360
- 361 - 400
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