Redwood Restoration: A project in thinning Young Redwood Stands

Brian Anderson

Ecological Restoration Capstone

Humboldt State University

Introduction

Coast Redwood (Sequoia Sempervirens) exists mostly in stands of second growth today due to the legacy of logging on its range. Therefore the restoration potential of these second growth stands is very high. Timber harvests have left large swaths of RedWood country with a high density of tree within them. Often times the stands have very little or no vertical distribution in canopy classes. There are many negative effects to this including impacts to wildlife, high fire hazard potential, slow carbon sequestration. Sivilcultural treatments can effect a stands successional pathway and increase near term old growth characteristics (Chittick & Keyes 2007).

It has been seen that thinning can increase the amount of growth in leave trees in a stand (Oliver, 1994) . This can result in the reproduction of old growth characteristics in the near term in a Redwood stand. This causes the stand to become more resilient to disturbance. Crowded stands are vulnerable to fire, bear damage, and pests. Larger Redwoods have more ecological, commercial, and aesthetic value.

Site

The site that was chosen for this project was a 10 acre parcel in the upland redwood ecosystem. The site is located in Humboldt County CA, close to the community of Kneeland. This site had been logged over in the 1950's by clear-cutting. This site is zoned in a Timber Production Zone (TPZ) . The land owner has stated that he does intend to do some single tree selection harvests in roughly 20 years. A half-acre section was chosen for this project. Slopes on this section were 5-20 percent. The site contained a dominant Redwood over story with less than 5% of Douglas Fir (Pseudotsuga menzezeii) ,Grand Fir (Abies grandis), and Tan Oak (Notholithocarpus spp.). Understory is suppressed due to high canopy closure but there are members of Sword Fern (Polystichum munitum) and Evergreen Huckleberry (Vaccinum spp.).

The landowner wishes the site to be thinned to promote old growth characteristics in this stand. The intended results for the landowner are to lower fire risk, increased benefits for wildlife, higher aesthetic value, and larger bowled trees for higher timber value.

Methods

A half-acre section of the 10 acre parcel was chosen for this project. This section measured 1 chain in width and five chains in length. Compasses and logger's tapes were used to map out edges of project area. Biodegradable flagging was used to mark out the edges of the project area and were placed in 1 chain intervals on the length of the area (fig, 1)

Fig:1

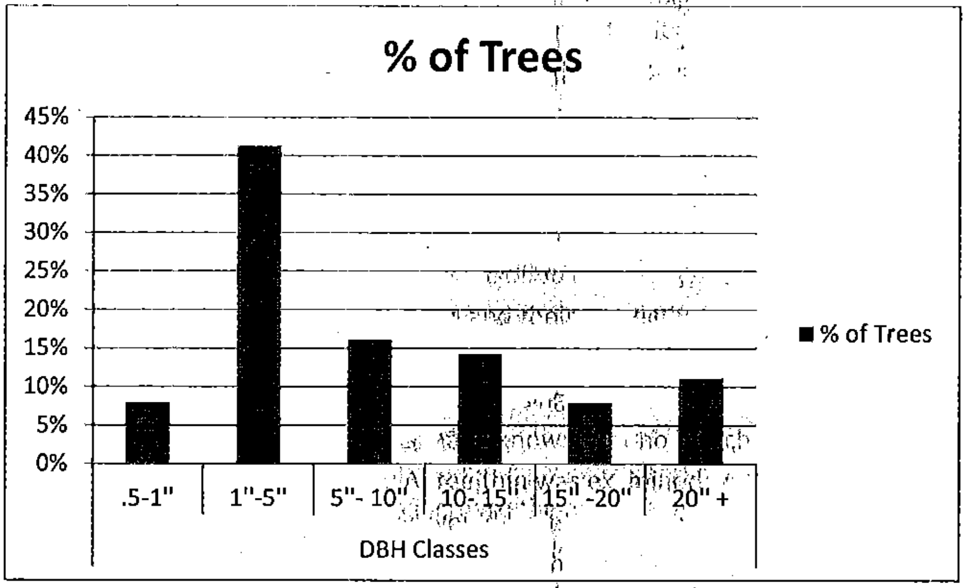
Baseline Data

A strip cruise was performed on a section of the project area measuring 11 feet wide and running the entire length of project site. All of the trees were measured within this strip. Compasses were used to ensure the correct direction of the strip. Species composition, basal area , stand density and other measurement were derived from this data (Table 1). The distribution of DbH in the cruised area is displayed in table 2.

Densitometer reading were taken at 1 chain intervals in the project site and then averaged. The average amount of canopy cover was found to be 98%.

Avg. DBH	8.7"
TPA	756
BA (ft2/ac)	312
SDI	604.575
SDImax(rw)	1000
Relative density(rw)	60%

(Table 1)



(Table 2)

Average diameter at breast high was 8.7 inches with average trees per acre of 756. The stand density index (SDI) was found to be right around 60 percent of its maximum of 1000. Redwood has a maximum stand density index of 1000 and if a redwood stand has an SDI of over 60 percent of its max there is going to be "imminent tree mortality" in the stand (Berril , 2012).

Project Design

Trees were assembled into size classes and their respective trees per acre. Three thinning diagrams were examined and discussed with the landowner. The three models examined were a crown thin (thinning larger diameter trees),a low thin(thinning smaller diameter trees), and a free thin (a combination of low and crown thin) .It was made known that no merchantable trees would be cut which excluded the possibility for a crown thin. A free thin was examined as well in which middle sized trees would be cut out and small and large trees would be left. There was a limit of 20 inches of the largest tree cut. It was specified that where possible trees in the 15"-20" size class should be non-merchantable as well.

There is a large body of research on Redwood thinning. A moderate density low thinning regime was chosen because of the lowered amount of wind throw damage to the stand, and because the landowner wishes to do a single tree selection of the property in roughly 15 years. Removal of a few crown trees of this stand will create more vigorous stump sprouts (Boe 1974). This will start a new cohort of trees which will add another age structure to the stand.

A moderate thin which ended up leaving around 200 TPA was chosen. As seen in Ohara et. al (2010) moderate thins of this nature results inl the most growth on the top 125 trees per acre. This also leaves the largest of most trees in the stand and causes them to grow the fastest.

Table 1 examines the three possibilities that researched and the different stand densities and TPA they would leave.

Class	current # trees per acre	currentTPA	low thin TPA	crown thin TPA	free thin TPA	Avg DbH per class	BA/tree	Low thinBA	Crown thinBA	Free thinB
.5-1	60.00	200.00	0.00	60.00	30.00	0.83	0.00	0.00	0.23	0.11
1"-5"	312.00	1040.00	0.00	200.00	50.00	2.73	0.04	0.00	8.13	2.03
5"-10"	120.00	400.00	40.00	60.00	0.00	7.66	0.32	12.80	19.20	0.00
10-15"	108.00	360.00	50.00	50.00	25.00	11.44	0.71	35.69	35.69	17.84
15"-20"	60.00	200.00	40.00	30.00	40.00	17.34	1.64	65.60	49.20	65.60
20"+	84.00	280.00	84.00	50.00	84.00	20.00	2.18	183.25	109.08	183.25
TPA	756.00		214.00	450.00	229.00					
BA (ft2/ac)								297.34	221.52	268.84
av. Tree BA								1.39	0.49	1.17
Quadratic mean DBH								15.96	9.50	14.67
SDI								453.24	414.47	423.66
relative density								0.45	0.41	0.42

Project

Trees were marked in with spray paint in the percentages that each size class needed to be removed (I.E if 25 percent of a size class was to remain three out of every four trees encountered in the project area was marked for removal). Trees were selected in their size classes for form, and percentage of live crown. Larger trees were to be removed that were deformed and therefore non- merchantable (see Fig. 2)

Fig 2

The thin proceeded with tree removal. Trees were felled by chainsaw and then limbed (Fig 3). Trees' were felled in order from smallest to largest, opening falling corridors to ensure damage to remaining trees was minimal .Limbed trunks of trees were then bucked and stacked if they were over 2 inches in diameter (see Fig 4).Stacked wood was removed offsite for use as firewood .Smaller trunks less than 2 inches diameter and slash underwent lop and scatter and was left on site

Fig 3

Fig 5

After marked trees were cut the landowner checked the project area and indicated hazard trees that he wished to be removed as well. These trees were removed as well.

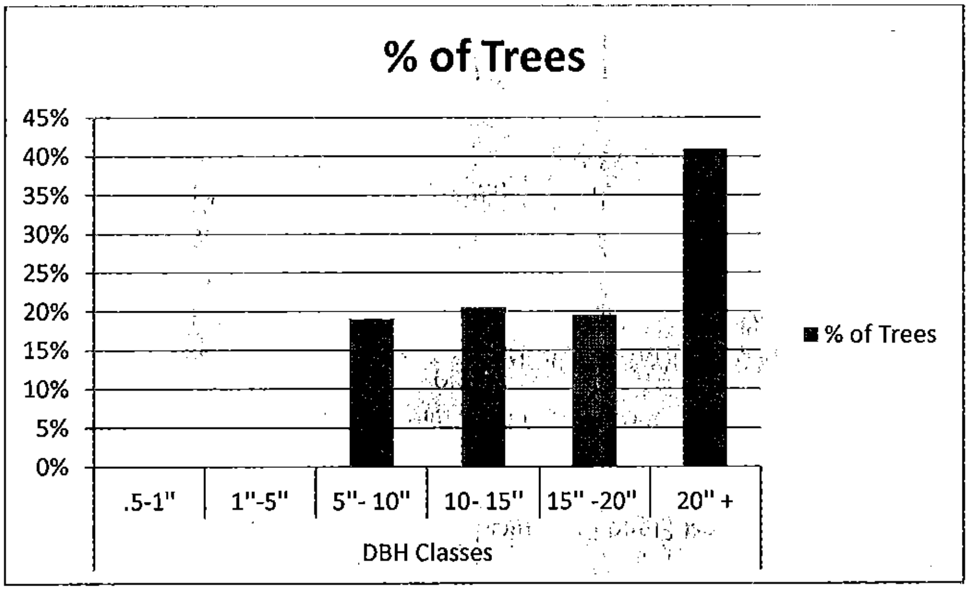
Results

The project area was recruised using the same strip cruise method on a different area on the project site to check to see how close the project got the site to its intended TPA in each size class.Percentages of Tree Dbh is found on Table 3.

Class	TPA	Avg. DHB per class	BA/ Per tree	Project BA
.5-1	0.00	0.00	0.00	0.00
1"-5"	0.00	0.00	0.00	0.00
5"-10"	39.00	8.10	0.36	13.96
10-15"	42.00	13.22	0.95	40.03
15"-20"	40.00	18.54	1.02	40.64
20"+	84.00	20.00	1.02	85.38
Total TPA	205.00			
BA (ft2/ac)	180.02			

Avg. Tree BA	0.88
Quadratic Mean DBH	12.69
SDI	423.10
Relative density	42%

Densiometer average 65% canopy cover



(Table 3)

Costs and Feasiblity

The time is took to complete this project was recorded in order to assess the costs of doing this work on other property pieces. Small landowners can use this to assess the costs of such a project on a per acre basis. Such things like model creation can be assumed to be constant unless more than one models are to be created for a parcel.

Man Hours for Project	
Flagging Project Area	2
Intial timber Cruise	1
Thinning Model Creation	5
Timber Marking	1
Timber Falling	25
Fuels Removal	20
Check Cruise	1
Total	55

Discussion

The thinning missed it's intended target of a stand denisity index of 45% by a very small margin . For all intesive purposes the thin achieved its goal and kept at least 40% SDI on the stand.A few more trees than intended were fallen given the site a stand denisty index of 42 %. In crowded Redwood stands often times more trees than intended have to be remove merely to safely fall trees. Unmarked trees therefore had to be cut in the stand. Also the nature of falling trees causes unavoidable damage to some leave trees. Some of these heavily damaged trees were also removed . No trees were damaged above the cut limit of 20".

Redwood should be thinned from anywhere from 25-40 percent relative denisty to maximize growing space and to prevent windthrow(Berril, 2012). The amount of thinning that was done on the site falls within in this amount of relative denisty. This stand is within the amount that leaves the stand resilant to windthrow. Losing large diamater trees to windthrow causes financial loss for the landowner as well as lost habitat for wildlife and lost carbon storage.

Ladder fuels were heavily removed from this stand. Historically speaking Redwood stands in Northern Humboldt County burned with low intenisty around every 5-10 years. However the policy of fire suppresion has raised the natural fire rotation almost 10 fold (Oneal,2006). Reduction of these ladder fuels and encouraging the growth of fire resistant larger trees is a step toward avoiding a catastrophic stand replacing event.

Thinning encourages larger tree growth, which are better at sequestering carbon than smaller diameter trees. It is useful when the stand has stagnated and is in the stem exlusion stage of forest stand development. When a stand is in stem exlusion stage of stand development growth has slowed greatly(Oliver & Larson 1996). Fire is also a threat to crowded stand in stem exlusion. Thinning like this project which encourages the growth of large diamter trees allows the stand to function as a better carbon sink. This is especially true in long lived speices such as Coast Redwood.

Thinning encourages a stand to enter the understory reiniation phase of stand development. Crowded second growth stands often have little to no understory vegetation. The removal of some trees which allows more light to filter to the forest floor will cause more understory species to grow there. This has ecological benefits to wildlife thus increasing biodiversity on the site.

Thinning also produces biomass energy. Biomass is a renewable local source of electricty and home heating. All large wood in this project was used as firewood. Using wood from thinning projects for biomass energy allows for some landowners to help pay for the cost of their thinning with the sale of the removed wood. This could be by selling the wood to local biomass plants or nearby residents.

Redwood however, has a very low selling price per cord. A cord of redwood is locally valued around $150 while other species such as Madrone (Arbutus Menziesii) sell for twice that amount. Any amount of money that can be recouped from a restoration project is useful.

Conclusion

The legacy ofl logging across the rewood region is vast. Huge tracts of land were clearcut and left to regenerate with no thought of later management. These stands have grown up into crowded stagnated stands in which little or no growth is occuring. These stands are of little ecological , or commerical value to the landowner. These stands are also in constant peril of complete destruction by a fire as well.

These stands will regenerate eventully over a long period of time .However ,thinning reduces all of these aforementioned risks and speeds along regeration of these stands in the near term. This will allow for increased ecological value for speices and stand compeistion. It increases the amount of carbon sequestoration in the long term. It also will increase the commerical value of the stand which can allow for funding of future restoration projects.

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