# A Comparison of Stand Structure and Composition Following Selective-Harvest at Byrne-Milliron Forest[1]

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## Abstract

The effects of selective-harvest on forest composition and structure in the southern range of the coast redwood (*Sequoia sempervirens* (D. Don) Endl.) forest have not been well documented. This case study focused on the Byrne-Milliron Forest in Santa Cruz County, California where selective-harvest is currently the primary method of timber extraction. The purpose of this research was to determine how forest structure and composition varied in regard to harvest intensity and management goals. We sampled 100 plots in the Byrne-Milliron Forest across five harvest sites. All sites had been essentially clear-cut in the late 19th or early 20th century, and subsequently selectively harvested in the late 20th and early 21st century. Four of the five sites have been managed primarily for timber production, while the fifth site, the Late Successional Unit (LSU), has been managed for old-forest conditions as well as timber production. We predicted the LSU would contain more late seral features, and that the presence of these features would be positively correlated to years since harvest, and negatively correlated to percentage cut and number of harvest re-entries. Data analysis procedures included one-way analysis of variance (ANOVA) for comparison between sites, and Pearson product-moment coefficient for correlations between variables. As expected, the LSU exhibited the most developed old-forest features, including the lowest stand density and exotic species richness among all sites evaluated. In addition, it contained the highest percentage of coast redwood associated herbaceous species and large woody debris (LWD). Results also indicated that percentage cut was the strongest predictor for canopy cover, stand density, LWD, and the cover of coast redwood associated herbaceous species. Our findings suggest that a lower percentage cut is more effective in maintaining conditions commonly associated with late seral forests such as snags, fire hollows, complex canopy structures and LWD, and these features can be present in selectively harvested stands if carefully managed.


Keywords: coast redwood, selective-harvest, *Sequoia sempervirens,* understory associates

## Introduction

Low to moderate disturbances within an ecosystem are a necessary component of community dynamics (Pickett and White 1985) and allow for changes in dominance while promoting species diversity (Huston 1979). In coast redwood (*Sequoia sempervirens* (D. Don) Endl.) forests, higher yield harvests do not mimic this model. Previous studies have indicated that intensive harvesting of this forest type contributes to crown dieback (Russell et al. 2000), loss of habitat (Carter and Erickson 1992), loss of understory associated species (Jules 1998, Kahmen and Jules 2005, Reader 1987, Rivas-Ederer and Kjeldsen 1998) and an increase in exotic understory flora (Russell 2009).

In the Byrne-Milliron forest in Santa Cruz County, California, low intensity harvests were employed in some areas in an attempt to allow the continuity of late seral forest characteristics. These features, including snags, fire hollows, and complex canopy structures create habitat essential to a variety of wildlife species (Hunter et al. 1995, Overtree and Kitayama 2013[3], Ralph and Miller 1995).

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[3] Overtree, L.; Kitayama, E. 2013. Byrne-Milliron Forest Preserve management plan. Prepared for the Land Trust of Santa Cruz County.

Large woody debris (LWD), which accumulates over time in late seral stands, provide habitat and also act as a stream buffer (Franklin et al. 1981, Lienkaemper and Swanson 1987). Understory floristic species associated with this forest type may take decades to recover following an intensive harvest event, and therefore a lighter cut is more beneficial in maintaining species diversity (Hageseth 2008, Halpern and Spies 1995).

Small group or selective harvest mimics the small patches created by tree fall gaps in late-seral coast redwood forests. Employing this method with regard to the aforementioned late seral forest characteristics enables forest managers to maintain a healthy forest ecosystem while actively managing for timber.

## Methods

Santa Cruz County has a Mediterranean climate typical of California's coast, defined by hot, dry summers and high precipitation during the winter. Annual rainfall is between 100 to 150 cm and morning fog is common during the summer months. Common coast redwood associate hardwoods in this region include California hazelnut (*Corylus cornuta* var. *californica* (A. DC.) Sharp), boxelder (*Acer negundo* L.), California bay (*Umbellularia californica* (Hook. & Arn.) Nutt.), Pacific madrone (*Arbutus menziesii* Pursh), big leaf maple (*Acer macrophyllum* Pursh), coast live oak (*Quercus agrifolia* Nee) and interior live oak (*Quercus wislizeni* A. DC.) (Cooney-Lazaneo and Lyons 1981, Lyons and Cuneo-Lazaneo 1988). Common coniferous associates include California nutmeg (*Torreya californica* Torr.), Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and knobcone pine (*Pinus attenuata* Lemm.).

Selective-harvest has been the required method of timber extraction since clear-cutting was banned in 1970. This was in adherence to regulations applicable to the Southern Subdistrict under the California Forest Practice Rules (CAL FIRE 2016). The coast redwood forests in this region are predominately second-growth with sparse patches of old-growth occurring intermittently throughout the county.

Our research was conducted in five distinct harvest areas within the Byrne-Milliron Forest, located 8 km (5 miles) north of Corralitos. This region is composed of coast redwood, mixed chaparral, montane hardwood, coastal scrub and eucalyptus (CAL FIRE 2001). Clear-cut in the late 1880s, the property consists predominately of even-aged coast redwood and Douglas-fir. Byrne-Milliron spans 163 ha with elevations ranging between 125 to 500 m and predominately west facing slopes (see footnote 3). Physiographic characteristics including elevation and slope are similar between sites (table 1). The median aspect was 42° in the 1987/2004 site, 71° in the 1990/2007 site, 90° in the 1996 site, 68° in the 2001 site, and 84° in the 2007 site, respectively. Situated atop the Purisima Formation, the soil types on the preserve include the Ben Lomond-Felton complex, Lompico-Felton complex, Nisene-Aptos complex and a small portion of Pfeiffer gravelly sandy loam located near the entrance (CAL FIRE 2001). Several small tributaries on the property lead to the nearby Browns Creek, although only one runs continuously throughout the year.

**Table 1—Physiographic characteristics of five treatments in the Byrne-Milliron Forest in Santa Cruz, California (dates listed pertain to the years that harvest occurred)**

| | 1987/2004 | | 1990/2007 | | 1996 | | 2001 | | 2007 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* |
| Elevation | 1213 | 25.42 | 928 | 19.68 | 1071 | 20.68 | 1475 | 21.46 | 1094 | 30.24 |
| Slope (%) | 41.9 | 2.97 | 36.05 | 1.72 | 39 | 2.84 | 41.6 | 2.62 | 39.8 | 3.18 |

The Land Trust of Santa Cruz County purchased the original 130 ha Byrne Forest in 1984. The Milliron property, which added an additional 32 ha, was purchased in 2008 (see footnote 3). For the purpose of this study, the Milliron property has been excluded. There have been a total of seven selective harvests since the Land Trust took ownership. The property is now broken up into several management units (fig. 1) including the Central Unit (56 ha), the Early Successional Unit (22 ha), the Late Successional Unit (LSU) (15 ha), and the Southern Unit (24 ha). Harvesting has been conducted at a variety of intensities using tractor, skyline cable, or both methods combined (table 2).

The management goals for the units were similar, with the exception of the LSU (CAL FIRE 2001). Goals for the Central and Southern Units included implementation of an uneven-aged stand structure, which promoted new growth and provided space to aid the residual stand. Other goals included maintaining current species composition, with special consideration to coast redwood, as well as creating and maintaining structural features beneficial to wildlife. Co-dominant tree species were removed as needed to promote an increase of coast redwood size classes. Pruning of sprout clumps and reseeding where necessary were also objectives. Although the LSU had similar management goals, the main focus was the creation and preservation of late successional features including a complex canopy, shady microclimate, and structural elements such as snags and LWD. Minimal logging and an overall reduction in disturbance were promoted to conserve aesthetic value and support the desired habitat features.

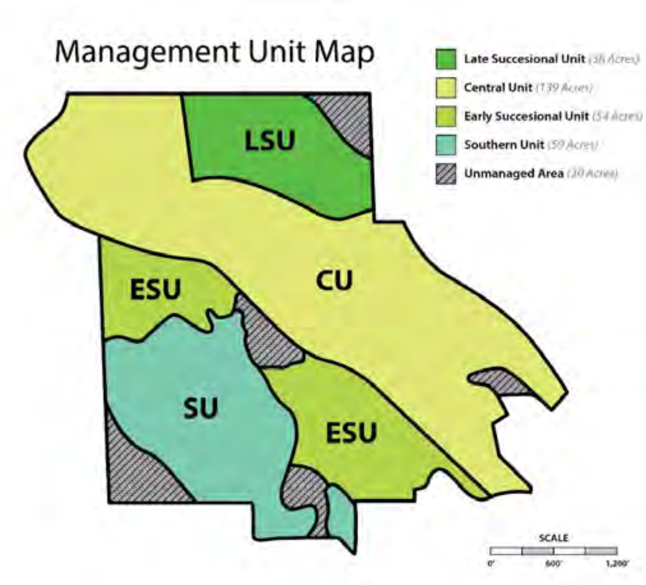


Figure 1—Management units at Byrne-Milliron Forest. (Image by Derrick Wynes)

**Table 2—Harvest data for five treatments in the Byrne-Milliron Forest in Santa Cruz, California**

| | 1987/2004 | 1990/2007 | 1996 | 2001 | 2007 |
|---|---|---|---|---|---|
| Unit name[a] | CU | CU | SU | CU | LSU |
| Harvest area (ha) | 22; 19 | 24; 17 | 26 | 12 | 15 |
| Harvest methods[b] | T | T | T, S | T | S |
| Years since harvest | 9 | 6 | 17 | 12 | 6 |
| Number of re-entries | 2 | 2 | 1 | 1 | 1 |
| Percentage cut[c] | 22.78 | 32.49 | 25.45 | 29.47 | 17.48 |

[a.] CU = Central Unit, SU = Southern Unit, LSU = Late Successional Unit.
[b] T = tractor, S = skyline cable.
[c] Percentage cut reflects the most recent harvest re-entry.

Five of the selective-harvests occurred in the Central Unit; two of these sites were harvested twice. The first site was harvested in 1987 and re-entered in 2004 and the second site was harvested in 1990 and re-entered in 2007. Both initial harvests were completed under Timber Management Plans (THP) and the latter were completed under one Non-Industrial Timber Management Plan (NTMP) prepared in 2001 (see footnote 3). All subsequent harvests were approved under this plan. The fifth harvest occurred in 2001 and was the first entry in that region since the clear-cut in the 1880s (CAL FIRE 2001). Other selective harvests completed include one in the Southern Unit, which was entered in 1996, as well as one harvest in the LSU, entered in 2007 for the first time since the clear-cut.

Plot site selection was determined by analyzing ground accessibility, timber harvest maps and applicable THPs and NTMPs. The replicated sample design consisted of five second-growth sites that had undergone selective-harvest since the property was acquired by the Land Trust of Santa Cruz County. Twenty 0.032 ha (20 m diameter) circular plots were randomly selected within each of the five sites, for a total of 100 plots. All plot locations were situated at least 10 m from sensitive habitats and 200 m from main access roads (Russell and Michels 2010). Plot locations were selected at random with the use of a random number generator and coordinates were recorded with a Garmin GPS device. Each plot was further divided into quadrants to determine relative herbaceous cover.

Data was collected between May 2012 and July 2013. Physiographic variables recorded at each plot included slope, aspect and elevation. All tree species > 10 cm were measured using a diameter at breast height (DBH; 1.37 m) tape. Canopy cover was determined using a convex spherical densiometer, with readings taken in each of the four cardinal directions from plot center. The LWD was also counted and circumference and length were recorded for each occurrence.

A Pearson's product-moment correlation matrix was used to analyze relationships between the independent variables (years since last harvest, number of harvest re-entries, and percentage cut per hectare) and dependent variables (aspect, elevation, slope, canopy cover, stand density, size classes of coast redwood, LWD density, coast redwood associated species, native species richness, exotic species richness, and relative dominance of coast redwood, which was calculated using the basal area). Size class tallies were conducted using the follow classes: < 10 cm, 10 to 24 cm, 25 to 49 cm, 50 to 99 cm, 100 to 149 cm, 150 to199 cm and > 200 cm DBH (Giusti 2007). Herbaceous species present throughout each plot were identified and visual cover estimates were made to determine relative species composition. In the event of an unidentifiable plant, a sample of the specimen was collected for later identification using the Jepson Manual (Baldwin et al. 2012). In addition, coast redwood associated herbaceous species were selected for further analysis. These included hooker's fairy bells (*Prosartes hookeri*), modesty (*Whipplea modesta*), Pacific starflower (*Lysimachia latifolia*), Pacific trillium (*Trillium ovatum*), redwood violet (*Viola sempervirens*), and redwood sorrel (*Oxalis oregana*). One-way analysis of variance (ANOVA) with Bonferroni post hoc analysis was used to analyze differences between treatments. All statistical analyses were conducted using IBM SPSS Statistics 21 and Microsoft Office Excel 2013.

## Results

Forest structure and composition varied significantly between treatments, with differences found in canopy cover, stand density, density of LWD, coast redwood associated herbaceous species, and several other metrics (table 3).

**Table 3—Results for structural and compositional variables on five treatments in the Byrne-Milliron Forest in Santa Cruz, California**

| | Years since harvest | | Number of re-entries | | Percentage cut | |
|---|---|---|---|---|---|---|
| | *p-value* | $r^2$ *value* | *p-value* | $r^2$ *value* | *p-value* | $r^2$ *value* |
| Stand density (all species) | 0.28 | 0.052 | 0.001 | 0.15 | 0.001 | 0.27 |
| Coast redwood density | 0.8 | -0.00036 | 0.007 | 0.1 | 0.02 | 0.26 |
| Tanoak density | 0.05 | 0.15 | 0.32 | 0.13 | 0.76 | -0.007 |
| Redwood basal area | 0.91 | -0.036 | 0.44 | -0.04 | 0.76 | 0.1 |
| Coast redwood dominance | 0.18 | -0.097 | 0.61 | -0.13 | 0.3 | 0.08 |
| LWD density | 0.004 | -0.32 | 0.99 | 0.052 | <0.001 | -0.36 |
| Coast redwood associates | 0.014 | -0.25 | 0.68 | -0.04 | <0.001 | -0.47 |
| Native species richness | 0.86 | -0.13 | 0.32 | 0.1 | 0.052 | 0.21 |
| Exotic species richness | 0.82 | -0.04 | 0.1 | 0.26 | 0.013 | 0.27 |
| Canopy cover | <0.001 | -0.04 | 0.2 | 0.06 | <0.001 | -0.04 |

### Stand Density

Stand density varied between the five treatments (table 4). The 1990/2007 harvest site had the highest density of all sites, followed by the 1987/2004 site, the 1996 site, the 2001 site, and the LSU (fig. 3). Pearson's product-moment correlation coefficient indicated that there was a positive relationship between stand density and number of re-entries ($r$ = 0.15) as well as percent cut ($r$ = 0.27). Variation between sites in regard to individual tree species density was particularly pronounced for redwood and tanoak (table 4). These species had a much lower density in the LSU compared to the other four sites. Variation for other tree species was all within the margin of error.

**Table 4—Comparison of mean stand density (trees/ha) on five treatments in the Byrne-Milliron Forest in Santa Cruz, California**

| | 1987/2004 | | 1990/2007 | | 1996 | | 2001 | | LSU | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stand density | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* |
| All tree species | 11.90 | 0.96 | 12.85 | 1.41 | 11.15 | 0.98 | 9.15 | 1.02 | 7.05 | 0.68 |
| Coast redwood | 10.10 | 0.81 | 11.25 | 1.24 | 9.10 | 1.09 | 8.85 | 1.04 | 6.55 | 0.69 |
| Tanoak | 49.15 | 11.49 | 69.15 | 14.67 | 49.65 | 8.61 | 25.95 | 5.78 | 16.85 | 2.69 |
| Pacific madrone | 0.60 | 0.50 | 0.10 | 0.07 | 0.30 | 0.15 | 3.10 | 1.44 | 1.25 | 0.95 |
| Oak | 2.35 | 1.25 | 4.60 | 1.22 | 5.40 | 3.12 | 0.55 | 0.26 | 0.65 | 0.25 |
| Douglas-fir | 0.40 | 0.28 | 0.40 | 0.28 | 0 | 0 | 0.60 | 0.29 | 0 | 0 |
| Big-leaf maple | 0.05 | 0.05 | 0.05 | 0.05 | 0.40 | 0.35 | 0 | 0 | 0.35 | 0.30 |

Size class distribution of coast redwood also varied between treatments (fig. 2). Overall, the LSU had the most even distribution as well as the lowest stand density with the fewest stems < 49 cm and the highest density of stems 150 to 199 cm. Sites entered twice, including the 1987/2004 and 1990/2007 harvest areas had the highest number of small stems and the most skewed ratio of small to large trees. There was a significant correlation between stems < 10 cm and years since harvest ($p$ = 0.001, $r$ = 0.18) as well as percentage cut per hectare ($p$ = 0.004, $r$ = -0.05) (table 5). When analyzed with number of harvest re-entries, stems 10 to 24 cm were significantly lower in sites with one re-entry compared with two re-entries ($p$ = < 0.001, r = 0.22). In relation to percentage cut, the LSU had significantly fewer stems 10 to 24 cm in comparison with all other sites ($p$ = < 0.001, $r$ = 0.36). In addition, the LSU had a significantly larger amount of stems 150 to 199 cm in comparison with all other sites analyzed ($p$ = 0.001, $r$ = -0.35). There were only a small number of occurrences where stems exceeded 200 cm. This included one occurrence in the 2001 site and one occurrence in the 1990/2007 site.

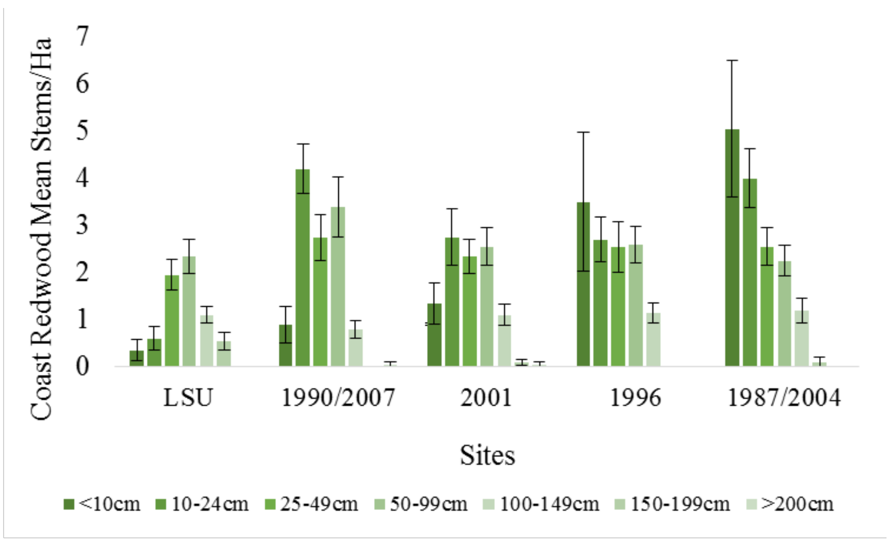


Figure 2—Coast redwood mean size class distribution on five treatments in the Byrne-Milliron Forest in Santa Cruz, California (n = 20 plots per treatment).

## Coast Redwood Basal Area and Dominance

Mean coast redwood basal area was highest in the 1990/2007 site, followed by the 1996 site, the 2001 site, the 1987/2004 site and the LSU (table 6). Relative dominance of coast redwood was highest in the 2001 site, followed by the 1990/2007 site, the LSU, the 1996 site and the 1987/2004 site. Analysis of these variables did not indicate a significant difference between the means.

**Table 6—Comparison of stand structure variables on five treatments types in the Byrne-Milliron Forest in Santa Cruz, California**

| | 1987/2004 | | 1990/2007 | | 1996 | | 2001 | | LSU | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* | *Mean* | *S.E.* |
| Redwood basal area | 20.80 | 3.65 | 27.81 | 6.22 | 22.15 | 4.77 | 20.85 | 4.05 | 20.42 | 3.34 |
| Coast redwood dominance | 90.65 | 5.21 | 96.85 | 1.60 | 90.75 | 4.73 | 99.3 | 0.41 | 96.05 | 2.80 |
| LWD density | 4.60 | 0.61 | 4.05 | 0.54 | 3.15 | 0.56 | 3.20 | 0.57 | 6.60 | 0.42 |
| Coast redwood associates | 20.03 | 3.66 | 15.09 | 2.89 | 16.20 | 3.22 | 13.54 | 3.31 | 43.99 | 5.95 |
| Canopy cover | 0.97 | 0.004 | 0.98 | 0.002 | 0.93 | 0.019 | 0.98 | 0.004 | 0.98 | 0.002 |

## Large Woody Debris

The occurrence of LWD varied among the five treatments (table 6). The LSU had the highest mean, followed by the 1987/2004 site, the 1990/2007 site, the 2001 site, and the 1996 site (fig. 3 ~~5~~). When analyzed with years since last harvest, LWD density was significantly higher in the LSU compared with the 1996 site and 2001 site ($p$ = 0.015, $p$ = 0.018). This relationship was negatively correlated ($r$ = -0.32). Analysis of LWD density and the percentage cut per hectare also indicated a significant difference between the LSU in comparison with other sites ($p$ = < 0.001, $r$ = -0.36).

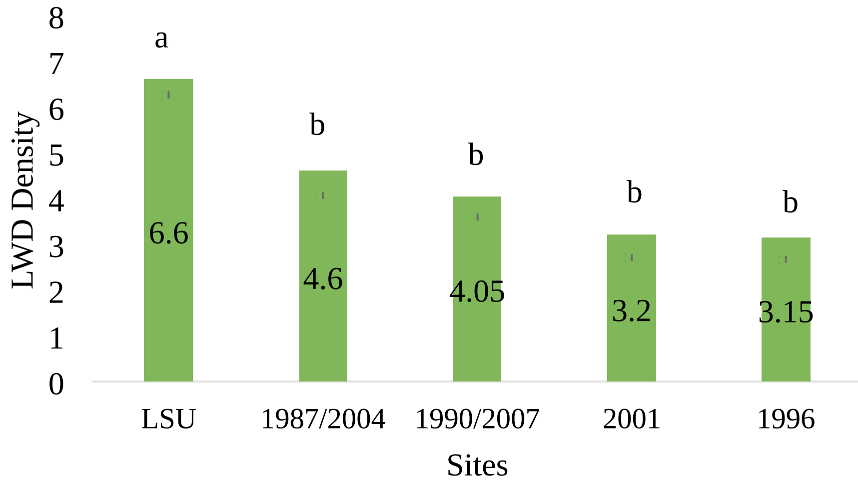


Figure 3—Mean large woody debris (LWD) among five treatments with 95% confidence intervals when correlated with percentage cut (sites with the same letter were not significantly different from one another).

## Understory Species

Common coast redwood herbaceous associates including hooker's fairy bells, modesty, Pacific starflower, Pacific trillium, redwood violet, and redwood sorrel were further analyzed to determine potential differences among treatments. The LSU had the highest mean of coast redwood associated species, followed by the 1987/2004 site, the 1996 site, the 1990/2007 site, and the 2001 site (table 6, fig. 4). When analyzed with years since last harvest, results indicated that the percentage of coast redwood associates was significantly higher in the LSU compared with the 2001 site ($p$ = 0.026, $r$ = -0.25). Analysis of percentage cut also indicated the LSU had a significantly higher amount of these species in comparison with all other treatments ($p$ = < 0.001, $r$ = -0.47). The 2001 site had the highest native species richness, followed by the 1990/2007 site, the 1987/2004 site, the LSU and the 1996 site. When ANOVA was used to analyze this data with the independent variables, there was not a significant difference for species richness between treatments.

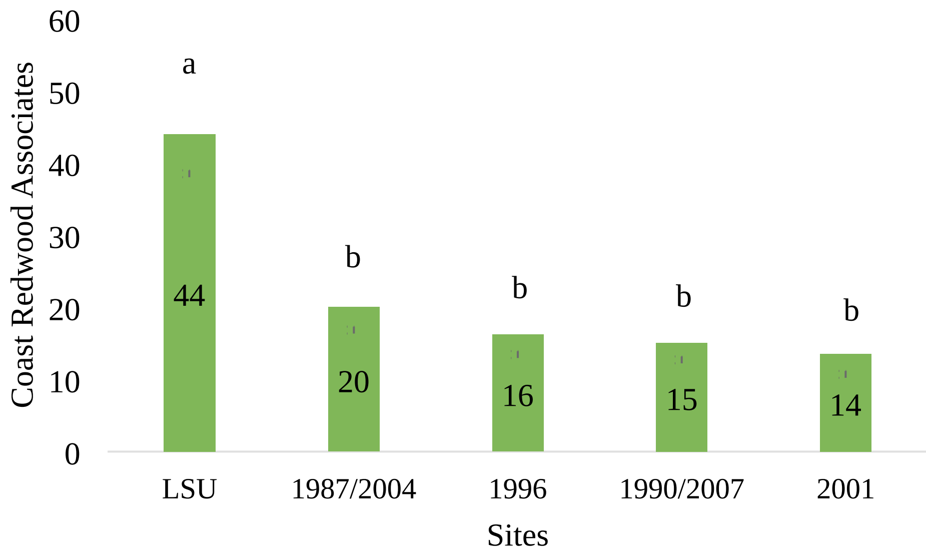


Figure 4—Mean percentage of coast redwood associated species among five treatments with 95 percent confidence intervals when correlated with percentage cut (sites with the same letter were not significantly different from one another).

The LSU had the lowest frequency of exotic species. This was followed by the 2001 site, the 1996 site, the 1987/2004 site, and the 1990/2007 site. There was a significant difference between the LSU and the 1990/2007 site when analyzed with percentage cut per hectare ($p$ = 0.007, $r$ = 0.27). Incidentally, the 1990/2007 site had the highest frequency of exotic species as well as the highest percentage cut, whereas the LSU had the lowest frequency and the lowest percentage cut.

## Canopy Cover

The LSU appeared to have the highest canopy cover, followed by the 1990/2007 site, the 2001 site, the 1987/2004 site, and the 1996 site (table 6). The 1996 site had significantly lower cover than all other sites in relation to years since last harvest and percentage cut ($p$ = < 0.001, $r$ = -0.04). Analysis of canopy cover and number of harvest re-entries indicated there was not a significant difference among sites ($p$ = 0.2).

## Discussion

The results of this study indicated that the LSU had a number of late seral features. Among the independent variables analyzed, percentage cut per hectare was the strongest predictor for a substantial number of the structural and compositional features, including stand density, LWD density, coast redwood associated species, exotic species richness, and canopy cover. Coast redwood associated species, LWD density, and canopy cover declined in response to higher harvest yields.

Mean stand density, which was lowest in the LSU, had the strongest correlation to the percentage cut per hectare. This was also the strongest independent variable for density of coast redwood. This was not an unexpected finding as coast redwoods sprout prolifically following a harvest event (Cole 1983). These results were further supported by analyses of size classes for coast redwood. Stems in smaller size classes were found to increase significantly while larger diameter coast redwoods were found to decline in response to heavier harvests. The LSU, which had the lowest percentage cut of all sites, had the lowest mean number of stems < 49 cm and the most even distribution of size classes. The sites entered twice, including the 1987/2004 site and the 1990/2007 site, had the highest stand density among all sites examined. Although studies have promoted heavier thinning intensities to speed up the attainment of desirable structural features (Berrill 2009, Oliver et al. 1994), this method does not prove to be applicable to coast redwood forests due to their prolific sprouting and ability to self-thin without outside management (Floyd et al. 2009, Lutz and Halpern 2006; Russell et al. 2014, Sachs et al. 1993).

Density of LWD, which was considered relatively uniform among treatments prior to harvest, was highest in the LSU. This was not unexpected, as LWD is a characteristic feature of late seral forests. However, results indicated a decline in LWD in relation to the percentage cut. This could be due in part to a regulation specific to the Southern Subdistrict which requires that remaining slash not exceed 76.2 cm (30 inches) (CAL FIRE 2016). It is possible that some pre-existing LWD was also removed during the clean-up process in an effort to adhere by these guidelines.

In addition, the LSU had a significantly higher percentage of coast redwood understory associated species in comparison with the other treatments. The 2001 site, which had one of the highest harvest yields, incidentally had the lowest percentage of coast redwood associated species. These species were found to decline significantly in relation to percentage cut per hectare; this was the strongest correlation of all dependent variables analyzed.

The LSU, which experienced the lowest level of disturbance, also had the lowest exotic richness of all sites. Exotic species richness increased with the number of harvest re-entries and the percentage cut per hectare. Sites re-entered twice, including the 1987/2004 site and the 1990/2007 site, exhibited the highest occurrence of exotic species. The site with the highest cut (1990/2007) had the highest exotic species richness. These results were not surprising since research has shown that exotic species are more likely to increase following a disturbance (Blair et al. 2010, Ebrecht and Schmidt 2003).

The LSU also had the highest canopy cover among treatments. Incidentally, the 1996 site, which had significantly lower canopy cover in comparison, had the lowest number of coast redwood associated species. A Pearson's product-moment correlation coefficient determined that canopy cover had two equally strong independent variables, years since last harvest and the percentage cut per hectare. Although the results obtained from ANOVA indicated that these findings were significant, both were weak correlations and other factors may have influenced these relationships. Previous research has indicated that canopy cover increases over time in the absence of outside disturbance (Russell et al. 2014), although it is possible that the time intervals since the last harvest entry were too short for long-term relationships to become evident. These stands are likely still in the early stages of recovery and may still be undergoing stand initiation (Oliver 1981).

In many respects, the LSU serves as a model for sustainable selective-harvest. The management goals set in place by the Land Trust of Santa Cruz County have ensured that this site maintained its structural and compositional integrity following harvest. In addition to a lighter harvest, specific regard for retainage of snags, large diameter trees, LWD, and development of complex canopy structures have allowed this area of the Byrne-Milliron Forest to maintain a healthy ecosystem amidst active management.

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