California Wildlife Habitat Relationships Program
Biogeographic Data Branch, Resource Management and Policy Division
California Department of Fish and Game

Clarification of the Measurement of California Wildlife Habitat Relationships (CWHR) System Size Class 5 and 6 for Tree Habitats

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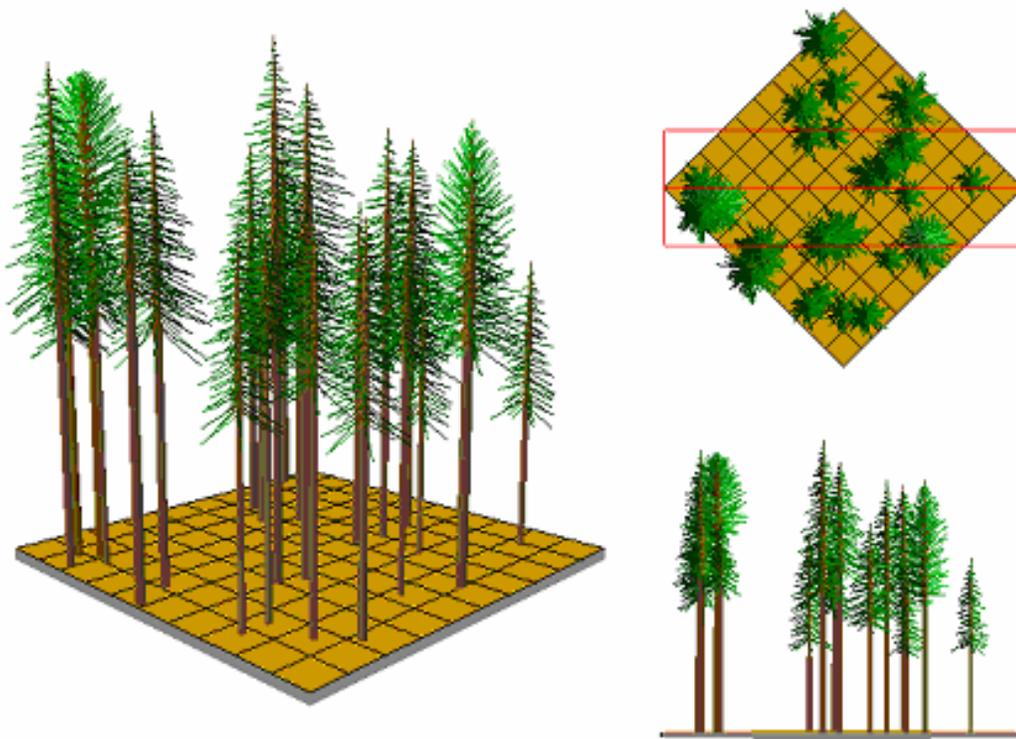
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(CWHR) System Size Classes 5 and 6 for Tree Habitats**

**California Wildlife Habitat Relationships Program
Biogeographic Data Branch, Resource Management and Policy Division
California Department of Fish and Game
Sacramento, California**

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Introduction

The primary purpose of this paper is to clarify the measurement of and intent behind
California Wildlife Habitat Relationships System (CWHR) size classes 5 and 6 for tree
habitats. Several CWHR reference documents contain information on this topic (Airola
1988, Garrison et al. 2002, Mayer and Laudenslayer 1988). The topic is also fully
addressed in the CWHR training manual and in the field and computer laboratory during
the CWHR training course. Memos in Appendix H of the training manual to Dr. Martin
Berbach (1996) and Mr. David Linkhart (1995) respond to specific questions regarding
even and uneven structure and the measuring of size class 6. Until now, however, there
has not been a paper to specifically address the use of the field forms for calculating size
classes 5 and 6 and help the user interpret plot data and classify a forest stand.

The paper begins with some background on the intent and proper use of the CWHR
habitat classification system, includes a description of habitat typing, and concludes with
an explanation of CWHR size classes 5 and 6 – including completion of the "Wooded
Habitat Sampling Datasheet", sample calculations using plot data from the Jackson and
Boggs Mountain Demonstration State Forests, and visualization models.

Intent and Proper Use of the CWHR Habitat Classification

The habitat classification is a component of CWHR, an information system and
predictive model for terrestrial wildlife species in California. The model for each species

includes suitability ratings for three life-requisites – breeding, cover and feeding – as determined by a species expert relative to a standardized list of habitats, stages of habitat development, and structural habitat elements.

One of the major assumptions of the CWHR model is that wildlife species respond to forest structure. In essence, wildlife species utilizing a forest stand can be expected to vary from a forest with multiple layers and a well-developed understory to one of trees that are all of an even size and height. For this reason, the CWHR habitat classification is structurally based. All tree species, both hardwood and conifer, contribute to forest structure.

Users should also note that CWHR was designed primarily as a wildlife model. Clarification on habitat classification is necessary for correct model input and output. The user accepts sole responsibility for the correct use of CWHR, the interpretation of its output, and any use of the output in environmental documents in California. No output from the CWHR model shall <u>by itself</u> be considered an official response from a state agency regarding any project subject to review by state or federal law.

Delineation of a Size Class 5 or 6 Forest Stand

For delineating a forest stand, the 40-acre minimum mapping unit is provided as a general rule in "A Guide to Wildlife Habitats of California" (Mayer and Laudenslayer 1988, p.12). However, there are exceptions to this rule and they are described in the guide. Even relatively uniform forest stands may contain habitat patches within them that are highly unique in terms of life form (e.g. a small wet meadow within a conifer stand) or structure (e.g. large trees with uneven structure and downed woody debris within a stand of otherwise small trees and even structure). These patches should be delineated and classified at a high enough resolution to accurately capture conditions meaningful to wildlife species in and around a project area.

Determination of Habitat Type

Habitat type for trees is assessed by the relative percent cover occupied by each tree species in the overstory. Overstory, as stated on the "Wooded Habitat Sampling Datasheet", includes pre-dominants, dominants and generally co-dominants. It can also include intermediate trees, depending on their relative crown position. The CWHR System uses the following definitions from the Society of American Forester's "Dictionary of Forestry" (Helms 1998):

> **pre-dominant** a tree whose crown has grown above the general level of the upper canopy

> **dominant** a tree whose crown extends above the general level of the main canopy of even-aged stands or, in uneven-aged stands, above the crowns of the tree's

immediate neighbors and receiving full light from above and partial light from the sides

co-dominant a tree whose crown helps to form the general level of the main canopy in even-aged stands or, in uneven-aged stands, the main canopy of the tree's immediate neighbors, receiving full light from above and comparatively little from the sides

intermediate a tree whose crown extends into the lower portion of the main canopy of even-aged stands or in uneven-aged stands, into the lower portion of the canopy formed by the trees immediate neighbors, but shorter in height than the codominants and receiving little light from above and none from the sides.

suppressed a tree of any of a variety of levels of vigor whose crown is completely overtopped by the crowns of one or more neighboring trees

Again, both hardwoods and conifers contribute to forest structure and either or both can be in a position of dominance. The habitat classification rules – updated at http://www.dfg.ca.gov/bdb/cwhr/pdfs/cwhr_rules.pdf and included here as an appendix – are used in conjunction with the descriptions in "A Guide to Wildlife Habitats of California" (Mayer and Laudenslayer 1988) to determine habitat type.

Determination of Size Class

Size Class 6 - Uneven Structure   Size class 6 is the only multi-storied stage available in the CWHR habitat classification. It is defined in part by a distinct height separation of canopy layers; in other words, uneven structure. If even structure were always assumed, no forest stand would ever be classified as a size class 6 in CWHR; QMD of all stems taken together would never exceed a size class 5, defined by an average stem diameter of >=24". Therefore, it is critical that the first determination is of stand structure. This determination can be subsequently confirmed with data collected. A space is provided for recording even or uneven structure at the top of the habitat sampling data sheet and definitions are provided in a box below this space. The automated processing of large inventory databases may require the use of computer algorithms to make this determination and is not addressed by this paper.

An uneven structured stand must either have 1) at least 10% canopy cover by each layer and distinctive height separation between layers (a few scattered trees in the understory would not likely meet the 10% threshold) or 2) at least 3 size classes present. Additionally, to meet the definition of size class 6, the overstory layer must be size class 5 ($\geq$ 24" QMD) and the understory layer at least a size class 3 (6.0-10.9" QMD) or 4 (11.0-23.9" QMD).

Note from the data sheet that it is possible to have an uneven structured stand that does not meet the definition of a size class 6. One example would be a distinct layer of size

class 2 trees under a layer of size class 4 or 5 trees. Another would be the presence of only size classes 2, 3, and 4 trees in a stand. It is also possible to have a size class 6 stand in which the layers do not skip an intervening class. An example would be a distinct layer of size class 4 trees under a distinct layer of size class 5 trees with height separation between the layers. Such is the case with some mature mixed stands in which conifers comprise the overstory and hardwoods the understory.

One way to measure distinctive height separation is to record the heights of a random subsample of trees and look at the overall distribution of these heights. A bimodal or multi-modal distribution would indicate distinct height classes. There is a space for recording tree height by stem on the habitat sampling data sheet. Often size class 6 may be determined with a visual assessment from the ground. Because it involves detection of an understory layer, however, it can be difficult to identify from remotely sensed imagery alone, especially when cover by the overstory layer exceeds 50%. In such cases, ground-truthing is recommended.

Once it is determined that the stand is of uneven structure, the QMD for overstory stems must be calculated separately from the QMD for understory stems. Space is provided on the habitat sampling data sheet for recording whether or not a stem is an overstory or an understory stem. A separate calculation of QMD for each layer or a frequency count of trees by CWHR size class in each layer are two ways to assess whether or not there is "a distinct layer of size class 5 trees over a distinct layer of size class 4 and/or 3 trees".

A visual representation of size class 6 and example of using plot data to calculate size class 6 are provided in Figures 1 and 2 below.
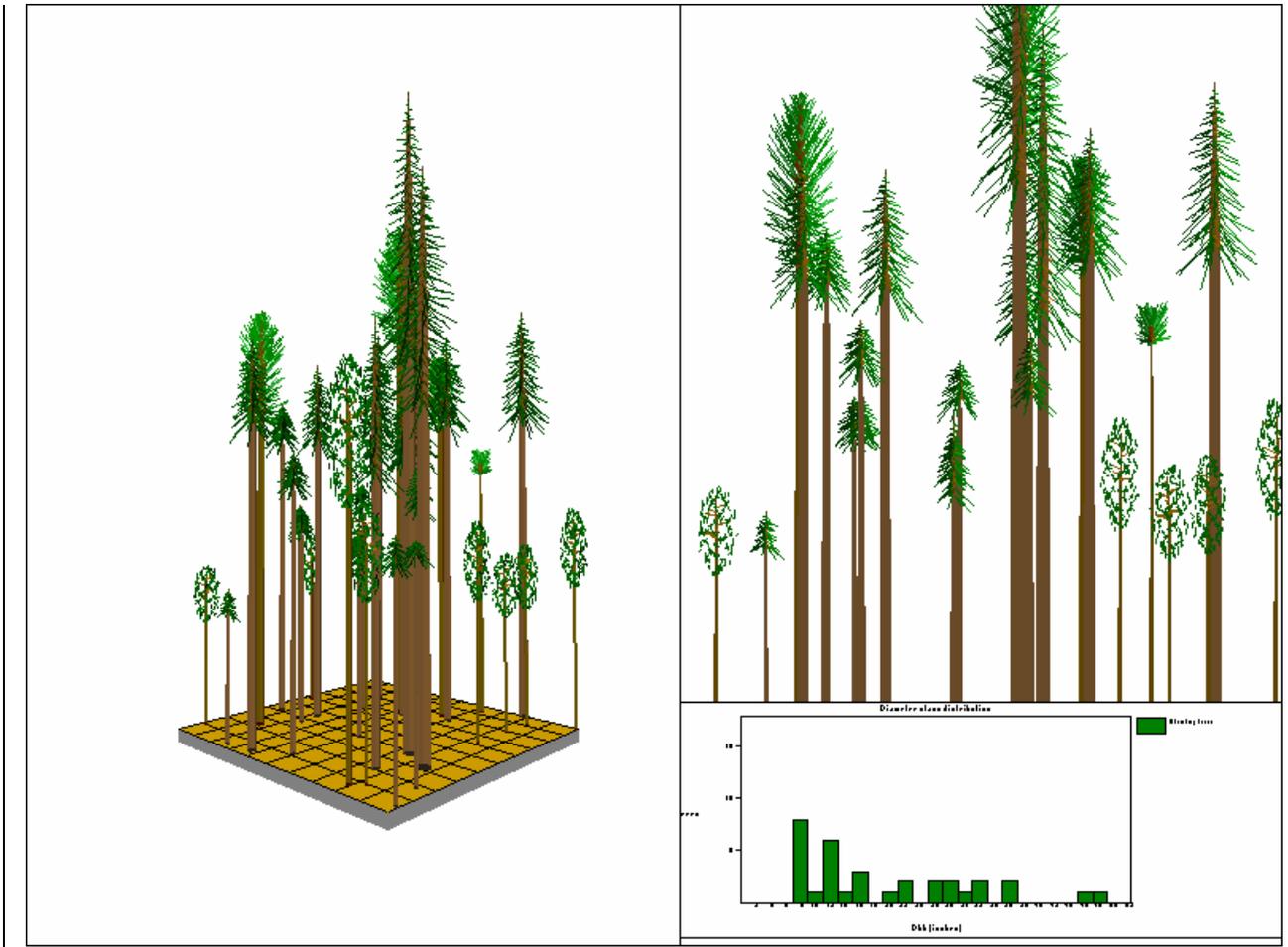
Figure 1. Stand visualization system (SVS) (McGaughey 2002) depiction of a WHR 6 plot including perspective view (left), cross section view (upper right) and diameter distribution graph (lower right). Data is from 2005 measurement of Jackson Demonstration State Forest continuous forest inventory plot 04-04.

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
WOODED HABITAT SAMPLING DATASHEET

Date: 7/7/2005 Sample Crew: J. Smith, B. Jones Plot Number: 04 Location: Line 04 JDSF

Visual estimate at plot center before sampling: CWHR habitat type, size class and canopy closure class: RWD 6
Structure: Even-structure: _____ or Uneven-structure: X

Standards For Tree Size					Standards For Canopy Closure		
CWHR Code	CWHR Size Class	Conifer Crown Diameter	Hardwood Crown Diameter	DBH	CWHR Code	CWHR Closure Class	Veg. Cover (Canopy Closure)
1	Seedling tree	n/a	n/a	<1.0"	S	Sparse Cover	10.0-24.9%
2	Sapling tree	n/a	<15.0'	1.0"-5.9"	P	Open cover	25.0-39.9%
3	Pole tree	<12.0'	15.0'-29.9'	6.0"-10.9"	M	Mod. Cover	40.0-59.9%
4	Small tree	12.0-23.9'	30.0'-44.9'	11.0"-23.9"	D	Dense Cover	≥60.0%
5	Medium/large tree	≥24.0'	≥45.0'	≥24.0"	Uneven-structure = ≥3 CWHR size classes, or if only 2 classes present, then the classes must skip an intervening class (e.g., 3 and 5 present but not 4) with distinctive height separation. Plots are even-structured if they do not meet uneven-structure definition.		
6	Multi-layered tree	A distinct layer of size class 5 trees over a distinct layer of size class 4 and/or 3 trees, and total tree canopy of the layers ≥ 60% (layers must have ≥ 10.0% canopy cover and distinctive height separation)					

Record species and dbh from all live woody stems ≥ 5.0" dbh in a 0.1-acre circular plot (37.2 ft radius). Crown diameter and height are from 1 tree/cardinal compass quarter with point-centered quarter for a total of 4 trees/plot. Overstory trees include pre-dominants and dominants, and generally co-dominants. Intermediate trees may be overstory or understory trees depending on relative crown position, while suppressed trees should always be understory trees.

Stem #	Species	Over/under	dbh (0.1 in) in	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad quad	Stem #	Species	Over/under	dbh (0.1 in)	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad
1	TO	U	5.0	13	72	NE	26						
2	TO	U	7.3				27						
3	DF	O	30.6				28						
4	TO	U	10.0				29						
5	RW	U	11.2				30						
6	TO	O	16.8				31						
7	TO	U	8.5				32						
8	DF	U	8.7	15	89	SE	33						
9	RW	U	8.1				34						
10	TO	U	7.2				35						
11	RW	O	45.9	40	172	SW	36						
12	RW	O	45.8				37						
13	RW	O	21.9				38						
14	RW	O	22.0				39						
15	RW	O	16.0				40						
16	RW	O	26.6				41						
17	RW	O	25.8				42						
18	RW	O	31.1				43						
19	RW	U	12.0				44						
20	TO	U	7.0	11	60	NW	45						
21	TO	U	7.1				46						
22							47						
23							48						
24							49						
25							50						

OVERSTORY CANOPY COVER MEASUREMENT
Overstory cover hits (+) and misses (0) measured through a sighting tube at 6.2 ft. intervals beginning at the North stake and proceeding along the N-S axis for 13 readings, then from the East stake along the E-W axis for 12 readings and skipping the center stake. Take readings with tube held over the 6.2 ft. interval.
Percent Cover = (23 (no. hits)/25)) * 100.
N-S: I I O I I I I I I I I I I   E-W: I O I I I I L I I I L I I
(Center stake)

$$Basal\ Area = [0.005454 \times \Sigma dbh^2] \times 10 \doteq 552$$

$$\% \ Cover = 92\%$$

$$Trees\ Per\ Acre \doteq 210$$

$$QMD = \left[\frac{\Sigma dbh^2}{TPA}\right]^{\frac{1}{2}} \doteq 22.0$$

Overstory TPA = 100
Overstory QMD ≐ 30
Understory TPA ≐ 110
Understory QMD ≐ 9

Figure 2. Plot data sheet for WHR 6 calculation. Data is from 2005 measurement of Jackson Demonstration State Forest continuous forest inventory plot 04-04

Even Structure   If a stand is to be treated as an even structured stand, then suppressed trees that do not comprise part of the overstory are not included in calculations of QMD. Again, a definition of overstory is provided on the habitat sampling data sheet. It includes dominants, co-dominants, and pre-dominants and can include intermediates. The habitat sampling data sheet includes space for measuring all live woody stems >= 5" dbh, but also a space for noting whether they are over or understory (clearly suppressed) trees. Suppressed trees >= 5" DBH are not included in the QMD calculation when part of an understory of less than 10% canopy closure. If the understory canopy closure of trees >= 5" DBH is >= 10% and the overstory trees are >= 24" and >= 10 % canopy closure then the stand may be a size class 6 (See "Size Class 6 – Uneven Structure" above.).

Visual representation of size class 5 stands and an example of using plot data to calculate size class 5 are provided in Figures 3 through 6 below.
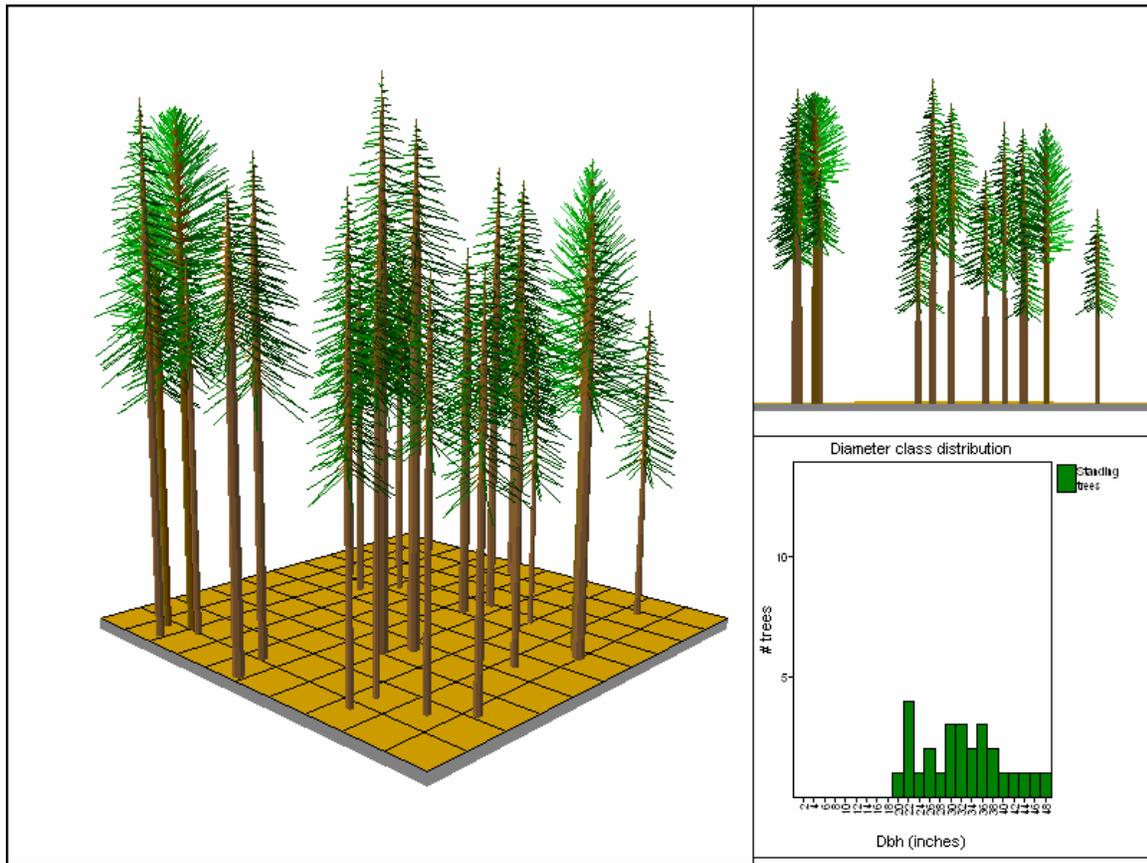
Figure 3. SVS depiction of a 5D plot including perspective view (left), cross section view (upper right) and diameter distribution graph (lower right). Data is from 2005 measurement of Jackson Demonstration State Forest Whiskey Springs thinning study (Lindquist 2004): 25% retention treatment.

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
WOODED HABITAT SAMPLING DATASHEET

Date: 11/7/2005 Sample Crew: F.P. Plot Number: 1 Location: Whiskey Springs, JDSF

Visual estimate at plot center before sampling: CWHR habitat type, size class and canopy closure class: RWD 5 D
Structure: Even-structure: X or Uneven-structure:

		Standards For Tree Size				Standards For Canopy Closure	
CWHR Code	CWHR Size Class	Conifer Crown Diameter	Hardwood Crown Diameter	DBH	CWHR Code	CWHR Closure Class	Veg. Cover (Canopy Closure)
1	Seedling tree	n/a	n/a	<1.0"	S	Sparse Cover	10.0-24.9%
2	Sapling tree	n/a	<15.0'	1.0"-5.9"	P	Open cover	25.0-39.9%
3	Pole tree	<12.0'	15.0'-29.9'	6.0"-10.9"	M	Mod. Cover	40.0-59.9%
4	Small tree	12.0'-23.9'	30.0'-44.9'	11.0"-23.9"	D	Dense Cover	>60.0%
5	Medium/large tree	≥24.0'	≥45.0'	≥24.0"			
6	Multi-layered tree	A distinct layer of size class 5 trees over a distinct layer of size class4 and/or 3 trees, and total tree canopy of the layers ≥ 60% (layers must have ≥ 10.0% canopy cover and distinctive height separation)			Uneven-structure = ≥3 CWHR size classes, or if only 2 classes present, then the classes must skip an intervening class (e.g. 5 and 3 present but not 4) with distinctive height separation. Plots are even-structured if they do not meet uneven-structure definition.		

Record species and dbh from all live woody stems ≥ 5.0" dbh in a 0.1-acre circular plot (37.2 ft radius). Crown diameter and height are from 1 tree/cardinal compass quarter with point-centered quarter for a total of 4 trees/plot. Overstory trees include pre-dominants and dominants, and generally co-dominants. Intermediate trees may be overstory or understory trees depending on relative crown position, while suppressed trees should always be understory trees.

Stem #	Species	Over/ under	dbh (0.1 in) in	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad quad	Stem #	Species	Over/ under	dbh (0.1 in)	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad
1	RW	O	47.3	21	134	NE	26						
2	DF	O	32.0	15	160	SE	27						
3	RW	O	26.6	13	127	NW	28						
4	RW	O	35.8				29						
5							30						
6							31						
7							32						
8							33						
9							34						
10							35						
11							36						
12							37						
13							38						
14							39						
15							40						
16							41						
17							42						
18							43						
19							44						
20							45						
21							46						
22							47						
23							48						
24							49						
25							50						

OVERSTORY CANOPY COVER MEASUREMENT
Overstory cover hits (+) and misses (0) measured through a sighting tube at 6.2 ft. intervals beginning at the North stake and proceeding along the N-S axis for 13 readings, then from the East stake along the E-W axis for 12 readings and skipping the center stake. Take readings with tube held over the 6.2 ft. interval.
Percent Cover = (2.0 (no. hits)/25)) * 100.
N-S: 0 0 I I I I I 0 I I I I I E-W: I I I I 0 I I I I I I I I
(Center stake)

$$Basal\ Area = [.005454 \times \Sigma dbh^2] \times 10 \doteq 286$$

$$\%\ Cover = 80\%$$

$$Trees\ Per\ Acre = 40$$

$$QMD = \left[\frac{\Sigma dbh^2}{TPA}\right]^{1/2} = 36.2$$

Figure 4. Plot data sheet for WHR 5D calculation. Data is from 2005 measurement of Jackson Demonstration State Forest Whiskey Springs thinning study (Lindquist 2004): 25% retention treatment.
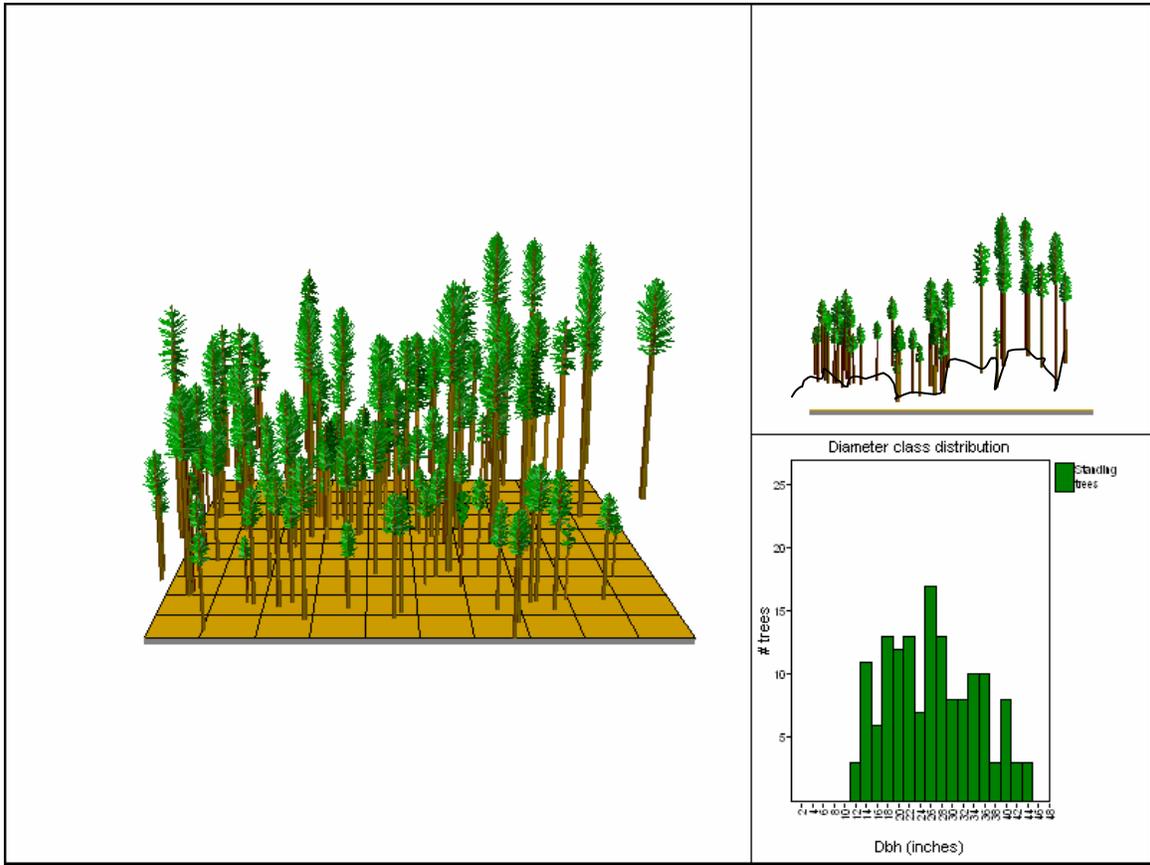
Figure 5. SVS depiction of a 5D plot including perspective view (left), cross section view (upper right) and diameter distribution graph (lower right). Data is from 2005 measurement of Boggs Mountain Demonstration State Forest growth and mortality plot number 6, which is 2.5 acres and stem mapped in three dimensions. Ground elevation varies.

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
WOODED HABITAT SAMPLING DATASHEET

Date: 8/17/05 Sample Crew: ML Plot Number: 6 Location: Boggs Mtn
DFR 5 M

Visual estimate at plot center before sampling: CWHR habitat type, size class and canopy closure class:
Structure: Even-structure: X   or Uneven-structure:

CWHR Code	CWHR Size Class	Conifer Crown Diameter	Hardwood Crown Diameter	DBH	CWHR Code	CWHR Closure Class	Veg. Cover (Canopy Closure)
1	Seedling tree	n/a	n/a	<1.0"	S	Sparse Cover	10.0-24.9%
2	Sapling tree	n/a	<15.0'	1.0"-5.9"	P	Open cover	25.0-39.9%
3	Pole tree	<12.0'	15.0'-29.9'	6.0"-10.9"	M	Mod. Cover	40.0-59.9%
4	Small tree	12.0-33.9'	30.0'-44.9'	11.0"-23.9"	D	Dense Cover	>60.0%
5	Medium/large tree	≥24.0'	≥45.0'	≥24.0"			
6	Multi-layered tree	A distinct layer of size class 5 trees over a distinct layer of size class 4 and/or 3 trees, and total tree canopy of the layers ≥ 60% (layers must have ≥ 10.0% canopy cover and distinctive height separation)			Uneven-structure = ≥3 CWHR size classes, or if only 2 classes present, then the classes must skip an intervening class (e.g. 5 and 3 present but not 4) with distinctive height separation. Plots are even-structured if they do not meet uneven-structure definition.		

Record species and dbh from all live woody stems ≥ 5.0" dbh in a 0.1-acre circular plot (37.2 ft radius). Crown diameter and height are from 1 tree/cardinal compass quarter with point-centered quarter for a total of 4 trees/plot. Overstory trees include pre-dominants and dominants, and generally co-dominants. Intermediate trees may be overstory or understory trees depending on relative crown position, while suppressed trees should always be understory trees.

Stem #	Species	Over/under	dbh (0.1 ht) in	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad	Stem #	Species	Over/under	dbh (0.1 ht)	Crown diam (ft)	Ht (ft)	pt-ctr 1/4 quad
1	DF	U	14.0	9	47	NE	26						
2	DF	O	19.1				27						
3	DF	O	22.4				28						
4	SP	O	39.5	20	123	SE	29						
5	DF	O	33.5				30						
6	DF	O	25.3	14	82	SW	31						
7	BO	U	6.8				32						
8	DF	U	13.1	9	44	NW	33						
9							34						
10							35						
11							36						
12							37						
13							38						
14							39						
15							40						
16							41						
17							42						
18							43						
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23							48						
24							49						
25							50						

OVERSTORY CANOPY COVER MEASUREMENT
Overstory cover hits (+) and misses (0) measured through a sighting tube at 6.2 ft. intervals beginning at the North stake and proceeding along the N-S axis for 13 readings, then from the East stake along the E-W axis for 12 readings and skipping the center stake. Tube readings with tube held over the 6.2 ft. interval.
Percent Cover = (15 (no. hits)/25) * 100.

N-S: 1 0 1 1 0 0 1 1 1 1 1 1 0   E-W: 0 1 1 1 0 1 0 1 0 1 0 0
(Center stake)

$$\text{Basal Area} = \left[0.005454 \times \Sigma\, dbh^2\right] \times 10 \doteq 253$$

$$\% \text{ Cover} = 60\%$$

$$\text{Trees Per Acre} = 80$$

$$\text{Overstory QMD} = 29.0$$

Figure 6. Plot data sheet for WHR 5D calculation. Data is from 2005 measurement of Boggs Mountain Demonstration State growth and mortality plot number 6.

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Habitat Classification Rules
California Wildlife Habitat Relationships System
California Department of Fish and Game
California Interagency Wildlife Task Group
April, 2005

Structure	Composition	Geographic Region

Tree-Dominated

> 10% total cover by live vegetation in an overstory position; not a desert habitat (per those listed below)

Hardwood Defined by Region - Upland

Generally, in non-coastal regions and dominated by montane hardwoods, with or without oaks, or in coastal regions with canyon live oak (*Quercus chrysolepis*), California black oak (*Q. kelloggii*) or Oregon white oak (*Q. garryana*) as the dominant oak. **MHW**

Generally, in coastal regions with coast live oak (*Q. agrifolia*) or Englemann oak (*Q. engelmannii*) as the dominant oak. **COW**

Hardwood

> 50% relative overstory cover by hardwoods and < 25% relative overstory cover by conifers

Hardwood Defined by Species

ASP, EUC, BOW, VOW

Hardwood Defined by Region - Riparian

Generally, in montane regions, often intergrading with wet meadows, or in coastal and foothill regions along steep-gradient streams with black cottonwood (*Populus trichocarpa*) or bigleaf maple (*Acer macrophyllum)* dominating the overstory. May also be dominated by willows (*Salix* spp.) or alders (*Alnus* spp.) **MRI**

Generally, in valley and foothill regions along low-gradient streams with Fremont cottonwood (*P. fremontii*), California Sycamore (*Platanus racemosa*) or Valley Oak (*Q. lobata*) dominating the overstory. May also be dominated by willows (*Salix* spp.) or alders (*Alnus* spp.) **VRI**

(Note: If habitat is dominated by desert species or is in South-eastern Great Basin, Mojave, Sonoran or Colorado deserts, even if dominated by P. fremontii, see DRI under "Desert Tree/Shrub ".)

Hardwood-Conifer

> 50% relative overstory cover by hardwoods and > 25% relative overstory cover by conifers

MHC, BOP
(Rule exception: Stands dominated by foothill pine crosswalk into BOP.)

Conifer

> 50% relative overstory cover by conifers

Single Species Conifer

50% relative conifer cover by a single conifer species, regardless of the number of conifer species in the overstory

(*Note: If dominant conifer species does not have its own CWHR type, see Mixed Conifer below. Rule exception: Stands dominated by Western Hemlock, Grand Fir, and Sitka Spruce crosswalk into RDW*.)

RFR, LPN, WFR, DFR, JPN, RDW, JUN

Single Species Conifer Defined by Region

On the west side of the Sierra Nevada. **PPN**

In the Southern Cascades, Modoc Plateau and east side of the Sierra Nevada on coarse well-drained basaltic soils. **EPN**

Mixed Conifer

< 50% relative conifer cover by a single conifer species with > 5% cover by at least one other conifer species
or
> 50% relative conifer cover by a single conifer species that does not have its own CWHR type

CPC, PJN

Mixed Conifer Defined by Region

In the Klamath Mountains, on mid-elevation slopes. **KMC**

In all other mountain ranges, on mid-elevation slopes. **SMC**

In all mountain ranges at high elevations; characterized by open canopy and trees of low to medium stature. **SCN**

Structure	Geographic Region

Shrub-Dominated
10% total cover by shrub species and < 10% cover by tree species; not a desert habitat (per those listed below)

Generally, only at the highest elevations in California, above 7,500 feet. **ADS**

Generally, in mountainous terrain, from mid-to-high elevations (3,000 – 10,000 feet). **MCP**

Generally, below 5000 feet in mountain ranges throughout California, except in deserts. **MCH, CRC**

With a few exceptions, east of the Cascade and Sierra Nevada crests. **LSG, BBR, SGB**

In coastal regions throughout the length of California. **CSC**

Desert
≥ 2% total cover by desert species and < 10% total cover by other tree or shrub species

Desert Tree/Shrub
Desert Tree (size classes based on diameter above bulge) – **POS, JST**
Desert Tree/Shrub (size classes based on height) -- **DRI, DSW**

Desert Shrub
Size classes based on % decadence as with other shrub –dominated habitats)

Generally, in low-elevation deserts, often with creosotebush (*Larrea tridentata*) as the dominant shrub or in eastern portions of Central California Coast Ranges, often with California Ephedra (*Ephedra californica*) or buckwheat (*Eriogonum* spp).as the dominant shrub. **DSC**

Generally, in low-elevation deserts with an overstory of succulents. **DSS**

In the Mojave Desert and portions of the Colorado Desert, Great Basin, and southern San Joaquin Valley, dominated by various species of shrubby saltbushes. **ASC**

Herbaceous-Dominated
≥ 2% total cover by herbaceous species and < 10% total cover by tree or shrub species

Generally, statewide. **AGS, PGS, PAS, FEW**

Limited to montane or northwestern regions. **WTM**

Limited to tidally-influenced portion of coastal regions. **SEW**

Aquatic
≥ 98% total cover by open water and ≤ 2% total cover by vegetation in the continually-exposed shore zone

Freshwater - **RIV, LAC**
Marine - **EST, MAR**

Agricultural/Developed
≥ 2% total cover by non-wildland vegetation grown for food, fiber, or landscaping and does not meet criteria for any wildland habitat

Woody Agricultural - **DOR, EOR, VIN**
Herbaceous Agricultural - **DGR, IGR, IRF, IRH, RIC**
Developed - **URB**

Barren
< 2% total cover by any vegetation

BAR