Armillaria Prescence in Old Growth Redwood Ecosystems

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In collaboration with

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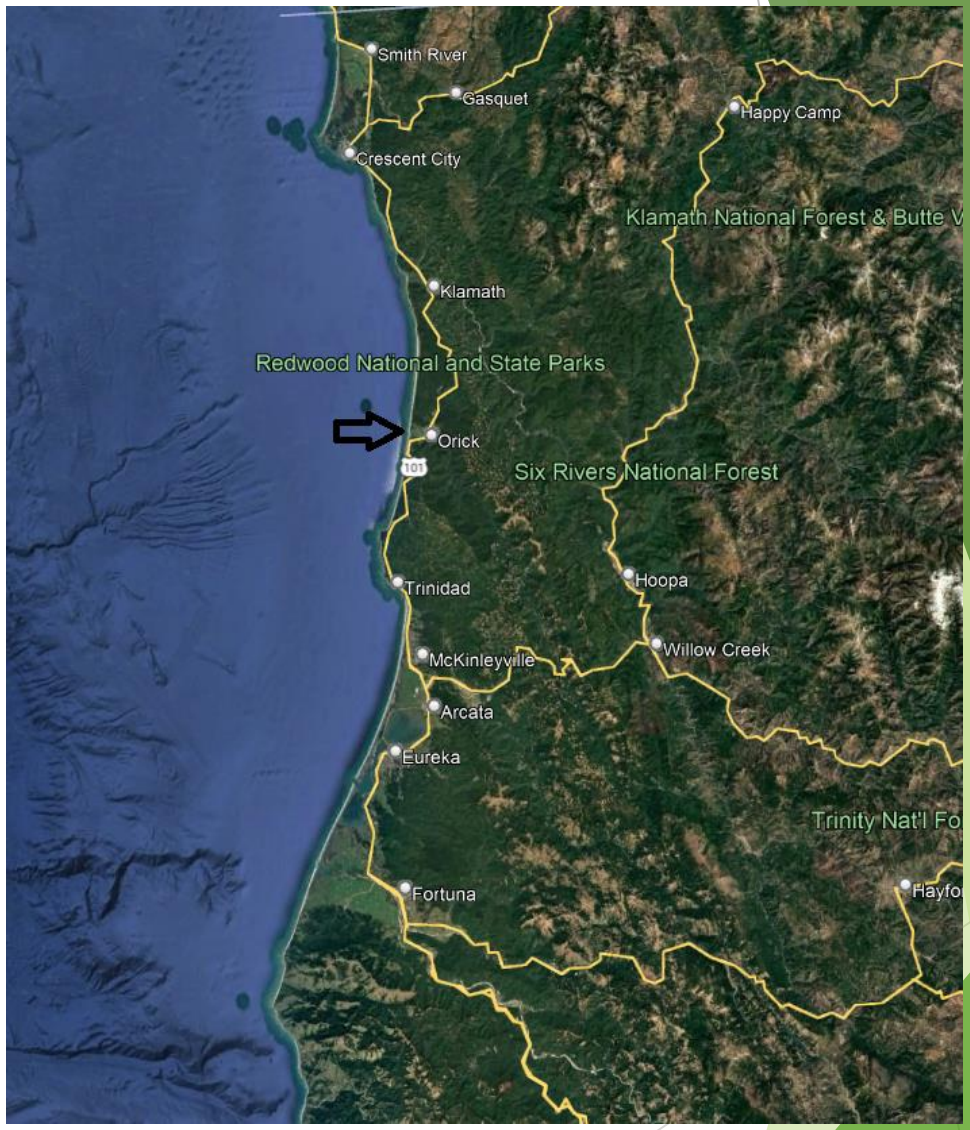
Background

- Cussins Plots
  - Six 1 ha plots in OG redwood near Orick
  - Established 1995
  - Remeasured every 5 years
  - Read Status 1-2 years
  - Remapped as accurately as possible
- Variable DBH threshold
  - Cussins 1 <- 5 cm threshold
  - All other Cussins plots <- 20 cm threshold



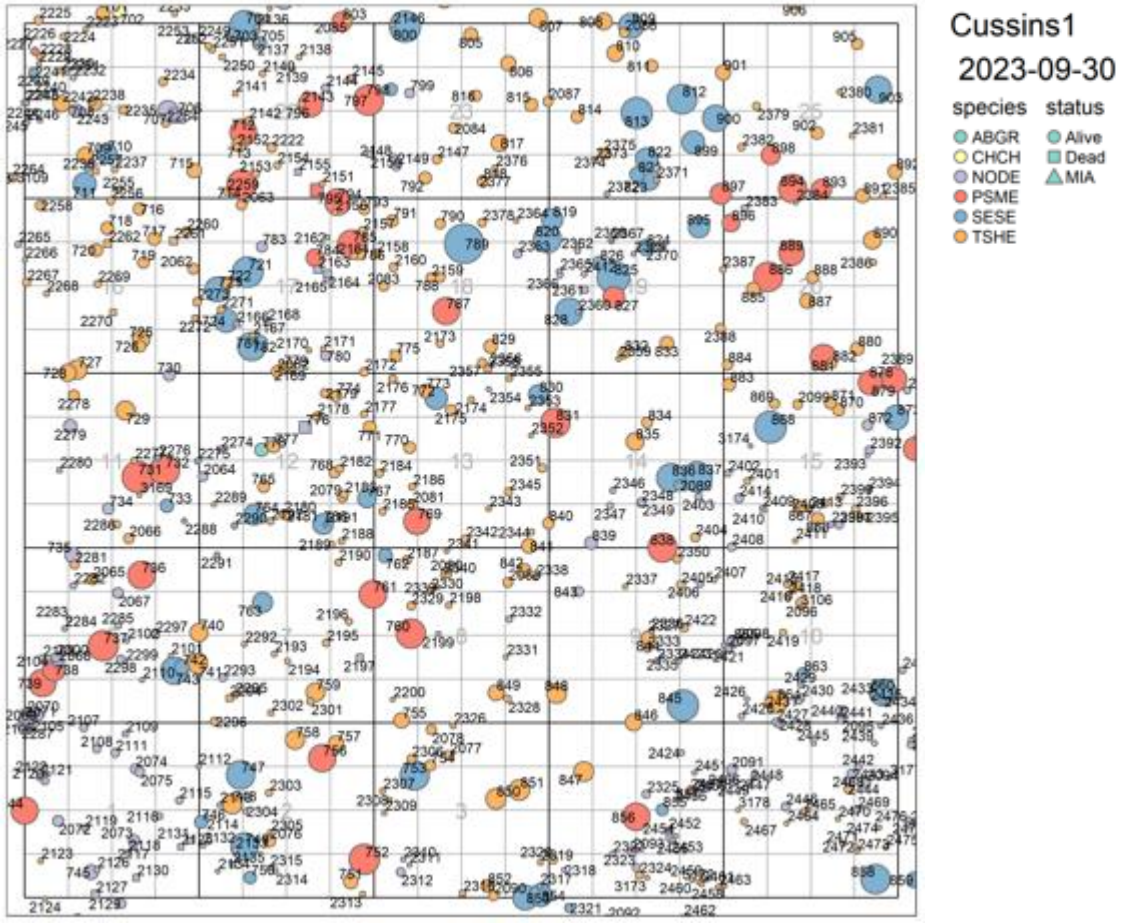
Location of Orick, CA
Credit: Google Earth Pro

Cussins Plots!

Cussins 3, the largest tree, #1292 clocking in at 470.2 cm in diameter.

Example Stem Map

Cussins 1 Stem Map – By Micah Wright - USGS



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Summary Data

Summary data by plot and species. Missing trees and Dead trees are a count.

	Species	TPHa	BA/ha (m^3)	QMD (cm)	Dead Trees	Missing Trees
Cussins1	ABGR	1	0.10752126	37	NA	NA
	CHCH	1	0.1479348	43.4	NA	NA
	NODE	134	3.88210339	19.205946	42	8
	PSME	38	63.9255485	146.35245	2	NA
	SESE	71	78.6548145	118.76488	2	1
	TSHE	263	19.8183501	30.974937	49	6
	Total	**508**	**166.536273**		**95**	**15**
Cussins2	ABGR	2	0.52583001	57.857843	NA	NA
	NODE	9	0.82739298	34.212847	NA	NA
	PSME	42	65.8869193	141.32842	4	NA
	SESE	49	89.069868	152.13247	NA	NA
	TSHE	82	19.8178529	55.472268	8	NA
	Total	**184**	**176.127863**		**12**	**0**
Cussins3	ABGR	24	4.34749531	48.025124	5	NA
	NODE	11	1.21560049	37.510568	2	NA
	PSME	12	38.6274156	202.44719	NA	NA
	SESE	58	190.424509	204.457	NA	NA
	TSHE	24	4.20155149	47.21215	3	NA
	Total	**129**	**238.816572**		**10**	**0**

	Species	TPHa	BA/ha (m^3)	QMD (cm)	Dead Trees	Missing Trees
Cussins4	ABGR	27	6.9074359	57.073053	6	NA
	NODE	37	2.81313	31.11348	11	NA
	PSME	8	29.673413	217.31681	NA	NA
	SESE	60	102.16937	147.24457	NA	NA
	TSHE	25	5.8329946	54.504246	2	NA
	Total	**157**	**147.39634**		**19**	**0**
Cussins5	NODE	45	7.6579241	46.5483	9	NA
	PSME	45	69.633195	140.36423	1	NA
	SESE	48	67.025764	133.33827	NA	NA
	TSHE	63	7.4017117	38.676784	1	NA
	Total	**201**	**151.71859**		**11**	**0**
Cussins6	NODE	3	0.2453275	32.267631	3	NA
	PSME	44	51.056138	121.54922	2	NA
	SESE	69	134.19302	157.36023	2	NA
	TSHE	59	17.382514	61.247003	9	NA
	Total	**175**	**202.877**		**16**	**0**

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All photos were taken on plot on 8/10 and 10/10 by Cameron Tavis

Armillaria Rhizomorphs on TSHE

Armillaria mycelial fans in young PSME

Armillaria Rhizomorphs on another section of TSHE

Armillaria Rhizomorphs on young TSHE roots

Methods

- Survey of mortality per plot for:
  - Decay class 1-5
  - Armillaria Prescence Y/N
  - Failure Type: SS, BS, FRP, PRP

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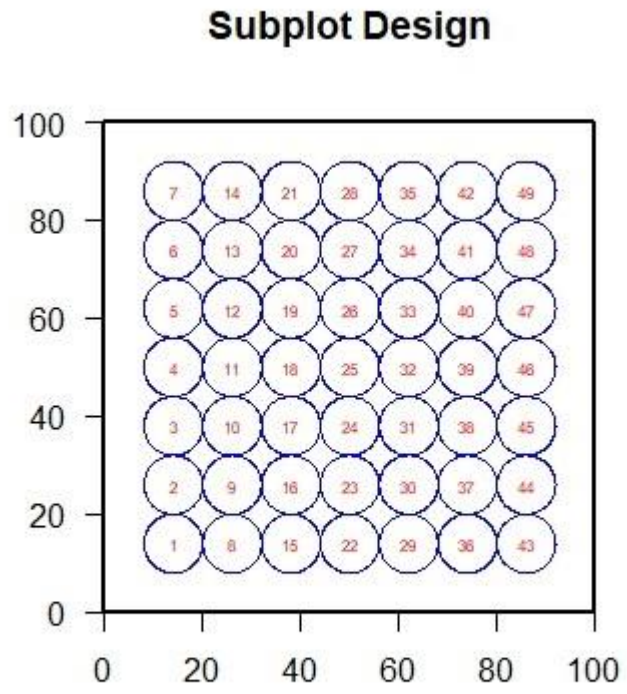
Analyses

- Mortality Tables
  - Sampling intensity
  - % occurrence of Armillaria by species
- Hegyi Competition Index
  - 6m kernel size
  - Buffered for edge effects
- Mapped Armillaria Occurrences
  - Using 49 subplots, competition per subplot was mapped using the summed Hegyi index for all plots

$$C_i = \sum_j \frac{D_j / D_i}{R_{ij}}$$

Hegyi Competition index standard form where D denotes dbh of target tree i and competitor tree j over distance R.



Subplot layout

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Mortality Table

Mortality Tables by plot and species. Pos. and Neg. refer to positive or negative detections respectively, and % total and % sample are percentage positive detection for the total and sampled mortality

Cussins 1	Mortality	Pos.	Neg.	sample intensity	% total	% sample	QMD
NODE	42	17	8	59.52	40.48	68.00	16.88
PSME	2	0	2	100.00	0.00	0.00	127.97
SESE	2	0	2	100.00	0.00	0.00	137.69
TSHE	49	14	22	73.47	28.57	38.89	21.16
Total	95	31	34				
Cussins2	Mortality	Pos.	Neg.	sample intensity	% total	% sample	QMD
PSME	4	0	4	100.00	0.00	0.00	156.78
TSHE	8	6	1	87.50	75.00	85.71	51.36
Total	12	6	5				
Cussins3	Mortality	Pos.	Neg.	sample intensity	% total	% sample	QMD
ABGR	5	5	0	100.00	100.00	100.00	58.72
NODE	2	1	1	100.00	50.00	50.00	45.50
TSHE	3	1	2	100.00	33.33	33.33	29.06
Total	10	7	3				

Cussins4	Mortality	Pos.	Neg.	sample intensity	% total	% sample	QMD
ABGR	6	5	1	100.00	83.33	83.33	59.47
NODE	11	6	2	72.73	54.55	75.00	29.85
TSHE	2	1	1	100.00	50.00	50.00	55.52
Total	19	12	4				
Cussins5	Mortality	Pos.	Neg.	sample intensity	% total	% sample	QMD
NODE	9	5	1	66.67	55.56	83.33	54.82
PSME	1	0	1	100.00	0.00	0.00	136.40
TSHE	1	1	0	100.00	100.00	100.00	25.10
Total	11	6	2				
Cussins6	Mortality	Pos.	Neg.	sample intensity	% total	% sample	QMD
NODE	3	1	0	33.33	33.33	100.00	38.78
PSME	2	0	2	100.00	0.00	0.00	130.32
SESE	2	0	1	50.00	0.00	0.00	62.70
TSHE	9	5	2	77.78	55.56	71.43	49.20
Total	16	6	5				

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Subplot Analyses

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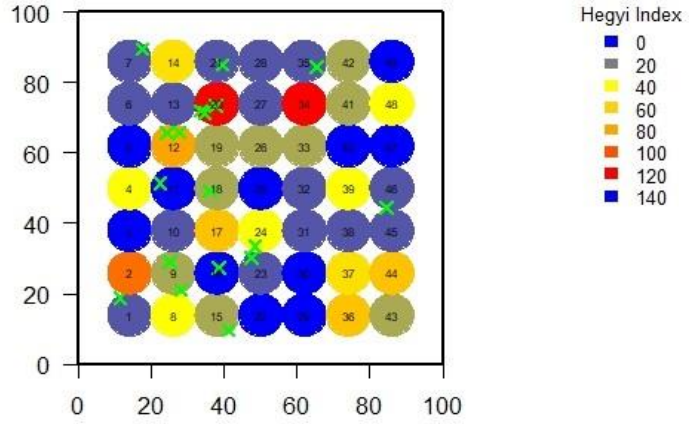
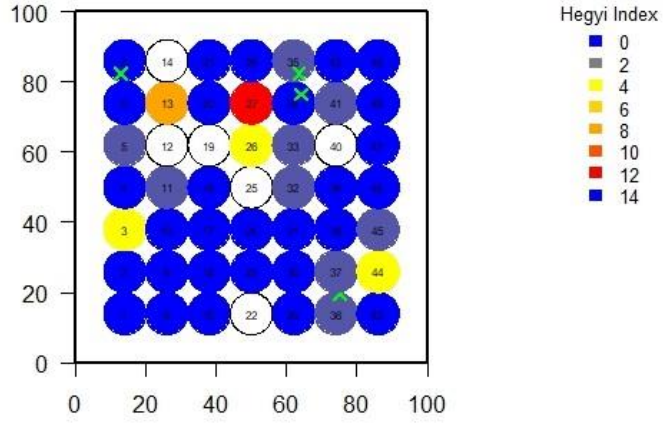
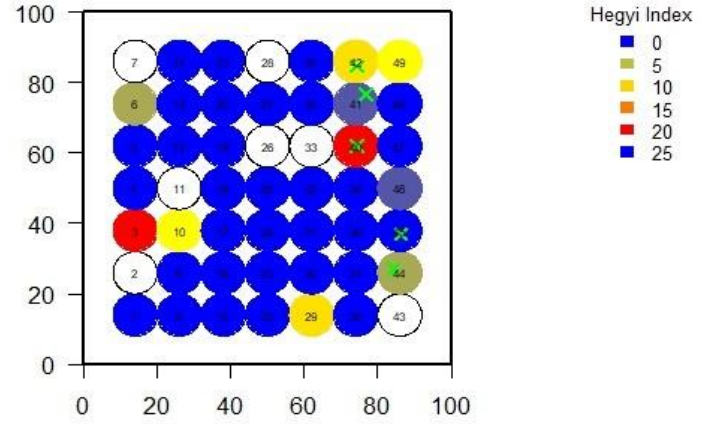
Tree Competition and Mortality: Cussins1



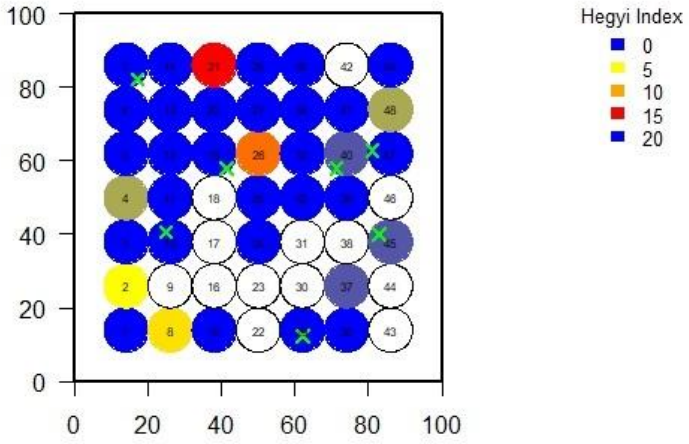
Tree Competition and Mortality: Cussins2



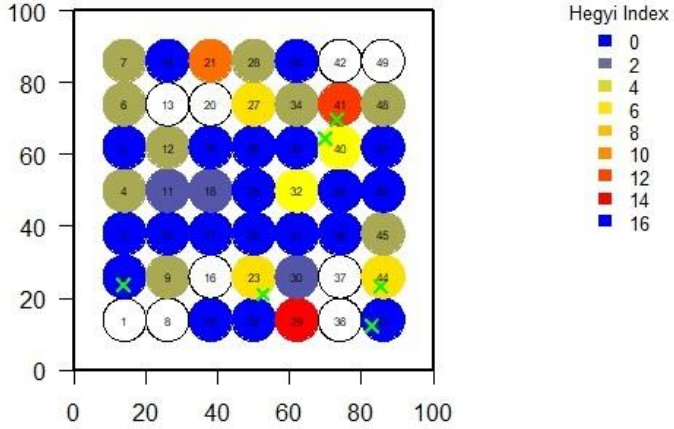
Tree Competition and Mortality: Cussins5



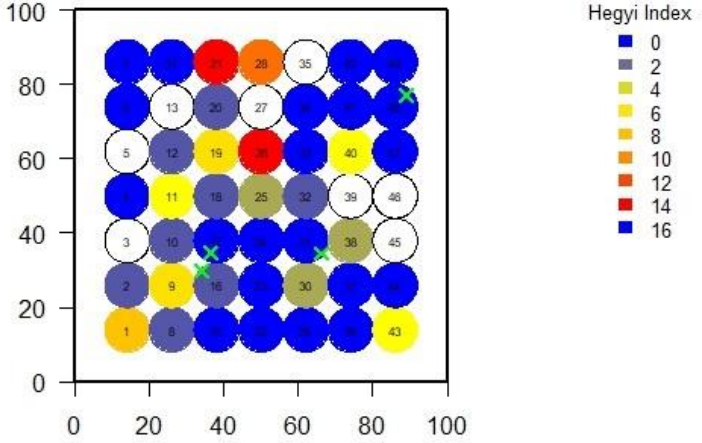
Tree Competition and Mortality: Cussins3



Tree Competition and Mortality: Cussins4



Tree Competition and Mortality: Cussins6



Subplots plotted by color according to summed Hegyi Index. Armillaria Positive Mortality is overlaid as the green x's

Discussion

- Limitations for sampling imposed by Cussins project goals
- Need for Armillaria baits in the future
- Other methods of determining competition (SDI?, BA/plot, Tree Count, etc.)
- DBH threshold influences comp.
- Chi square tests for armillaria occurrences according to Decay, Species and Hegyi index.

Questions?

References

- Hegyi, Frank. (1974) A Simulation Model for Managing Jack-pine Stands. P. 7490 in Fries, J. (Ed.) Growth Models for Tree and Stand Simulation. Royal College of Forestry, Department of Forest Yield Research, Research Notes 30. Stockholm, Sweden