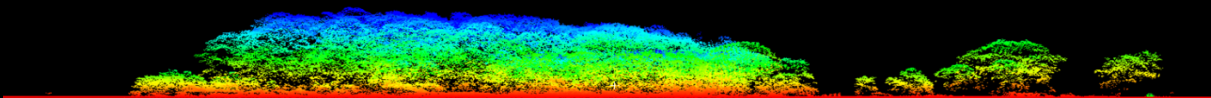


College of Forestry

Spatially Explicit Model of Slender-billed Nuthatch Nesting Habitat in the Willamette Valley, Oregon, using forest structure metrics derived from LiDAR

Ramiro Aragon Perez

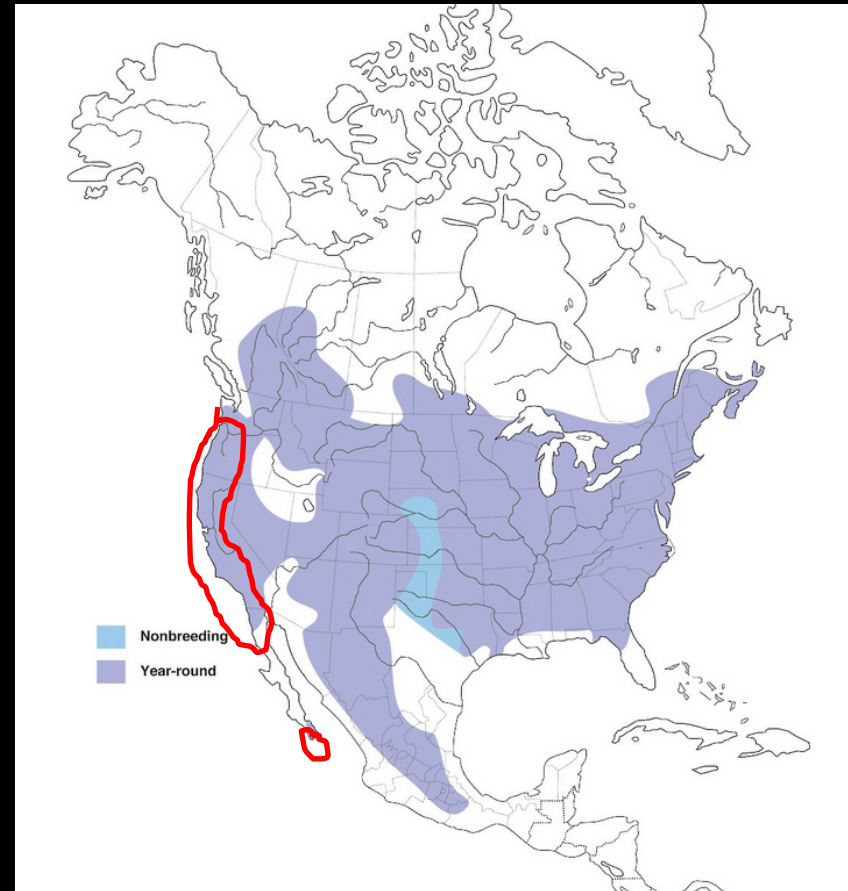


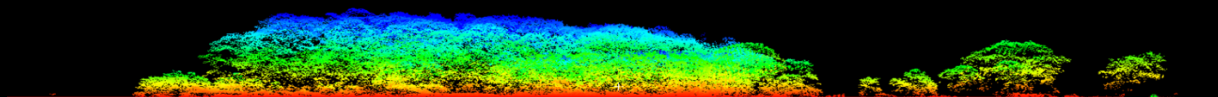
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Introduction

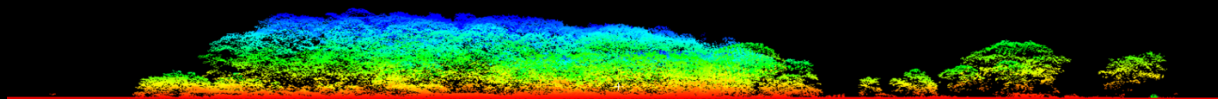
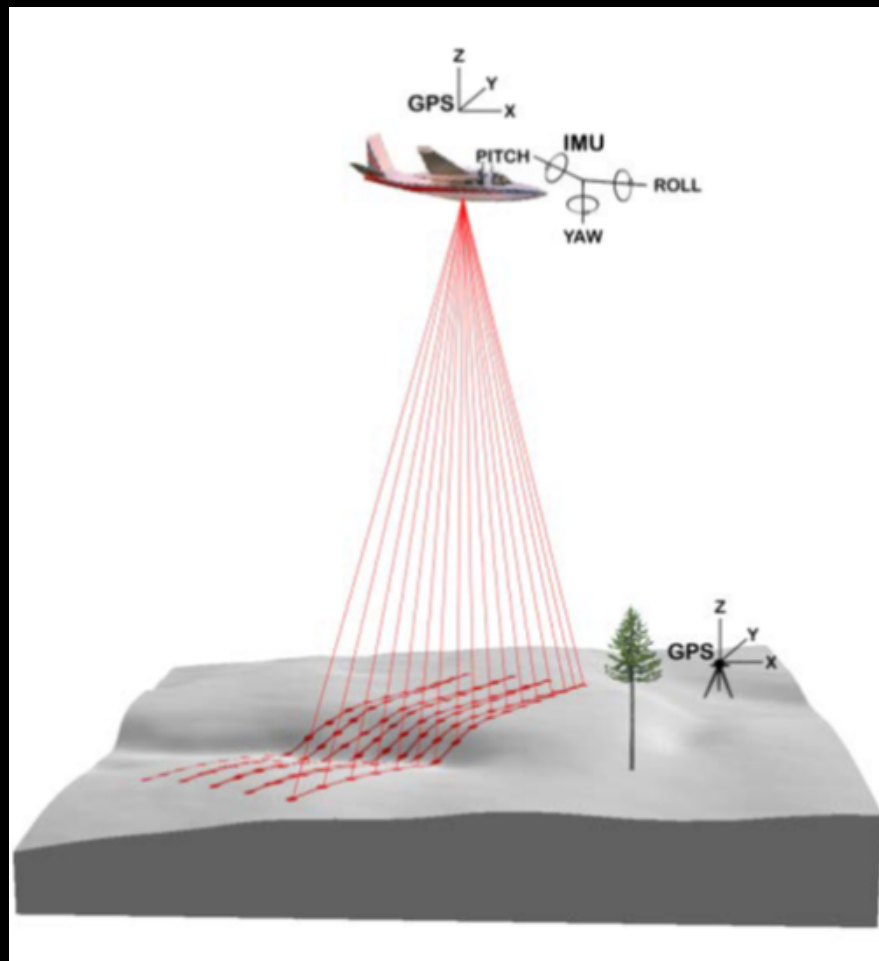


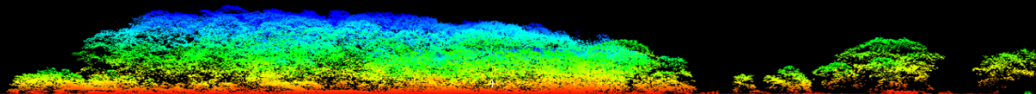
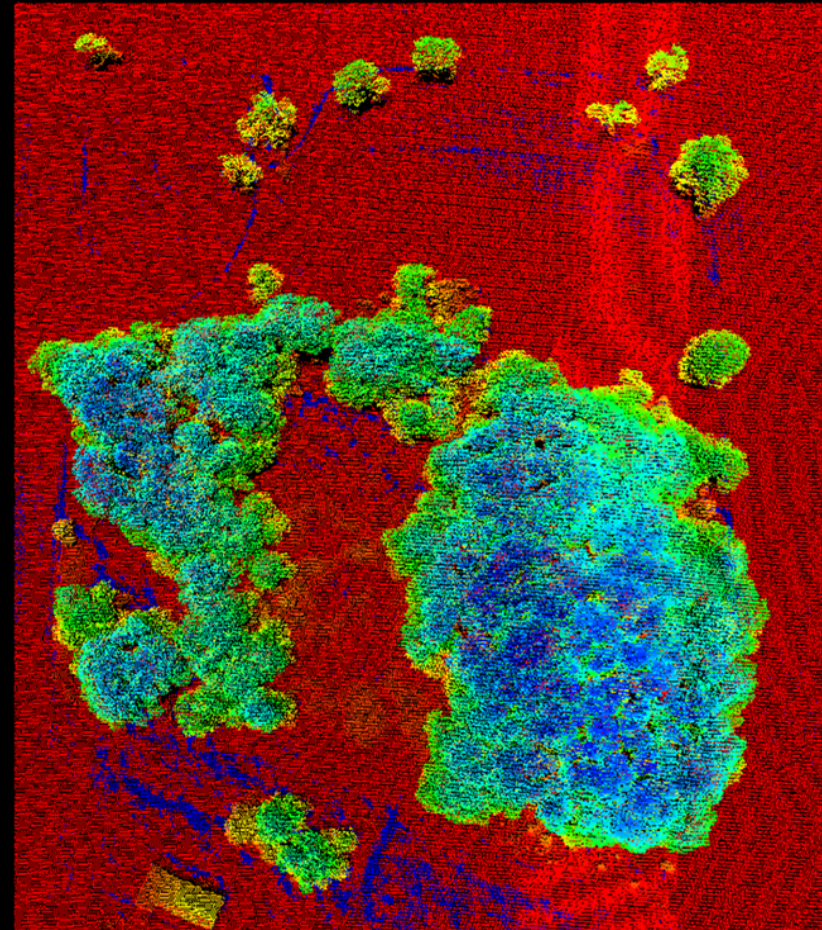
Slender-billed Nuthatch
(*Sitta carolinensis aculeate*)

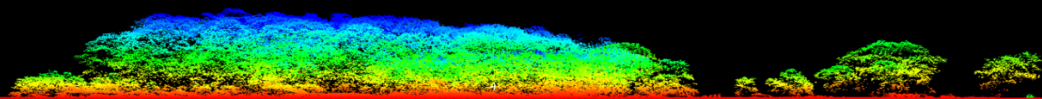
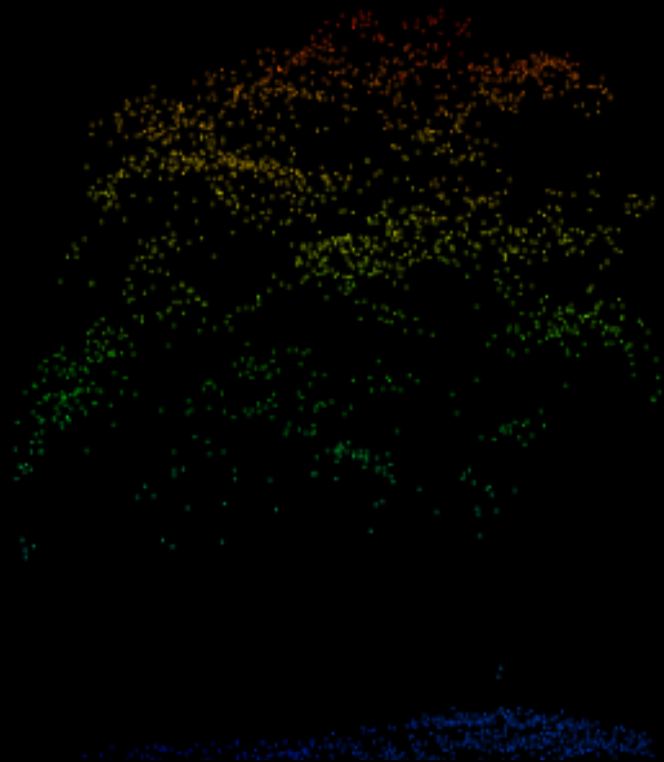




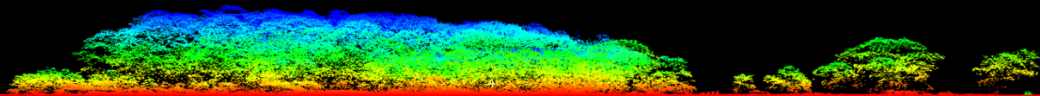
- Light Detection and Ranging (LiDAR)







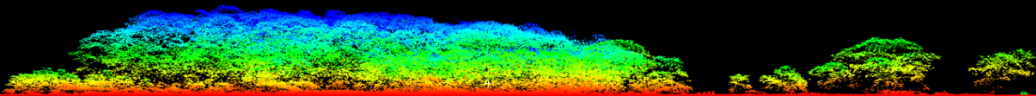
Objective:
to develop a spatially explicit model of nesting
habitat at tree level scale for the SBNU in the
Willamette Valley Ecoregion, using metrics
derived from high resolution LiDAR.



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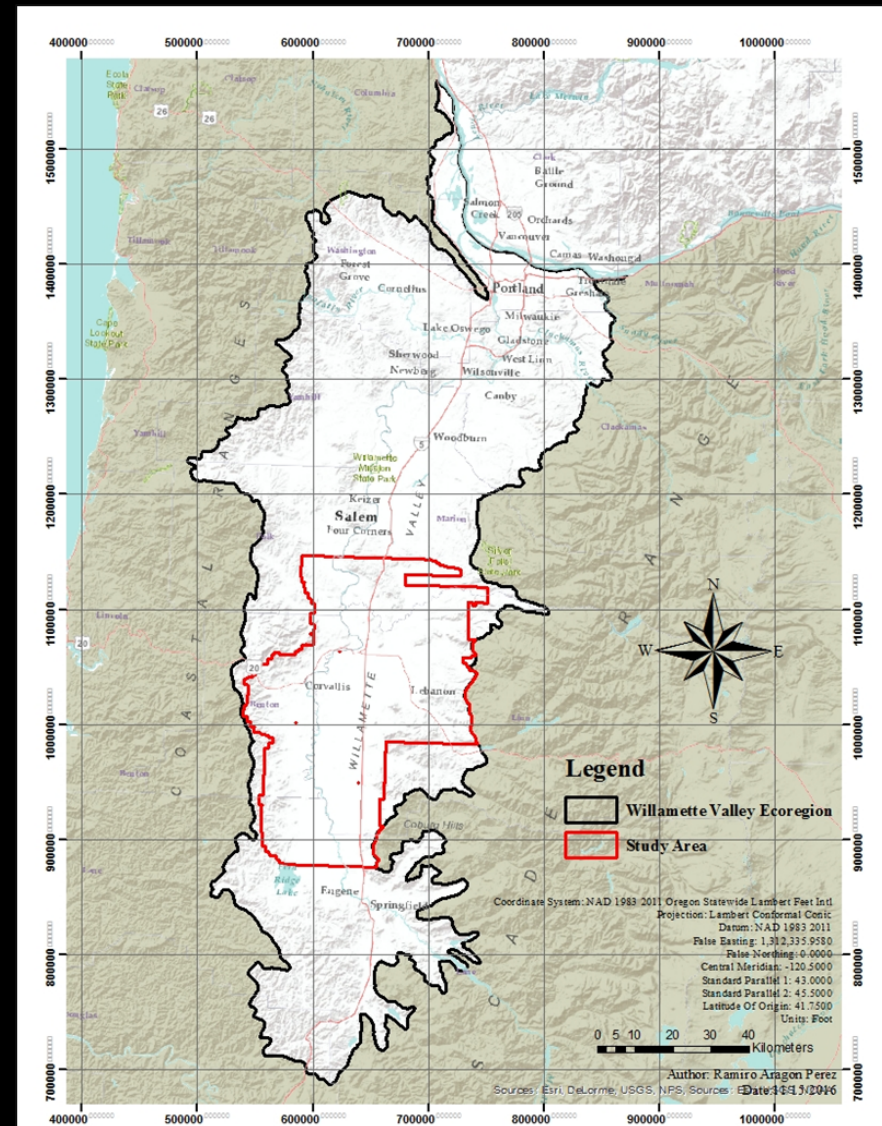


Method



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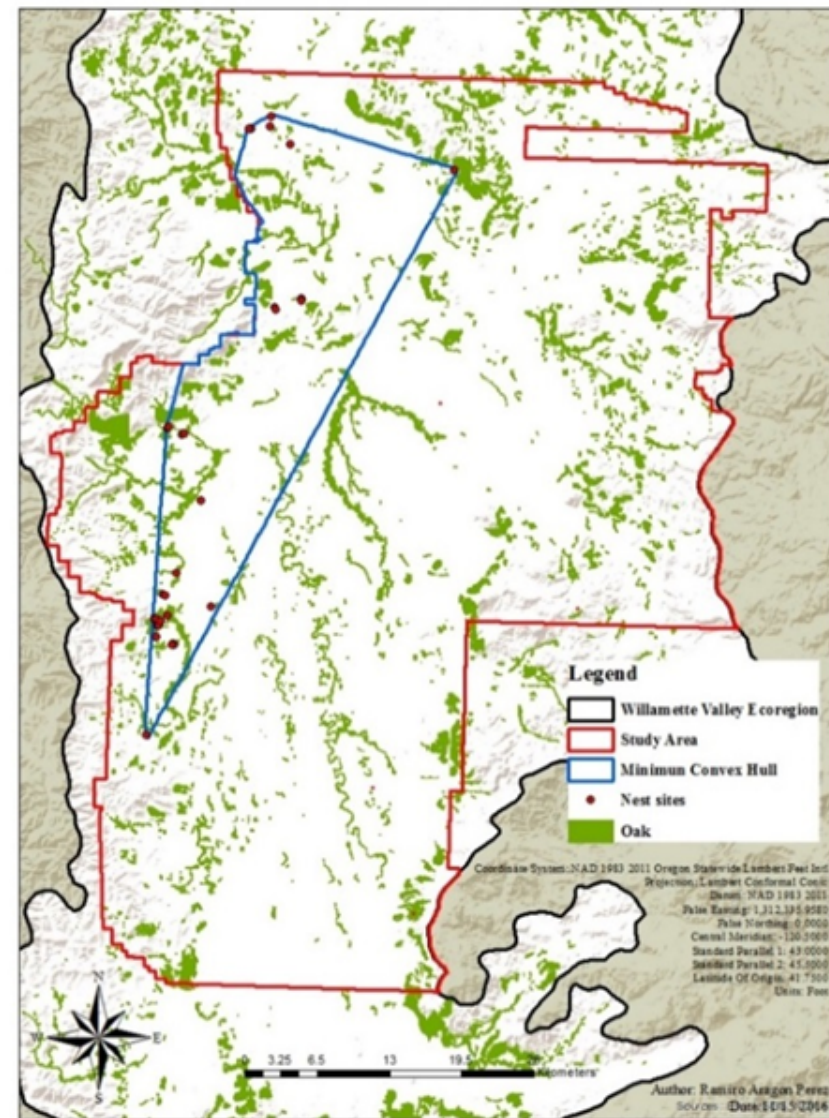
Study Area



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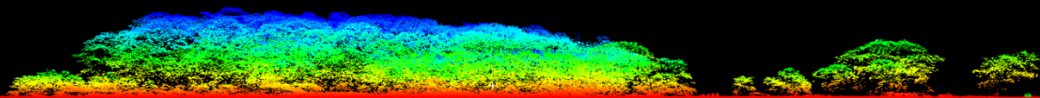
- 35 Nest Locations
(Viste-Sparkman,
2005)

Presence only dataset



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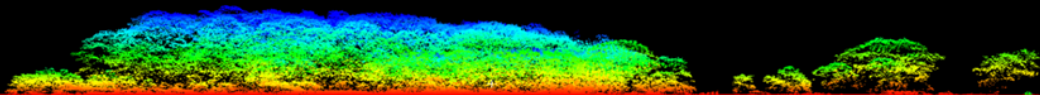
Variables



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Variables

- CANCOV+CANCOV.2 (Quadratic relationship of the Percentage of First Returns above 4 m)
- CANHEI (Elevation Maximum)
- STRAT1 (Proportion of all Returns within 0.5-2.0 m)
- STRAT2 (Proportion of all Returns within 2.0-5.0 m)

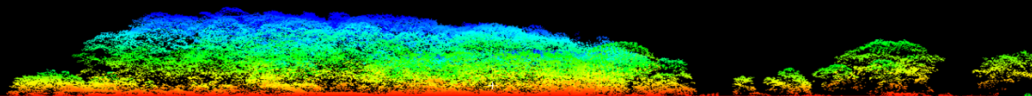
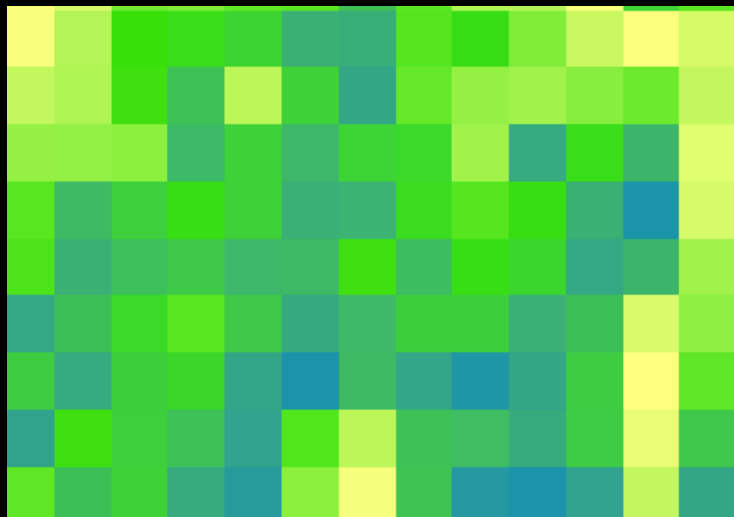


- Rasters of 12.4 m pixel size were generated = mean of nesting tree crown diameter (14 m)

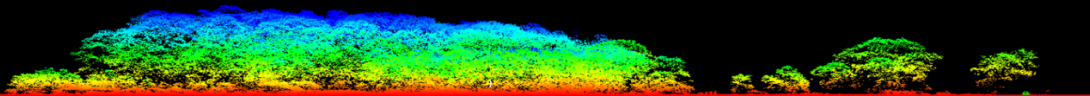
2	2	3	1
2	2	3	3
2	1	3	3
1	1	1	3

Focal mean →

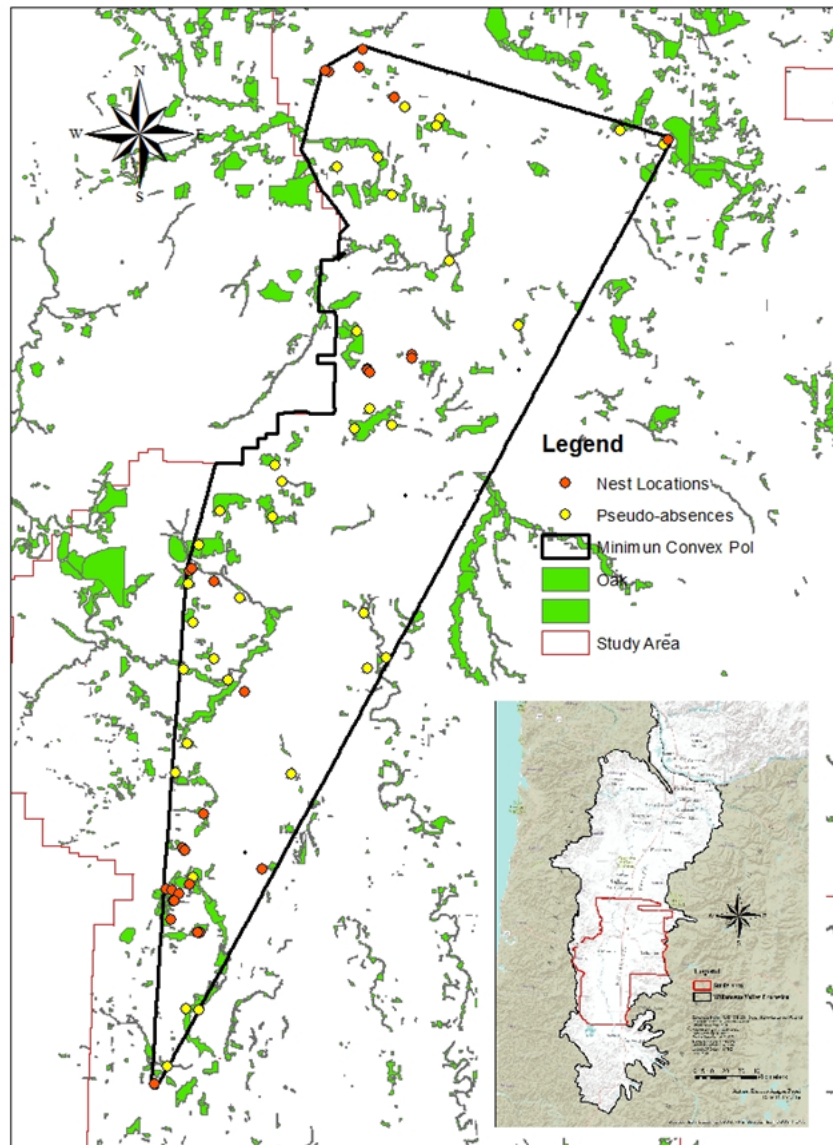
2	2.3	2.3	2.5
1.8	2.2	2.3	2.7
1.5	1.8	2.2	2.7
1.3	1.5	2.0	2.5



- LOGIT to evaluate the relationship of SBNU occupancy and forest structure.
- Needed to generate pseudo-absences



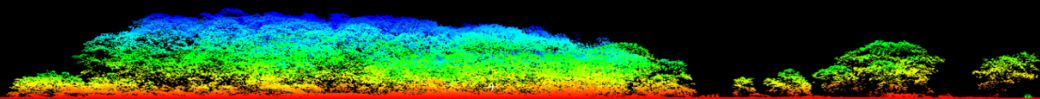
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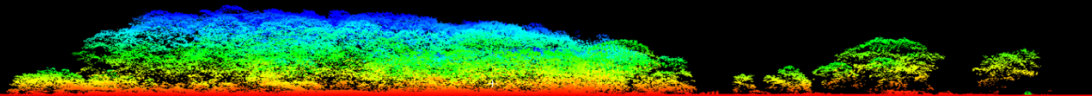
Candidate models

Variables

Model 1	Intercept-only (null model)
Model 2	STRAT1+STRAT2+CANHEI+CANCOV+CANCO.2 (global model)
Model 3	STRAT1+STRAT2
Model 4	STRAT1+STRAT2+CANHEI
Model 5	STRAT1+STRAT2+CANCOV+CANCO.2
Model 6	STRAT1+CANHEI
Model 7	STRAT1+CANCOV+CANCO.2
Model 8	STRAT2+CANHEI
Model 9	STRAT2+CANCOV+CANCO.2
Model 10	CANHEI+CANCOV+CANCO.2
Model 11	STRAT1
Model 12	STRAT2
Model 13	CANHEI
Model 14	CANCOV+CANCO.2

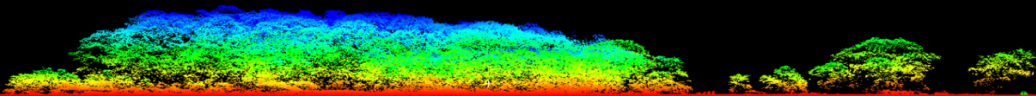


- Logistic regression to evaluate the relationship between the SBNU binary outcome and the forest structure variables derived from LiDAR
- Used Second-Order Information Criterion AICc for small samples to select the best model.
- Used Leave One Out Cross Validation (LOOCV) to validate the model.
- The best model was implemented using map algebra (Spatial Analysis, ArcMap 10.3)

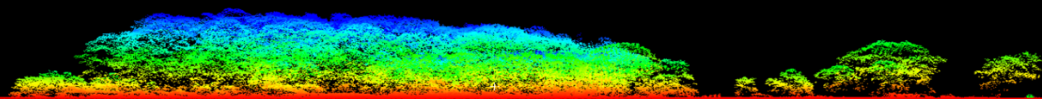
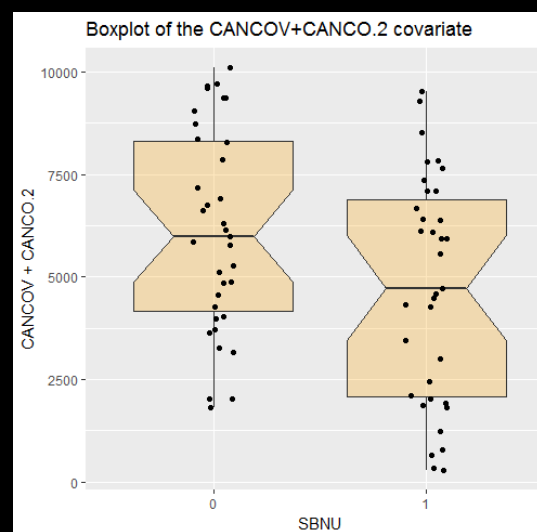
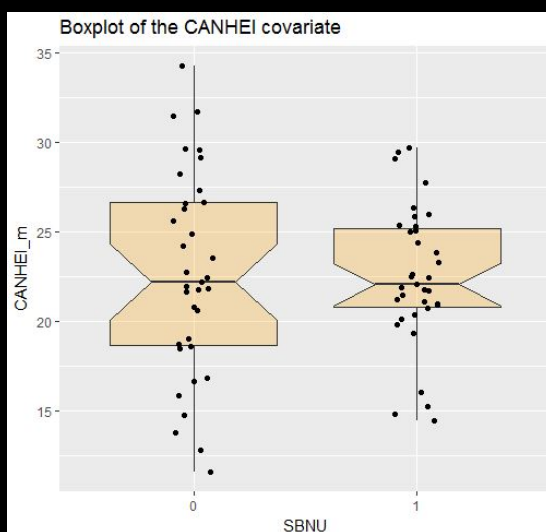
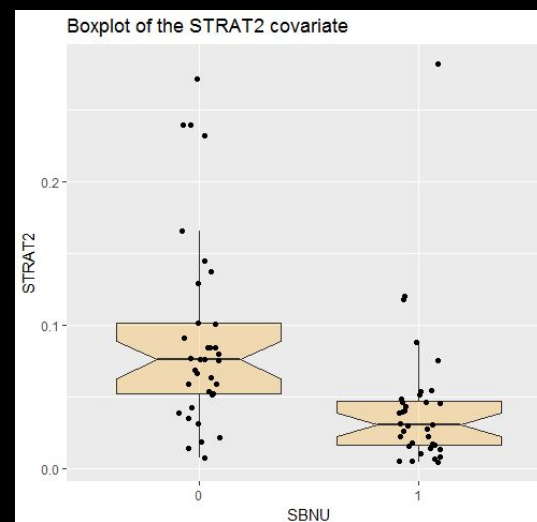
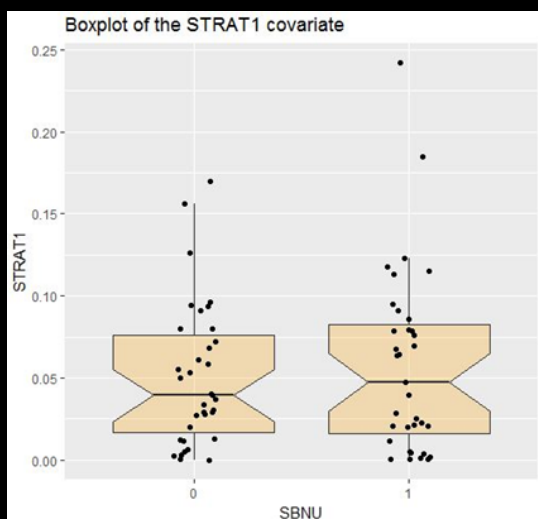




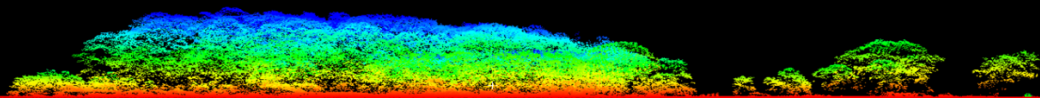
Results



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Mod	(Intrc)	CANCO.2	CANCOV	CANHE	STRAT1	STRAT2	df	logLik	AICc	Δ AICc	weight
5	4.88E+00	0.000456	-0.09308		15.01	-24.67	5	-37.411	85.8	0	0.313
3	6.59E-01				15.65	-24.27	3	-39.82	86	0.24	0.277
2	3.63E+00	0.000313	-0.08256	0.01761	13.97	-24.31	6	-37.071	87.5	1.72	0.133
9	4.24E+00	0.0002	-0.05996			-17.21	4	-39.672	88	2.2	0.104
4	1.24E+00			-0.00777	15.79	-24.5	4	-39.713	88	2.28	0.1
12	1.07E+00					-17.57	2	-42.602	89.4	3.62	0.051
8	1.52E+00			-0.00601		-17.74	3	-42.533	91.4	5.67	0.018
14	4.22E+00	0.000538	-0.1004				3	-45.247	96.9	11.1	0.001
10	2.63E+00	0.000378	-0.08897	0.02208			4	-44.575	97.8	12	0.001
7	4.19E+00	0.000553	-0.102		1.053		4	-45.228	99.1	13.31	0
1	-1.59E-16						1	-48.52	99.1	13.34	0
11	-1.58E-01				2.923		2	-48.342	100.9	15.1	0
13	1.24E-01			-0.00168			2	-48.514	101.2	15.45	0
6	-7.63E-03			-0.00205	2.949		3	-48.332	103	17.27	0

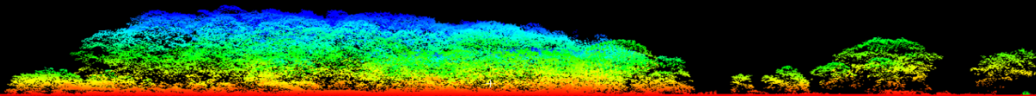


Confusion Matrix (0.5 threshold)

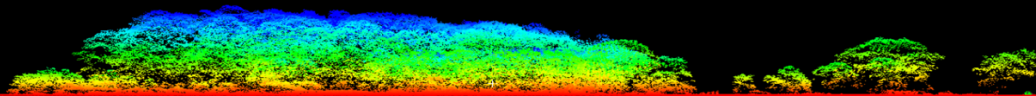
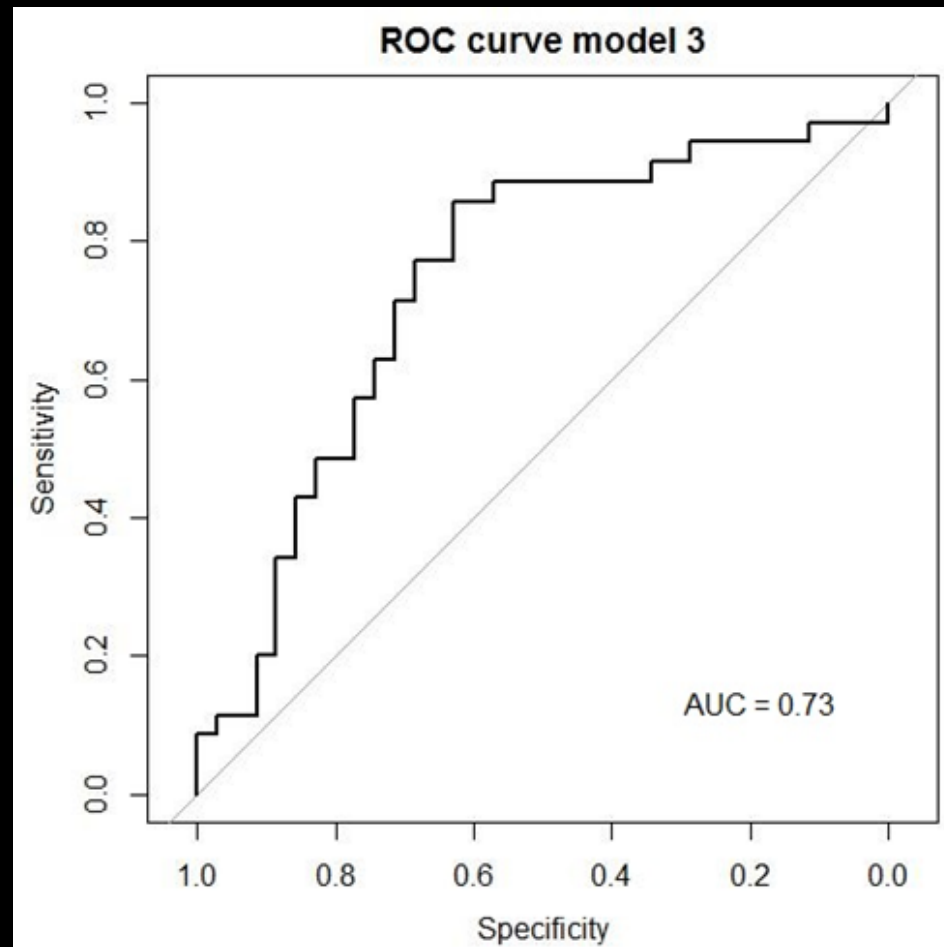
	Observed 1	Observed 0
Predicted 1	27	12
Predicted 0	8	23

Model Performance

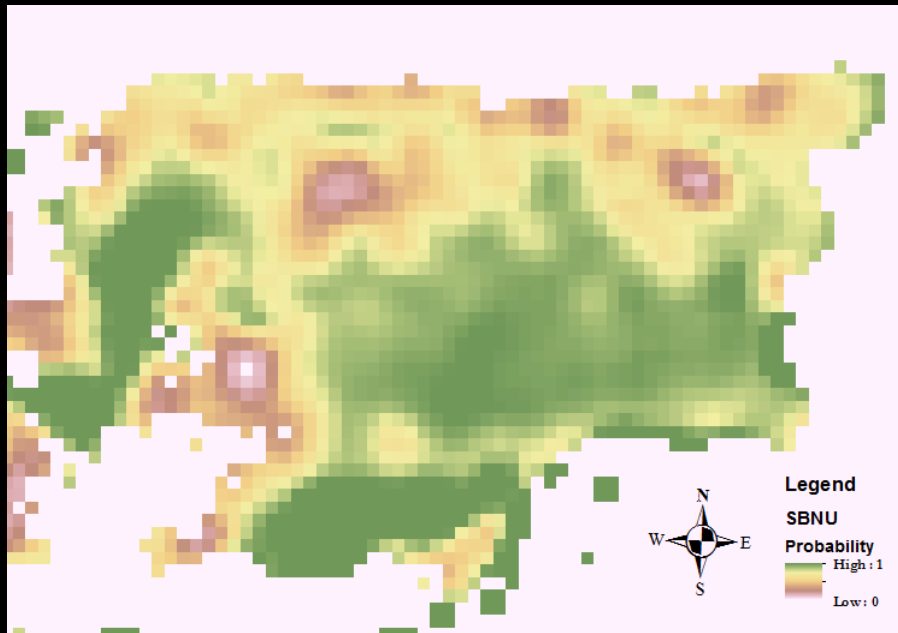
	Model 3
Sensitivity	0.77
Specificity	0.65
Kappa statistic	0.71
AUC	0.73



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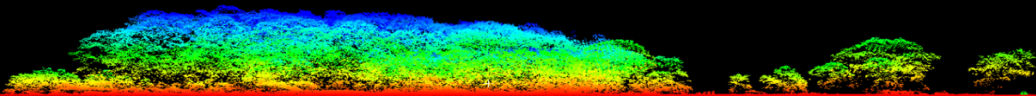




Limitations

It cannot distinguish the oak from other species

Landscape variables that might influence on the nesting habitat were not evaluated in this study (i.e. stand size, distance to edge, and disturbance or management).



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- Oak Woodland Structure does matter. Density of the vegetation on the 2 strata are important variables to discriminate SBNU nesting habitat in the Willamette Valley.
- I was able to use LiDAR to characterize the nesting habitat of SBNU.
- I was able to create a spatially explicit model to predict the nesting habitat of SBNU using remote sensing technology (LiDAR).
- Field validation.

