Monitoring the Effects of Power Fire Herbicide Treatments on Complex Early Seral Forest Birds

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Presentation to the ACCG Monitoring Work Group

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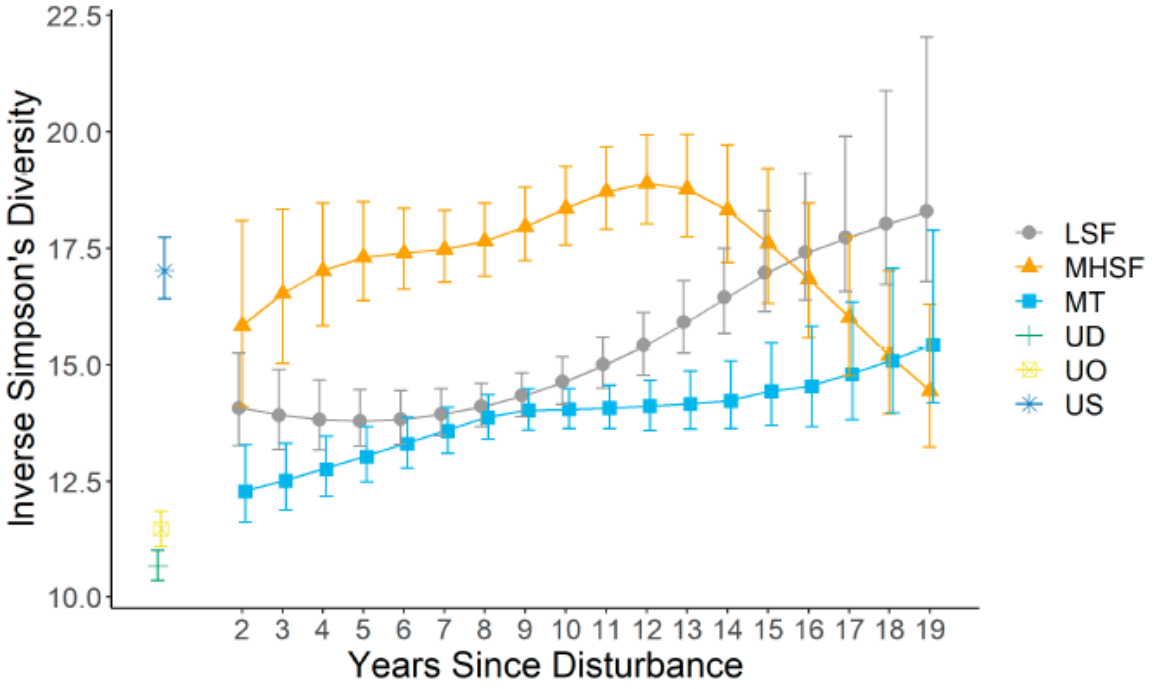
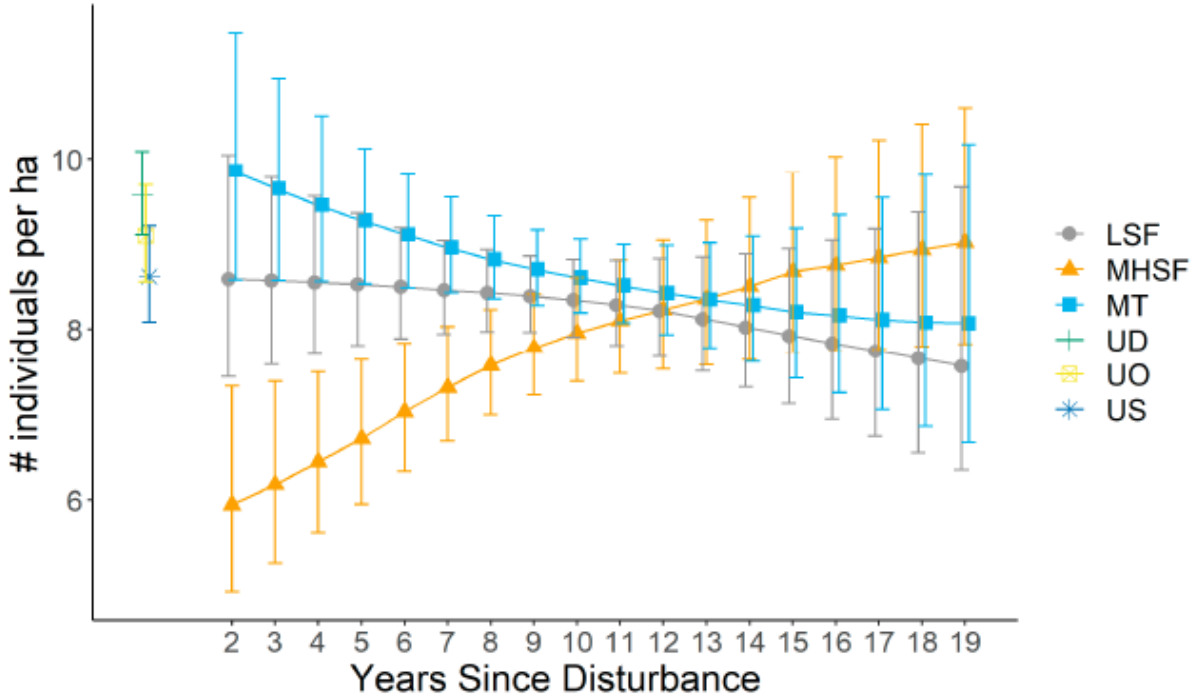
Conservation science for a healthy planet.

Power Fire Shrubs and Regenerating Conifers
Photo by Zack Steel

Value of Older Burned Areas for Birds





Roberts et al. 2021 Forests

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Steel et al. 2021
Diversity &
Distributions

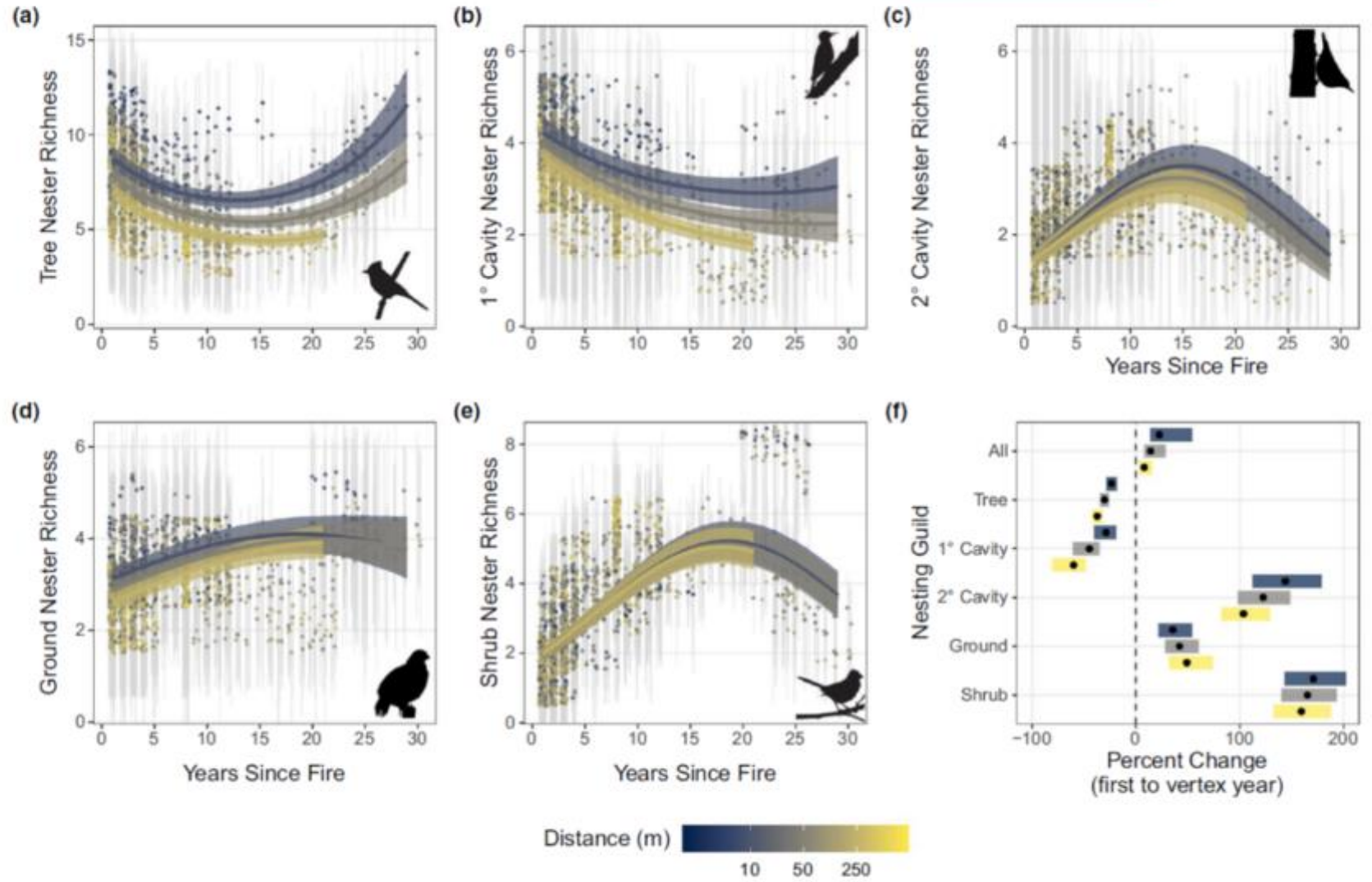

FIGURE 5 Marginal effects of years since fire and internal distance from high-severity patch edge on avian guild richness in the Sierra

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Post-fire Management

- *Salvage Logging*
- *Chipping small material*
- *Reduce shrub & herbaceous competition*
- *Replanted with conifers*
- *Shrubs continue to be controlled especially on private land*

Herbicide Effects on Birds

- Most research is from intensively managed conifer plantations where early seral forest birds are declining
- Foliage gleaners and shrub nesters declined, and open habitat birds benefited
- Effects can be short-term if vegetation resprouts
- Post-fire herbicide effects has been little studied

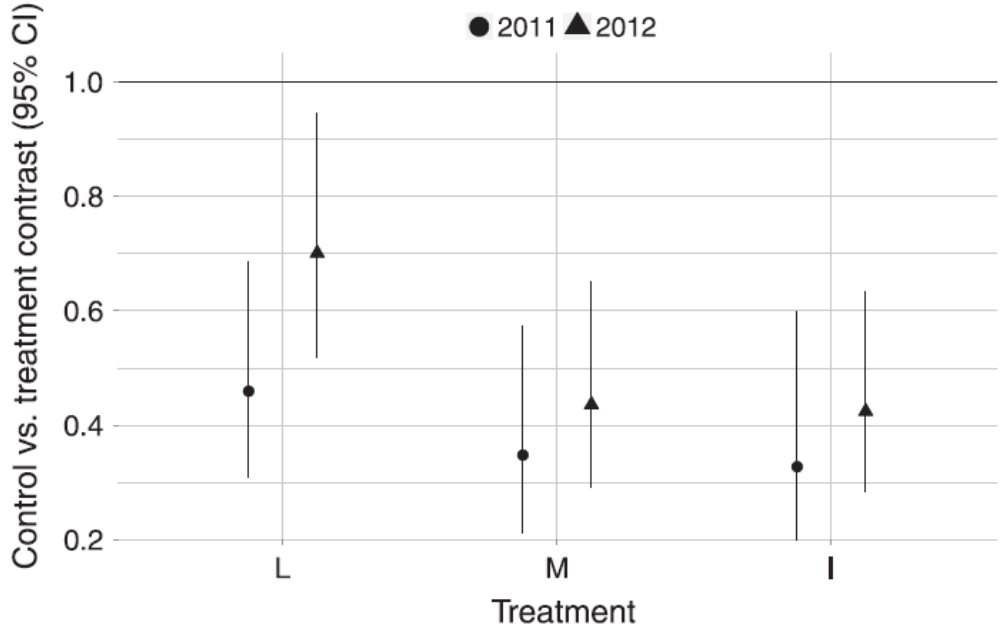

Fig. 4. Back-transformed model estimates (95% confidence interval) for three intensive forest management treatments in relation to untreated controls for species expected to be associated with early seral hardwood forest (orange-crowned warbler, rufous hummingbird, song sparrow, Swainson's thrush, white-crowned sparrow and Wilson's warbler), Oregon Coast Range, US, 2011–2012. Treatments comprise Light (L), Moderate (M) and Intensive (I).

Betts et al. 2013 Forest Ecology & Management

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Power Fire Bird Research

2014-16, 2019-20

- Collected baseline bird data at 138 locations in 2014-2016 (10-12 years post-fire)
- Mechanical and herbicide treatments took place in 2018-19
- Resurveyed bird locations in 2019-2020 to measure effects 1-2 years post-treatment (and 15-16 years post-fire)

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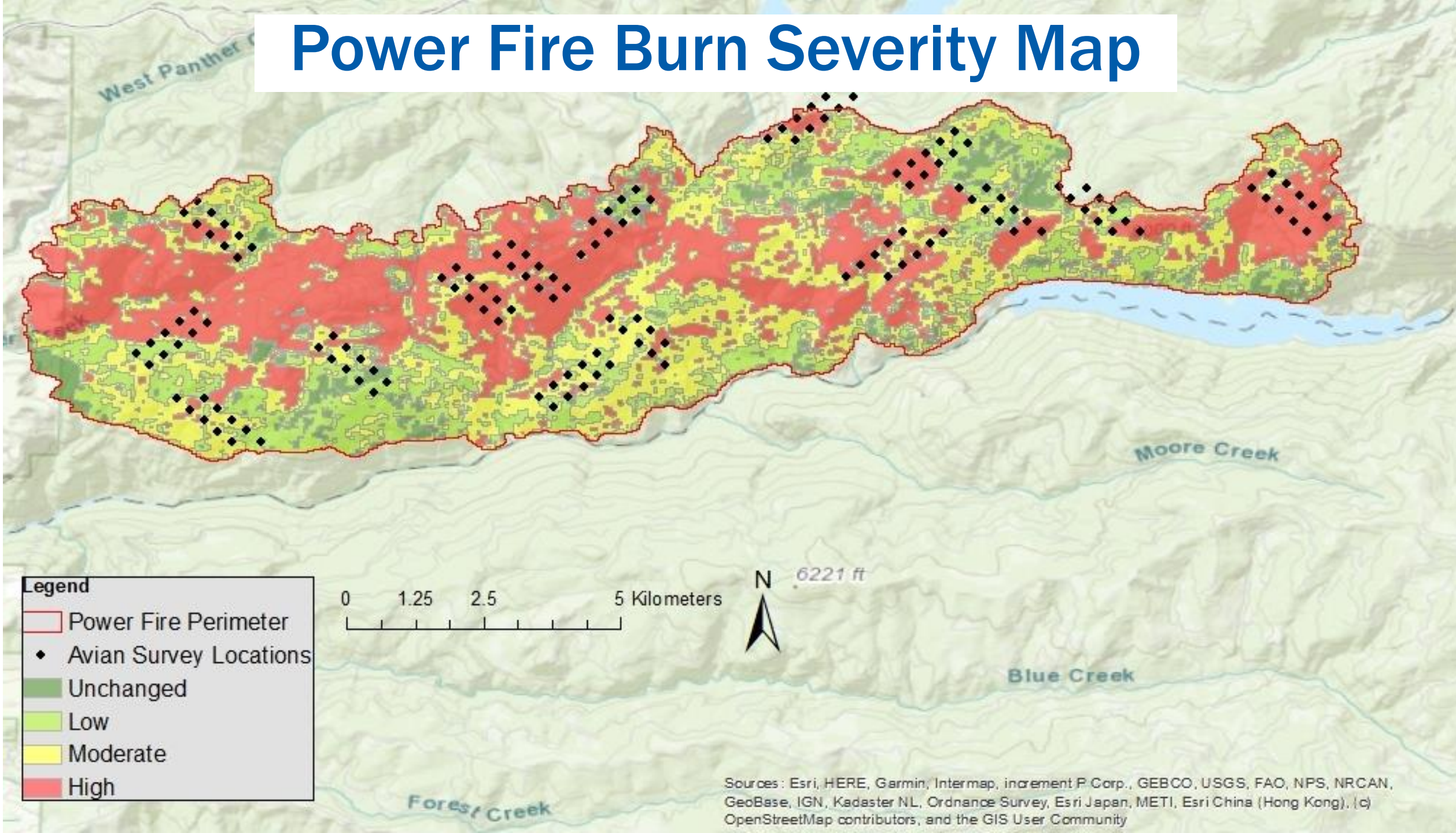
Power Fire Burn Severity Map



Reforestation Treatments

2017 Power Fire Reforestation ROD

- Treatments proposed across 3500 acres (~65% of CESF within USFS-owned fire area)
- Herbicide application to whitethorn ceanothus, bear clover, grasses and other herbaceous vegetation
- Chainsaw removal of deerbrush ceanothus followed up with herbicide application
- Glyphosate and triclopyr applied during spring 2018 and 2019 (during nesting season)
- Dozer piling and clearing, followed by conifer planting (did not analyze)

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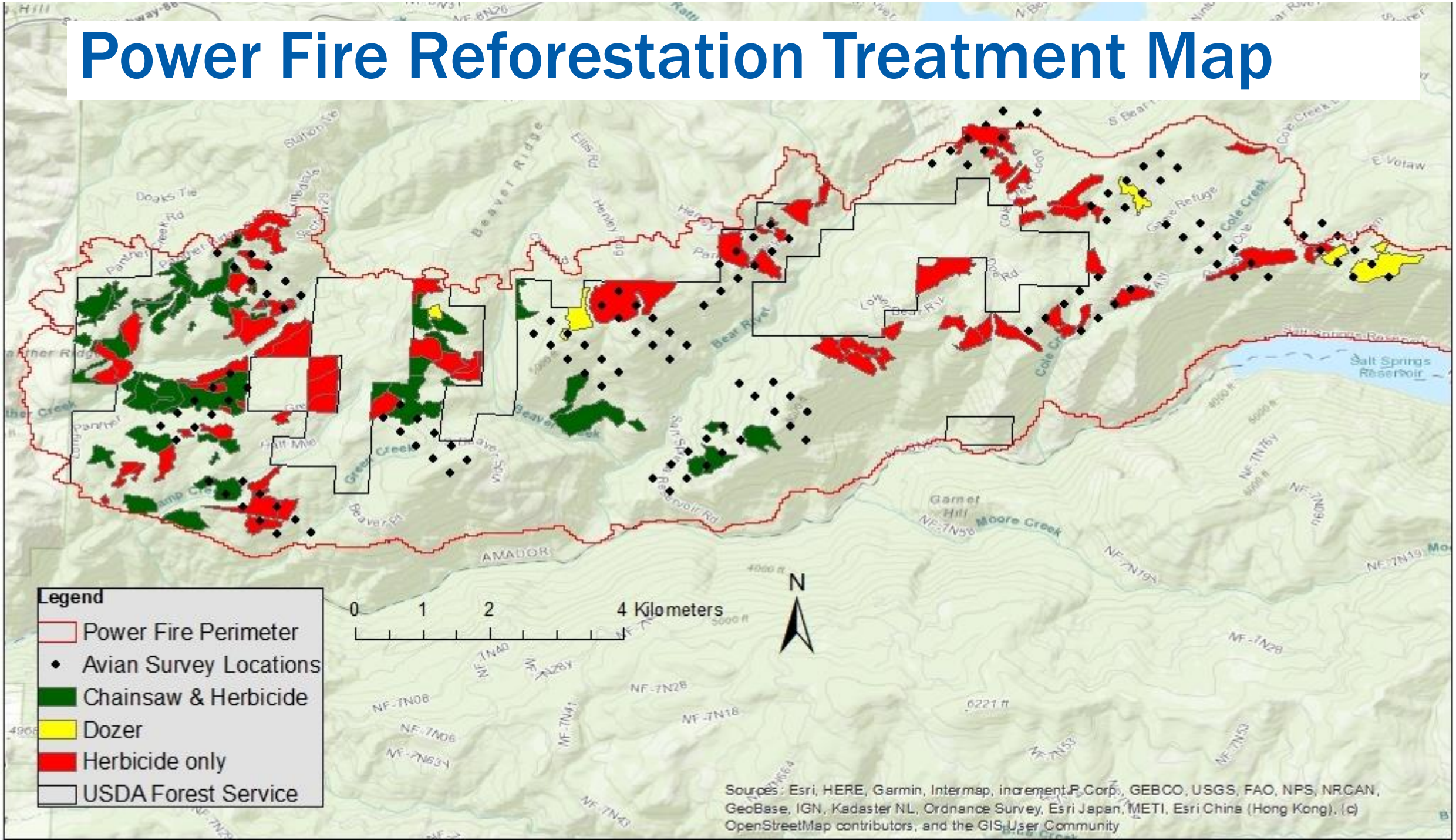
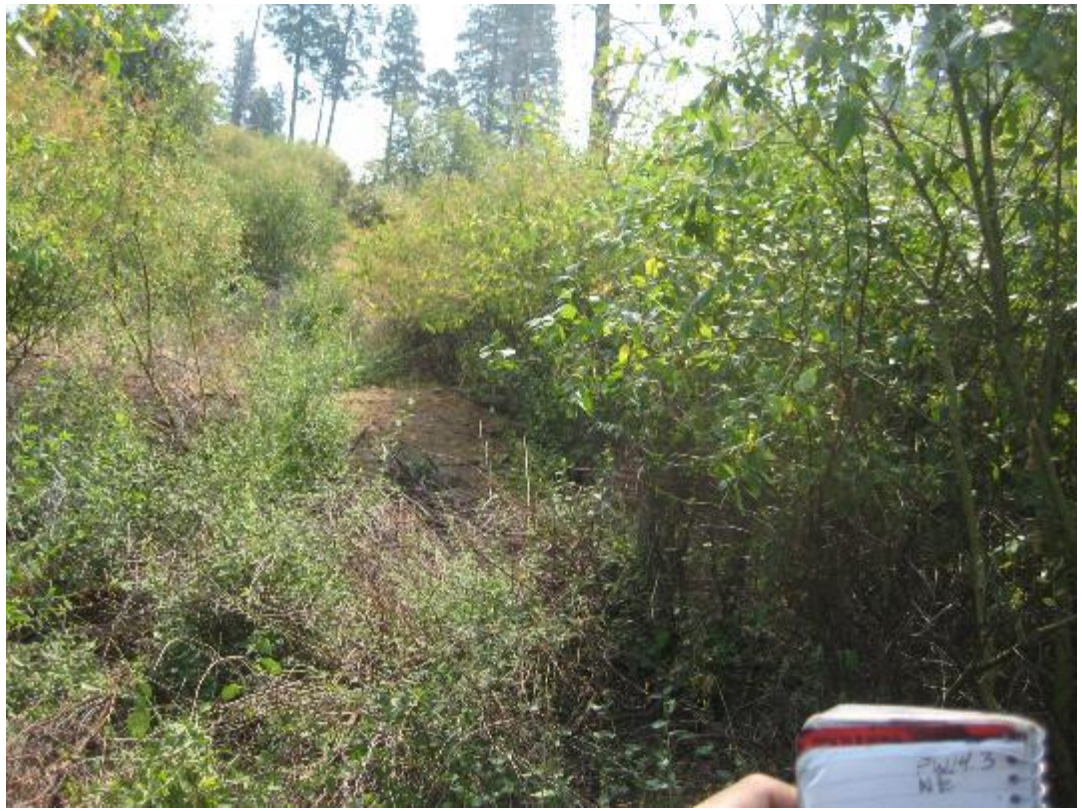
Power Fire Reforestation Treatment Map



Reforestation Treatments

Before/After (Deerbrush clearing and herbicide)



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Reforestation Treatments

Before/After (whitethorn ceanothus herbicide)

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Reforestation Treatments

Before/After (dozer clearing, burning, replanting)

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Survey Methods

- Avian surveys 1-2/year during 2014-16 and 2019-20
- Vegetation surveys before/after treatments
  - Live Shrub cover
  - Dead shrub cover
  - Young conifer cover (<16ft tall)
  - Mature conifer cover (>16ft tall)

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Analysis

Herbicide Effects

- Focused on complex early seral forest (CESF species)
- 31 treated locations and 53 control locations
- Mixed effects abundance modeling
  - Treatment and habitat covariates to estimate per-point abundance before and after treatments
  - ANOVA hypothesis test
    - time, treatment, time*treatment effect










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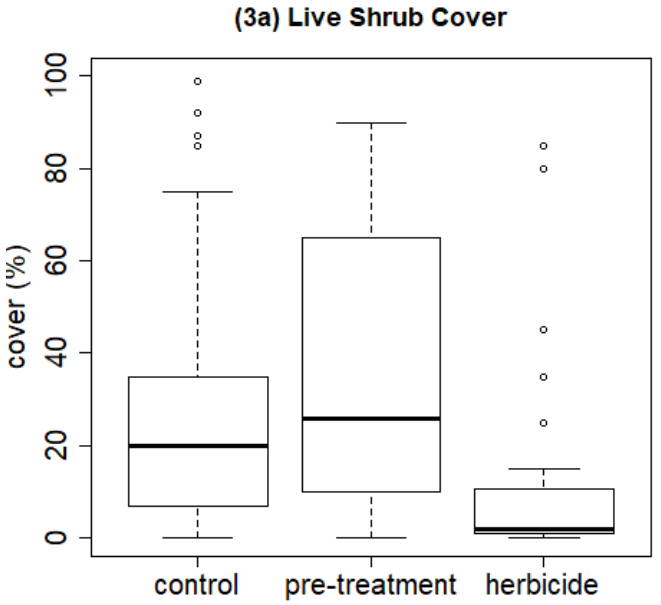
Results

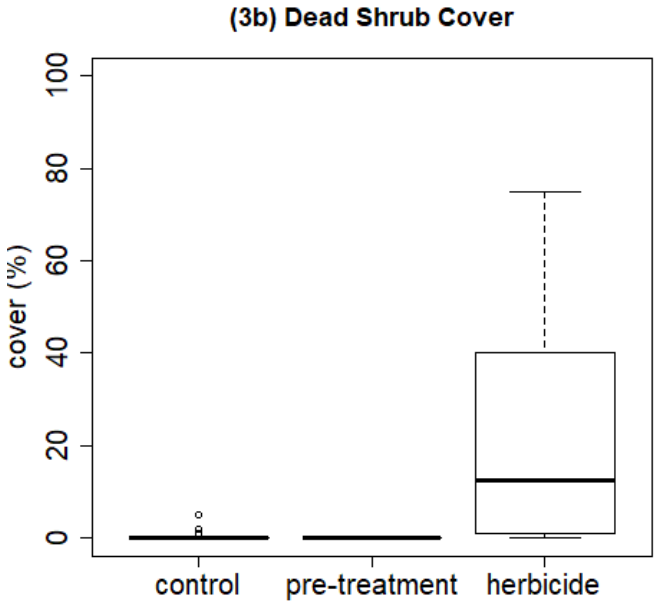
Vegetation Data

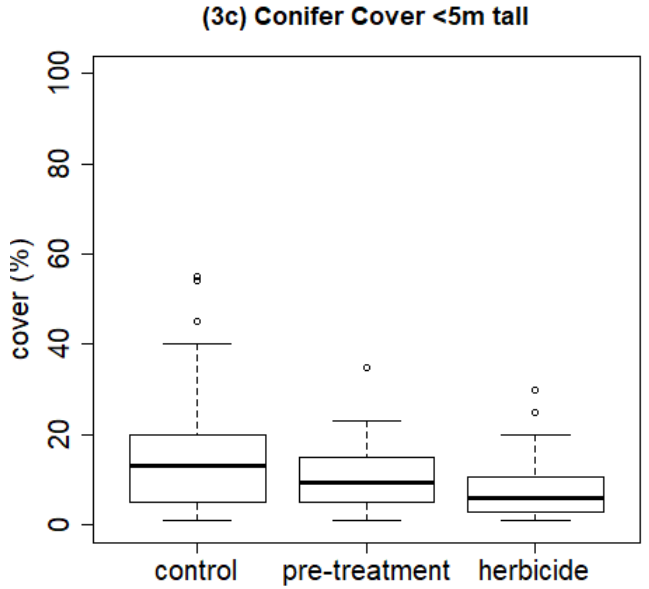
Pre-treatment points started out with higher shrub cover than control locations, but it was greatly reduced.

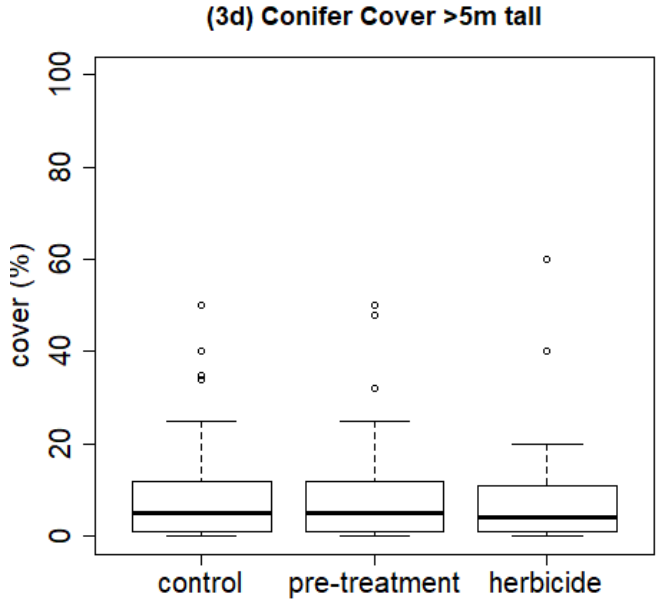
Large variation in dead shrub (skeletons) at herbicide points

Conifer cover (young [<5m tall] and mature [>5m tall]) was similar among treatments and years.









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Abundance models show mechanisms of herbicide response

- Shrub Cover – positive 5 species
- Young conifers (<5m tall) – positive 2 species
- Mature conifers – mixed positive and negative
- Treated covariate – all negative except for Green-tailed Towhee

	Intercept	treated	salvaged	elevation	live basal area	shrub cover	dead shrub cover	young conifer cover	treated: salvaged
Fox Sparrow	**-2.28 (0.16)**	**-1.32 (0.56)**	0.26 (0.20)	**0.80 (0.09)**	**0.21 (0.09)**	**0.49 (0.08)**	**0.31 (0.10)**	0.07 (0.09)	0.51 (0.61)
House Wren	**-1.57 (0.12)**	**-1.08 (0.48)**	-0.28* (0.17)	**-0.33 (0.09)**	**-0.56 (0.10)**	-0.01 (0.07)	0.10 (0.12)	**0.16 (0.07)**	0.51 (0.59)
Spotted Towhee	**-1.75 (0.14)**	-0.17 (0.37)	-0.01 (0.15)	**-0.41 (0.07)**	-0.05 (0.07)	**0.18 (0.06)**	-0.05 (0.12)	-0.02 (0.07)	-0.04 (0.46)
Lazuli Bunting	**-1.82 (0.17)**	-0.25 (0.37)	0.12 (0.13)	**-0.28 (0.07)**	**-0.45 (0.08)**	0.09 (0.06)	-0.15 (0.12)	-0.02 (0.06)	0.02 (0.46)
Nashville Warbler	**-1.89 (0.20)**	-0.23 (0.47)	-0.38* (0.20)	-0.03 (0.10)	-0.13 (0.10)	0.05 (0.09)	-0.09 (0.13)	0.09 (0.09)	0.58 (0.54)
Green-tailed Towhee	**-2.59 (0.17)**	0.16 (0.43)	**0.39 (0.20)**	**0.86 (0.10)**	**-0.21 (0.10)**	0.07 (0.09)	0.09 (0.10)	0.09 (0.09)	-0.60 (0.51)
MacGillivray's Warbler	**-2.47 (0.17)**	-0.74 (0.56)	-0.21 (0.23)	0.20* (0.11)	0.03 (0.10)	**0.33 (0.10)**	-0.09 (0.18)	-0.04 (0.11)	NA (NA)
Dusky Flycatcher	**-3.17 (0.26)**	-0.58 (0.65)	0.51* (0.28)	**0.55 (0.12)**	**0.29 (0.12)**	**0.35 (0.11)**	0.18 (0.12)	**0.25 (0.12)**	0.59 (0.73)
Yellow Warbler	**-3.79 (0.35)**	-0.42 (0.84)	0.19 (0.39)	-0.10 (0.18)	0.01 (0.18)	**0.77 (0.16)**	-0.15 (0.46)	-0.11 (0.20)	-0.80 (1.30)
Mountain Quail	**-4.08 (0.46)**	-0.63 (0.81)	0.72* (0.37)	**0.39 (0.15)**	**0.34 (0.16)**	0.28* (0.15)	-0.02 (0.24)	-0.10 (0.18)	-0.03 (0.96)

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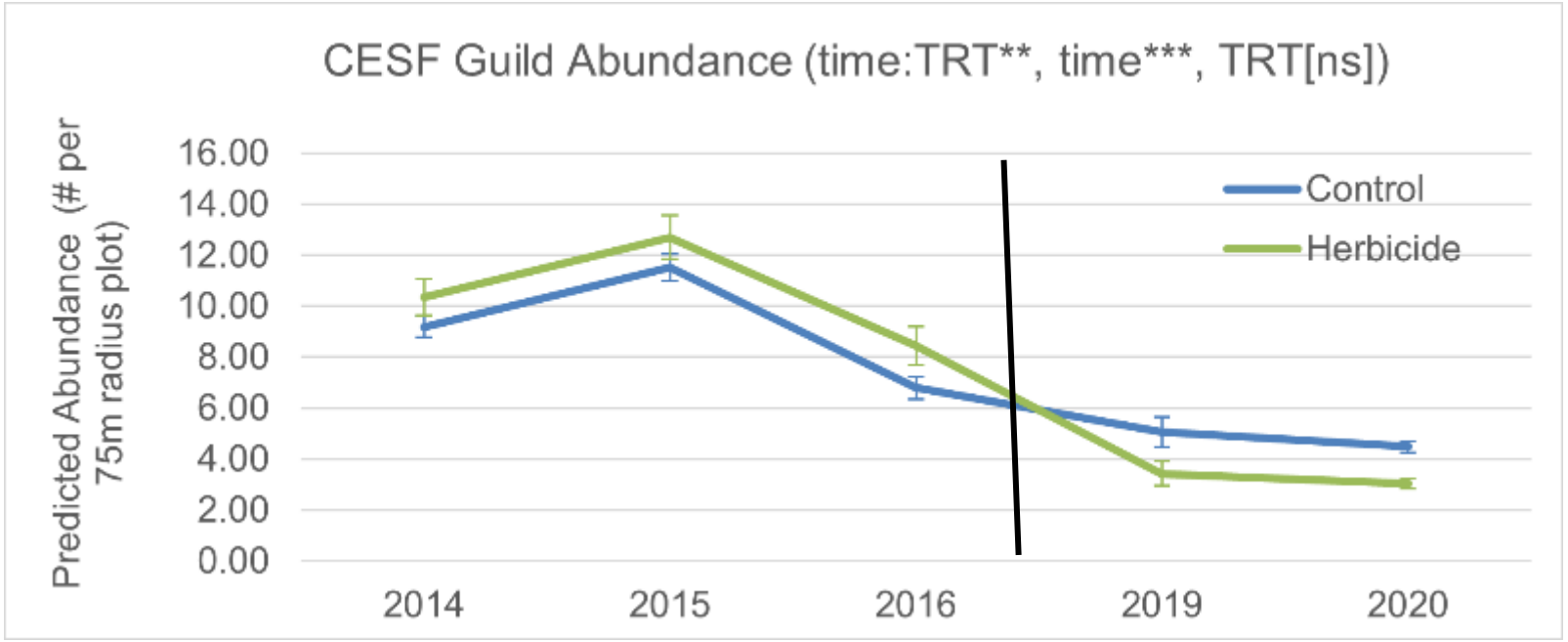
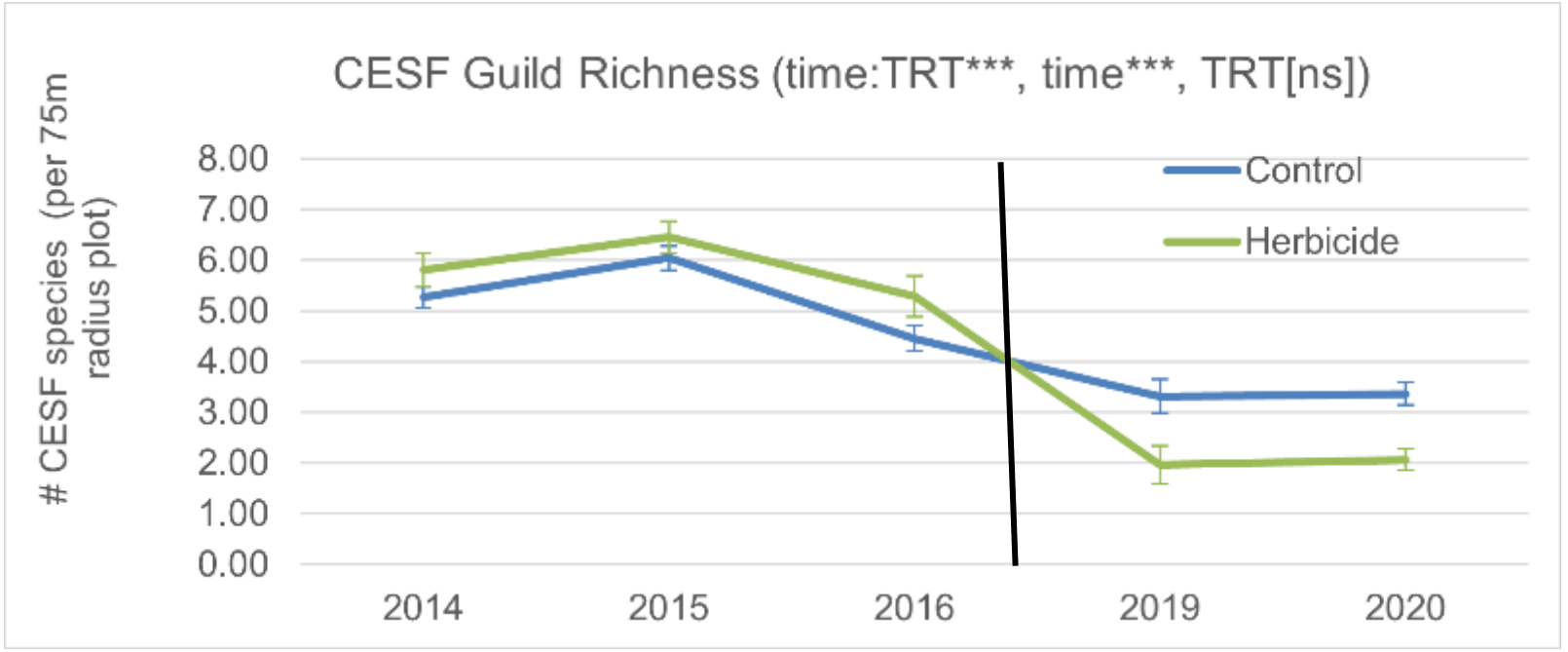
Results

CESF Abundance and Richness

ANOVA tests indicate highly significant time, showing an overall declining trend, and treatment*time interactions, indicating negative herbicide effects

**Annual trends likely reflect climate/weather patterns but still concerning





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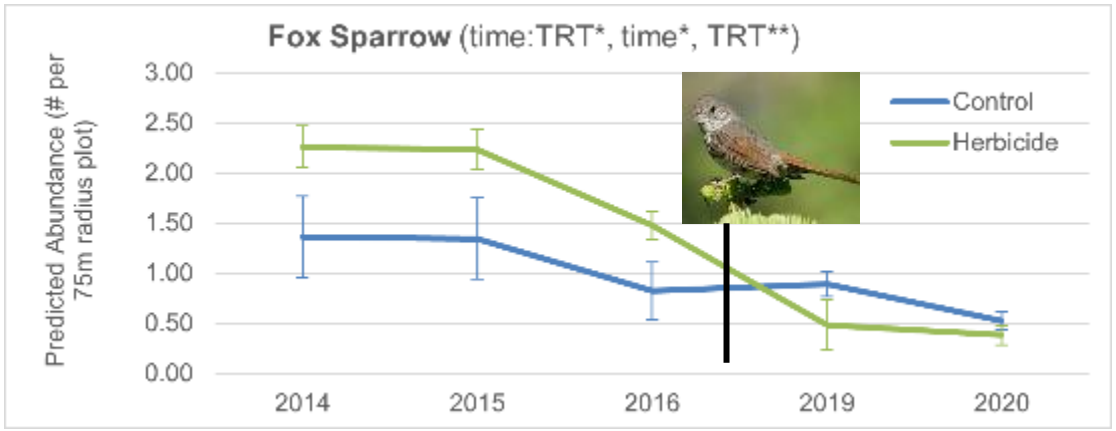
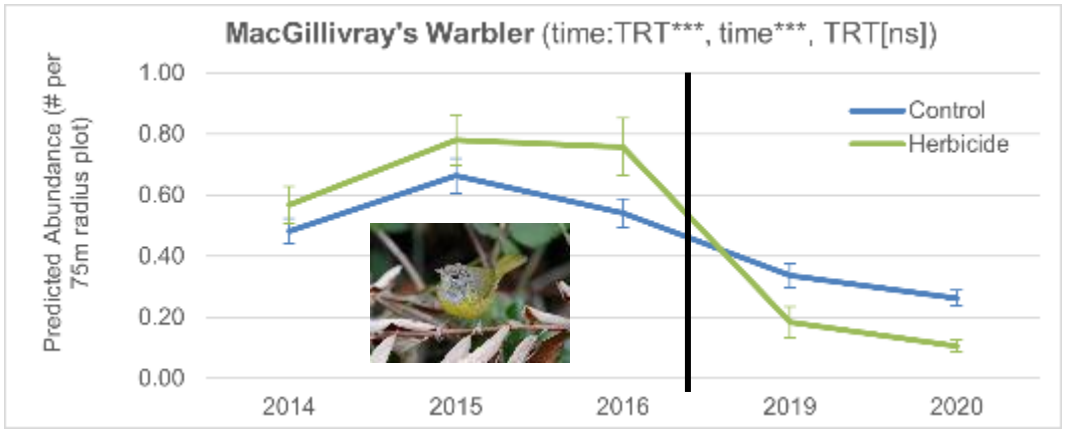
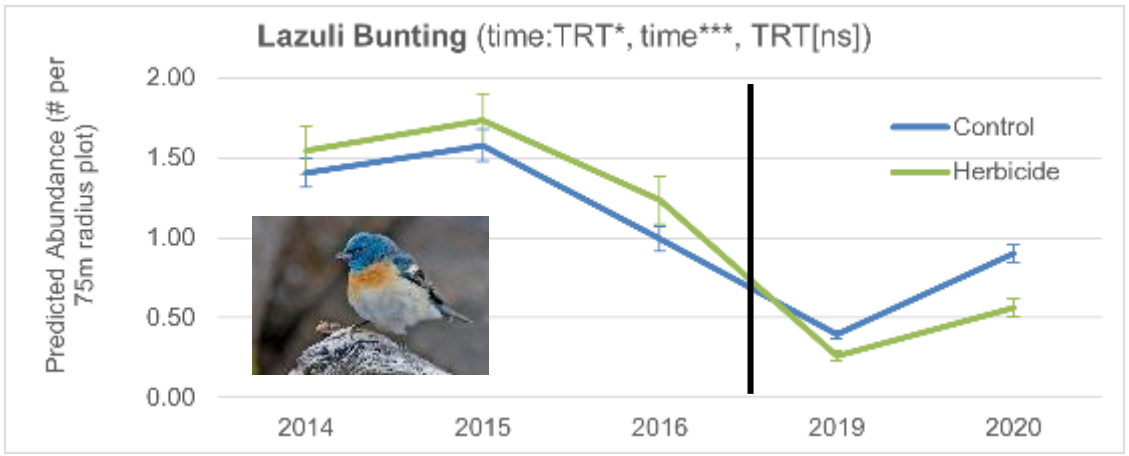
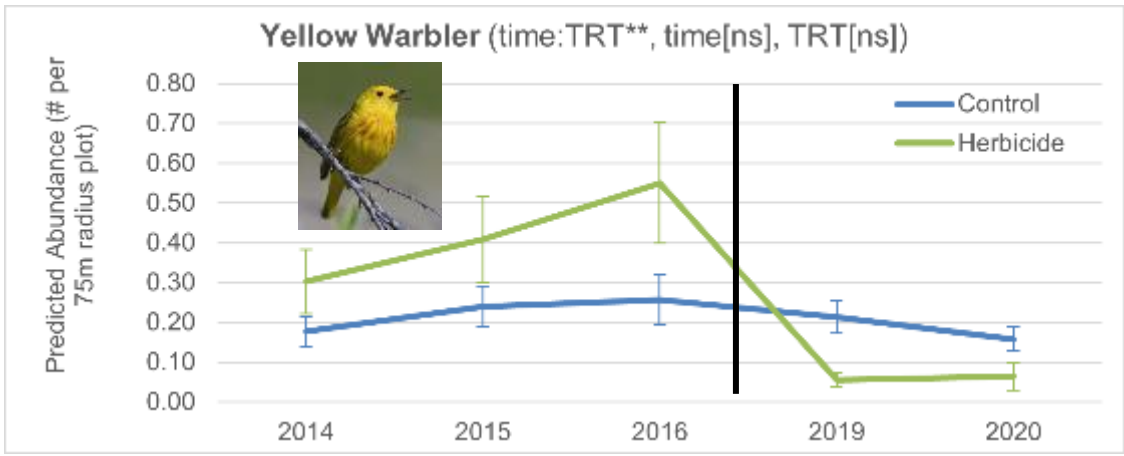
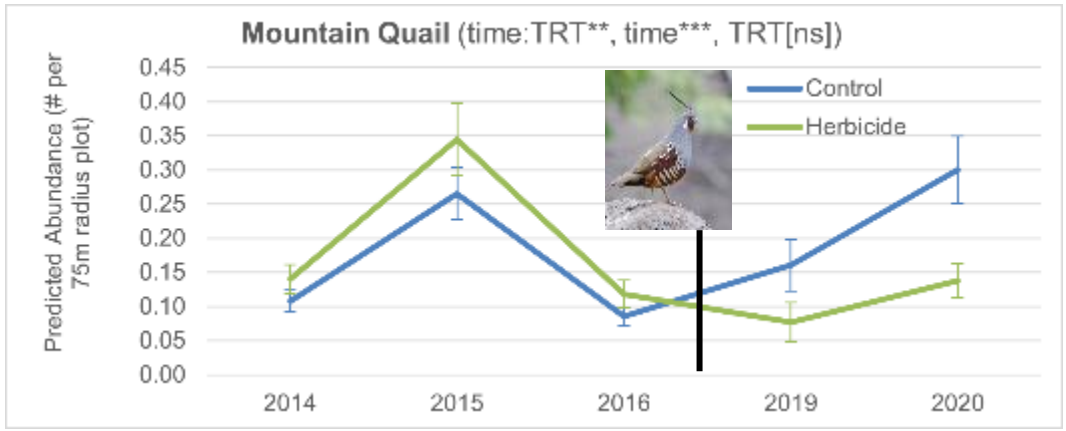

Fox Sparrow (time:TRT*, time*, TRT**)
Predicted Abundance (# per 75m radius plot)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2014
2015
2016
2019
2020
Control
Herbicide


MacGillivray's Warbler (time:TRT***, time***, TRT[ns])
Predicted Abundance (# per 75m radius plot)
1.00
0.80
0.60
0.40
0.20
0.00
2014
2015
2016
2019
2020
Control
Herbicide


Lazuli Bunting (time:TRT*, time***, TRT[ns])
Predicted Abundance (# per 75m radius plot)
2.00
1.50
1.00
0.50
0.00
2014
2015
2016
2019
2020
Control
Herbicide


Yellow Warbler (time:TRT**, time[ns], TRT[ns])
Predicted Abundance (# per 75m radius plot)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
2014
2015
2016
2019
2020
Control
Herbicide


Mountain Quail (time:TRT**, time***, TRT[ns])
Predicted Abundance (# per 75m radius plot)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2014
2015
2016
2019
2020
Control
Herbicide

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Summary

- Early seral species abundance and richness declined significantly in treated areas
- Likely due to reduction in habitat
- Results concur with other studies
- Shrub and hardwood retention may mitigate for negative effects

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Management Recommendations

- Limit herbicide use during nesting season (May-August)
- Use a targeted approach with smallest radius around conifers
- Leave patches of intact shrubs and consider widening riparian buffers
- Evaluate the fire history of the watershed and consider leaving a larger part of the fire area unmanaged if watershed is largely undisturbed
- Consider whether reforested areas have high chance of conifer survival under future conditions
- Experiment with prescribed fire in plantations

Thank You

- Eldorado National Forest
- Amador Ranger District
- Amador Calaveras Consensus Group
- Project collaborators
- Field technicians

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