Big projects, small monitoring budgets: Assessing treatment effectiveness for control of Cortaderia jubata

California Invasive Plant Council Symposium

Riverside, CA October 17, 2019 Ellen Hamingson, Point Reyes National Seashore

All photos: NPS

Assessing control of Cortaderia jubata

- What did we treat where?
- What treatment methods did we use?
- Were methods effective?
- How did we know if methods were effective?
- Management implications

Point Reyes National Seashore

- 90,000 acres under NPS management
 - Elevation 0-438 meters

Diverse ecosystems

1000 plant taxa, about 2/3 native
33,000-acre Phillip Burton Wilderness



20 FE species (#10 in NPS)49 special status plants

Jubata grass (Cortaderia jubata)

- Large clumping perennial grass
- Apomictic
- Abundant short-lived seedbank
- Can flower 2x/year
- Wind-dispersed up to 20 miles
- Adventitious roots in moist soil
- Relatively long-lived plants
- Fire hazard
- 1 of PRNS's TOP 10 priority invasive plant species



Control Jubata Grass in Point Reyes Wilderness 2016-18

- Within central zone of Wilderness
- Project area: 16,000 landscape acres

Treatments July 2016-February 2019

- 11 watersheds across 3300 landscape acres
- 9 Gross Infested Acres
- ~ 3.3 Net Infested Acres (NIA)
- 278 patches
 - 0.5 sq meters to 2 acres

Project Area





15% of patches treated chemically, 85% manually



3% Round-up Custom[®] 1.5% Habitat[®] 1% Competitor[®]

Management Questions

- Did management significantly reduce jubata grass among treated patches?
- Did treatments differ in effect?
 - Manual x None
 - Manual x Retreatment
 - Chemical x None
 - Chemical x Retreatment
- What factors might explain variability in treatment effects?



How did we know if methods were effective?

- Observational
- Not controlled, balanced, fully replicated study with treatments randomly assigned

Jubata grass percent cover Pre-treatment vs. post-treatment (2019 Monitor)

- Patch level
- Spatial data





Patch 4: 3 points, ea. 1-3 plants, Total 12 sq m. @ 75-95% cover



Response variables

- Jubata % cover over original area
 - Ocular estimate
- Regrowth YES/NO
- New Plants YES/NO

71 patches monitored

TRT	Chemical x None	Chemical x Retrt	Manual x None	Manual x Retrt
% of all treated patches	9.5%	5.9%	79.5%	5.1%
% of total sampled	31%	15.5%	38%	15.5%
# monitored	22	11	27	11

Patches from 9 of 11 treated watersheds

June 25 – July 11, 2019

Hypotheses

- Q1: Mgt. reduced jubata grass % cover
- EVENT = Trt1, Trt2, Monitor

Q2: No effect difference among treatment combinations

- TRT =
- Chemical x None
- **Chemical x Retrt**
- Manual x None
- Manual x Retrt

Possible explanatory variables

- Slope
- Soil type (sandy v. loamy)
- Plant community type
- Initial patch size
- Plant distribution: isolated to clustered
- Distance to nearest jubata grass
- Plant life stage
- Timing relative to rain
- Trt1 Julian date or month
- Trt1 treatment type
- Trt2 treatment type

Statistical analyses

• R 3.6.1

Ordinal logistic regression on ordered cover classes

• Response variable = **Cov.class**:

0%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, >95%

- Random effect of Location: (1|Subgrp/Patch): Pairs Patch PRE/POST; controls spatial correlations
- Exploratory analyses and graphs using PCTcover as response variable
- Model comparison for effects of EVENT, TRT, & explanatory factors

Q1: EVENT effect

Highly significant all models

P-values 1.33 x 10 ⁽⁻⁸⁾ to 2.33 x 10 ⁽⁻¹⁶⁾



Q2: No significant difference in TRT effects



Q3: Effects of explanatory variables

Dataset	Model: Cov.class ~ x	AIC	P-values
Trt1, Trt2, Monitor	EVENT *Sq. m	532.70	EVENT = 2 x 10 ⁻¹⁶ *** EVENT * Sq.m = 0.0205 *
Trt1, Monitor	EVENT * Distribution	429.93	EVENT = 1.33 x 10 ⁻⁸ *** EVENT * Distribution = 0.0007 ***
Monitor only	SOIL + Distribution + Sq. m	199.51	SOIL = 0.028 *
Monitor only	TRT + SOIL + Distribution + Sq. m	200.06	SOIL = 0.028 * Distribution = 0.0177 *
Monitor only	TRT * SOIL +Distribution + Sq. m	201.89	SOIL = 0.028 * Distribution = 0.0177 *
Monitor only	SOIL	201.94	SOIL = 0.046 *

PCT cover ~ EVENT x Distribution



POST-treatment PCT cover ~ SOIL TYPE





Elimination?

Regrowth = TRUE/FALSE

Generalized linear mixed effect regressions, binomial Explanatory variables:

- TRT
- Soil, Sq.m, Distribution, Plant Community
- RainPost1, RainPre1
- Trt1.type, Trt2.type

Best model? Regrowth ~ SOIL2 + scale (Sq.m) + (1|Subgrp/Patch) p (Sq.m) = 0.0637 AIC = 70.4 (cf. highest AIC = 97 w/ 4 parameters)





EVENT

Regrowth among patches treated 2X

If Trt2 dominant plant stage = Seedling or Immature: 0 regrowth

If Trt2 @ Mature, Flowering, or Seeds dispersed stage:

100% of patches >449.5 sq.m. regrew
60% of <499.5 sq.m. regrew.



Terminal nodes: % of patches Regrowth = YES

81% of deviance explained

Conclusions

- Management actions significantly reduced jubata grass % cover
- Manage adaptively: All treatments can be effective
- No clear explanatory factors for post-treatment variability but...
 - Patch size matters?
 - Results vary by SOIL and DISTRIBUTION?
 - Worth investigating:
 - Soil moisture and/or rain timing
 - Treatment timing (Julian dates)
 - Soil type interacting w/ treatment type

Management Implications

- Species-specific treatment effectiveness monitoring design
- Standardize pre- and post-treatment measurements
- No significant effect ≠ no ecological impact
- Further investigations: soil type, timing, weather
 - Controllable vs. measurable factors—why bother?
- Collaborate: Meta-analyses + connect with researchers

Thanks for invaluable help with ...

• Challenging fieldwork

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Q2: No TRT significant effect

