Seed Rain, Seed Predation and Seed Bank Dynamics of Adenostoma fasciculatum

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Introduction

- The principal chaparral dominant in California, Adenostoma fasciculatum, is broadly distributed and provides habitat and food resources for a large animal community. The effects of climate change and human impacts, including increased temperatures, fire frequency and severity, have placed pressure on habitats in California. It is important to investigate the potential resiliency of *A. fasciculatum* by providing greater detail on the life-history phases and plantanimal interactions.
- In this study we focus on potential stand regeneration by seed using a series of experiments to document the length and quantity of seed rain, seed predation, by parsing the importance of the community of granivores, and determining the connection between stand age and germination rate from persistent soil seed banks.
- Our research documented seed rain duration, multiple species of seed predators and points to the probability of native ants playing a role in the seed dispersal process. This is important given the recent advancement of the invasive Argentine ant (*Linepthema humile*) into Californian chaparral. We documented that a mid-aged stand had higher germination rates than others and how seed banks play a major role in assuring resiliency following fire.



Temporal Patterns of Predation



Seed rain and predation rates by species group. Mt. Diablo State Park.

Seed Rain



- Single study site: Mt.
 Diablo State Park
- 12 seed rain stations Each station contained
- open & closed trays Total seed rain
- gathered bi-weekly for duration of seed rain
- period (Aug-March) Seeds were bagged
- and counted on a biweekly basis

Seed Predation



- Mt. Diablo Study Site • 6 camera traps
- positioned over seed rain stations Documented wide
- range of seed predators • Included mammals,
- passerines and insects



Mt. Diablo A. fasciculatum Seed Predation Open vs. Closed Seed Traps 6000 -Closed Tray Open Tray

Mean closed vs. open tray seed count Mt. Diablo. Wilcoxon Sign Ranked test p-value=0.0004883; Paired t-test p= 3.413e-06. Both tests showed a significant difference between open vs. closed seed traps.

Seed Bank Dynamics



Seed bank germination rate by strata at five tests sites throughout Northern California. Germination rates were consistently higher in the lower 3 cm of soil. Midrange stand had the highest overall germination rate.

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Methods





- 4 test stations at Mt. Diablo site
- Seed offering of 100 seeds were provided in open, partially covered and completely covered trays
- Camera traps were set up at each station

Seed Bank Dynamics



- 5 Study sites throughout California Coastal Range
- Ages of sites varied from 16 to 71
- 12 stratified soil seedbank were samples collected at each site (24 total per
- Germination test of upper 2 vs lower 3 cm

- rain?
- What community of granivores feed on *A. fasciculatum*? Is there a differential preference between insects, birds or rodents in seed
- consumption?



Differential predation test - closed, partially closed and open seed trays. Paired t-test: Open Tray vs. Closed Tray p= 0.032; Open Tray vs. Elevated Cover 0.039; Elevated Cover vs. Closed Tray p=0.43 thus showing significance between Open vs. Closed and Elevated vs. Closed

Frequency of Species Visit to Seed Trays		2016		2017							
		Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	Total
Catharus guttacus	Hermit thrush			2		33	1	37	7	4	77
Sitta carolinensus	Nuthatch			1		1					2
Spinus psaltria	Goldfinch					3					3
Junco hyemalus	Dark Eye Junco					27	34	29)		90
Passer domesticus	English sparrow			1 2							3
	Chestnut-backed										
Pecile rufensens	chickadee					1		1			2
Melazone crisalis	California Towhee									3	3
Zonotrichia											
atricapilla	Gold Crowned Sparrow						1	2			3
Peromyscus											
maniculatus	Deer Mouse			17	3	30		8		1	59
Neotoma cinerea	Bushy tailed wood rat			8		9		9		4	30
Dipodomys											
californicus	Kangaroo rat			10		1					11
Prenolepis											
imparis and	Smooth Harvester Ant or										
Veromessor sp.	False Honey Pot Ant			3 1	3)					7
	Total	() 4	4 41	6	105	36	86	0	12	290



Seed Rain:

Adenostoma seed rain was lengthy and prodigious with a cumulative average of more than 1 million seeds per m2. Peak seed rain deposition period was late September to early October More than 75% of seeds were consumed in open vs. closed seed traps.

A lengthier seed rain (bradychory) and an aerial seed bank suggests a plant/animal conditional mutualism that provides enough seed for granivores while allowing for seed deposition and replenishment of the soil seedbank. **Predation**

Seed predators were diverse and included passerines (both resident and migratory), rodents and insects. Camera trap and seed rain samples indicated that ants and seed bugs may play a role as seed predators and dispersers.

Some seeds within the seed rain samples were also observed to have insect bore holes suggesting pre-dispersal seed predation. While it is not known which insects caused this damage, several members of the *Rhyparochromidae* (dirt colored seed bugs) family were found in the seed samples.

Seed Bank Dynamics

The germination study seemed to validate previously held hypotheses that germination rate is related to stand age as the middle-aged stand had significantly higher rates than either younger or older stands.

A best-fit regression line analysis was also performed for germination rate by Stand Age and showing a slight significance between stand age and germination rate.

Research Questions

What is the rate, length and peak period of a mid-aged *A. fasciculatum* stand seed

Is there a correlation between stand age and seed bank germination rates?

Granivores