The Decline of South Sound Prairies

Using plant interactions for conservation

Dr. Alejandra Feliciano,
Certified Professional Horticulturist,
LEED AP BD+C

WASHINGTON STATE
UNIVERSITY

BACKGROUND

What is Community Assembly?

Community assembly are the constant processes that regulate recruitment into a community and shape its structure and composition.

Community assembly are the rules and mechanisms that dictate local diversity patterns in context of a regional species pool.

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Community Assembly Filters

DISPERSAL

Phenotype is able to disperse into the community.

SRESS

Phenotype is able to tolerate seasonal abiotic stresses present at the site.

INTERACTION

Phenotype is able to persist despite competition from existing community residents.

RECRUITMENT

BACKGROUND

Phylogenetic vs. Functional Analysis

Grouping plants by their **function** rather than by **species** can help us understand the role they play in the plant community.

What is my job?

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Factors Affecting Plant Biomass Production

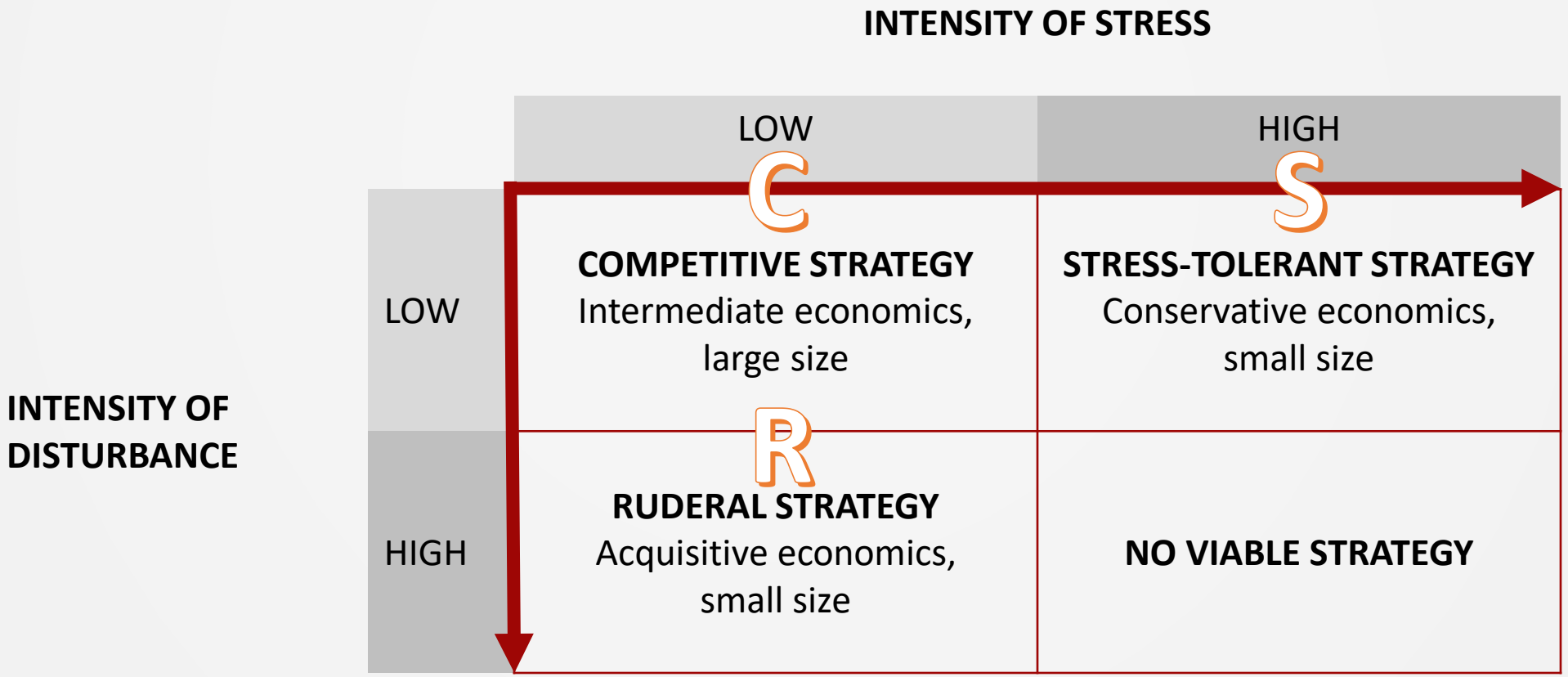
DISTURBANCE

The partial or total destruction of plant biomass (from herbivory, human activity, or from natural phenomena)

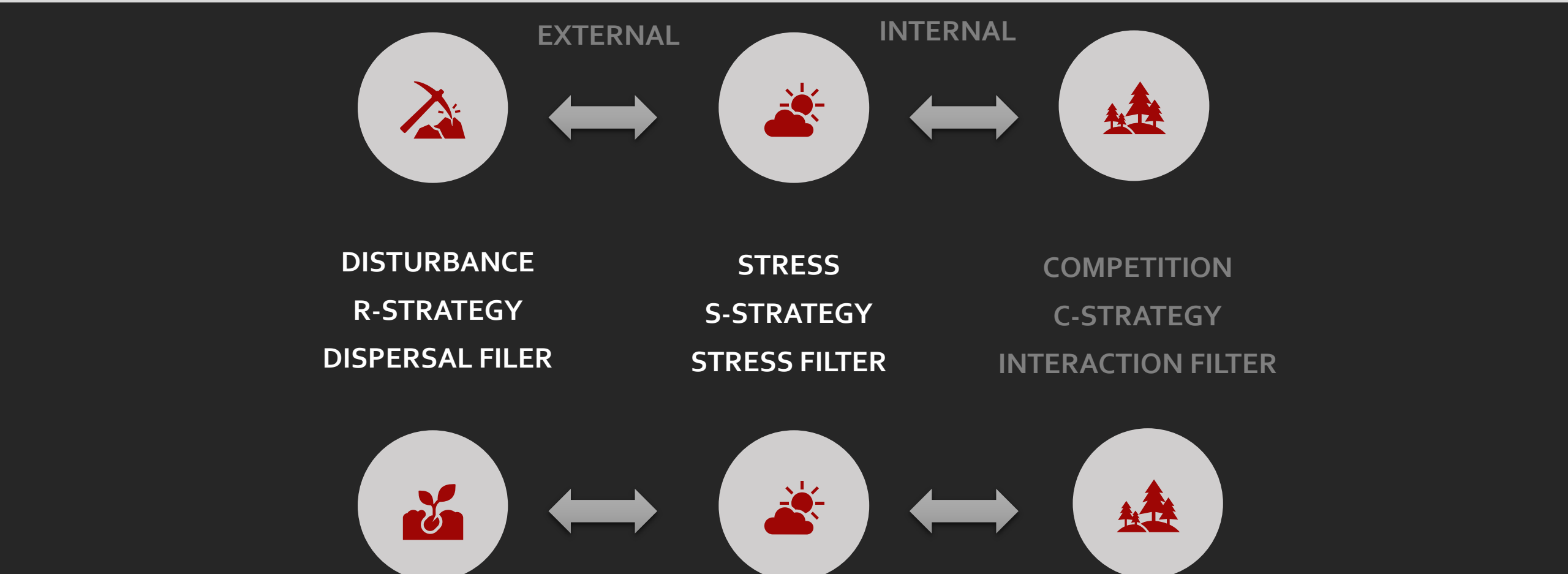
STRESS

Conditions that restrict plant biomass production (shortages of water, light, nutrient, or suboptimal temperatures)

Plant Functional Roles



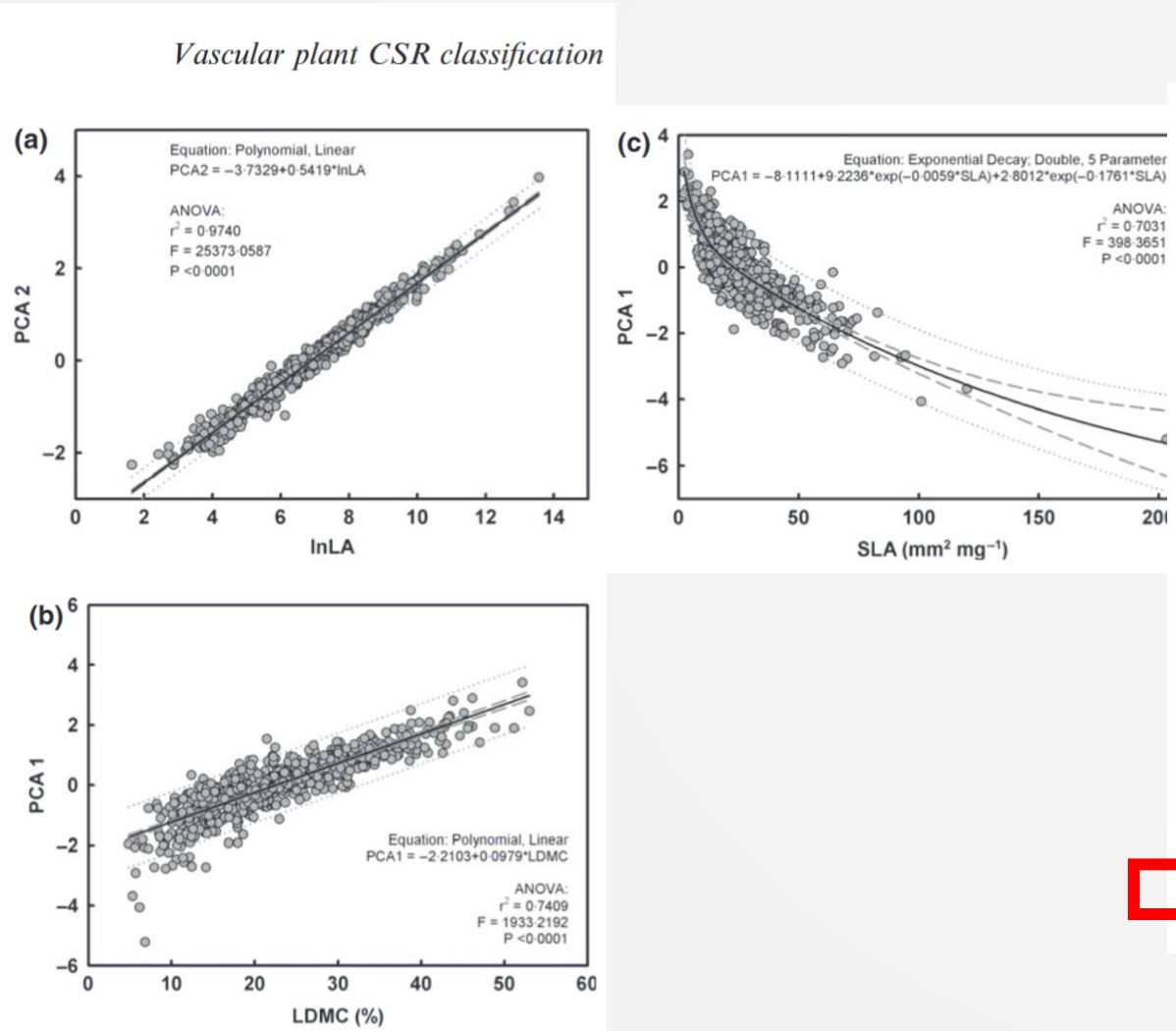
Plant Functional Roles & Community Assembly



Role Detection: CSR Estimation

LEAF TRAITS AT ECONOMIC SPECTRUM EXTREMES	AQUISITIVE	CONSERVATIVE
SLA Specific Leaf Area (surface area per unit mass)	High	Low
Protein content	High	Low
Mineral concentration	High	Low
LNC Leaf Nitrogen Concentration (Nitrogen per unit mass)	High	Low
LPC Leaf Phosphorous Concentration (Phosphorus per unit mass)	High	Low
Cytosol: cell wall ratio	High	Low
Photosynthetic capacity	High	Low
Dark respiration rate	High	Low
RGR Relative Growth Rate	High	Low
Fiber content (fiber per unit mass)	Low	High
Lipid concentration (lipid per unit mass)	Low	High
LCC Leaf Carbon Content (Carbon per unit mass)	Low	High
Leaf lifespan	Low	High
LDMC Leaf Dry Matter Content (dry matter per unit mass)	Low	High
Tolerance to herbivory	Low	High

Role Detection: CSR Estimation



Species	Family	Life cycl	Plant gro	C (%)	S (%)	R (%)
Abarema cochliocarpos (Gomes) A	Fabaceae	Peren.	tree	22.83	61.39	15.78
Abarema macradenia (Pittier) Barn	Fabaceae	Peren.	tree	54.76	45.24	0.00
Abuta racemosa (Thunb.) Triana &	Menispermaceae	Peren.	liana	29.59	63.12	7.28
Abutilon theophrasti Medik.	Malvaceae	Annual	forb	66.59	14.07	19.34
Acalypha diversifolia Jacq.	Euphorbiaceae	Peren.	shrub	43.52	35.93	20.55
Acalypha macrostachya Jacq.	Euphorbiaceae	Peren.	shrub	67.91	11.30	20.79
Acalypha virginica L.	Euphorbiaceae	Annual	forb	28.02	30.08	41.90
Acer campestre L.	Sapindaceae	Peren.	tree	42.29	29.41	28.30
Acer monspessulanum L.	Sapindaceae	Peren.	tree	23.49	68.83	7.69
Acer negundo L.	Sapindaceae	Peren.	tree	50.38	23.31	26.31
Acer opalus Mill.	Sapindaceae	Peren.	tree	47.55	25.57	26.88
Acer platanoides L.	Sapindaceae	Peren.	tree	48.76	35.31	15.93
Acer pseudoplatanus L.	Sapindaceae	Peren.	tree	37.51	54.93	7.55
Acer saccharum Marshall	Sapindaceae	Peren.	tree	27.13	56.44	16.43
Aceras anthropophorum (L.) W.T.	Orchidaceae	Peren.	forb	41.33	0.00	58.67
Achillea atrata L.	Asteraceae	Peren.	forb	10.13	25.27	64.60
Achillea cartilaginea Ledeb.	Asteraceae	Peren.	forb	23.48	26.19	50.33

Study Objectives

1. Characterize diversity loss of the South Sound Prairies.
2. Use functional analysis to determine the community assembly dynamics that have led to these changes.

Methods

1. South Sound plant lists from the most recent flora published by Dunwiddie et al (2006) were used for analysis.
2. South Sound species were cross-referenced with published CSR coordinates (C%S%R%) by Pierce et al (2017) to create a list which could be statistically analyzed by functional role, endemism, and occurrence in time.

	Phylogenetic Sample Size	Functional Sample Size	Significant Sample Size $n = N / (1 + Ne^2)$
Contemporary community	41 species	25 species (61%)	0.134
Historical community	84 species	22 species (26%)	0.135

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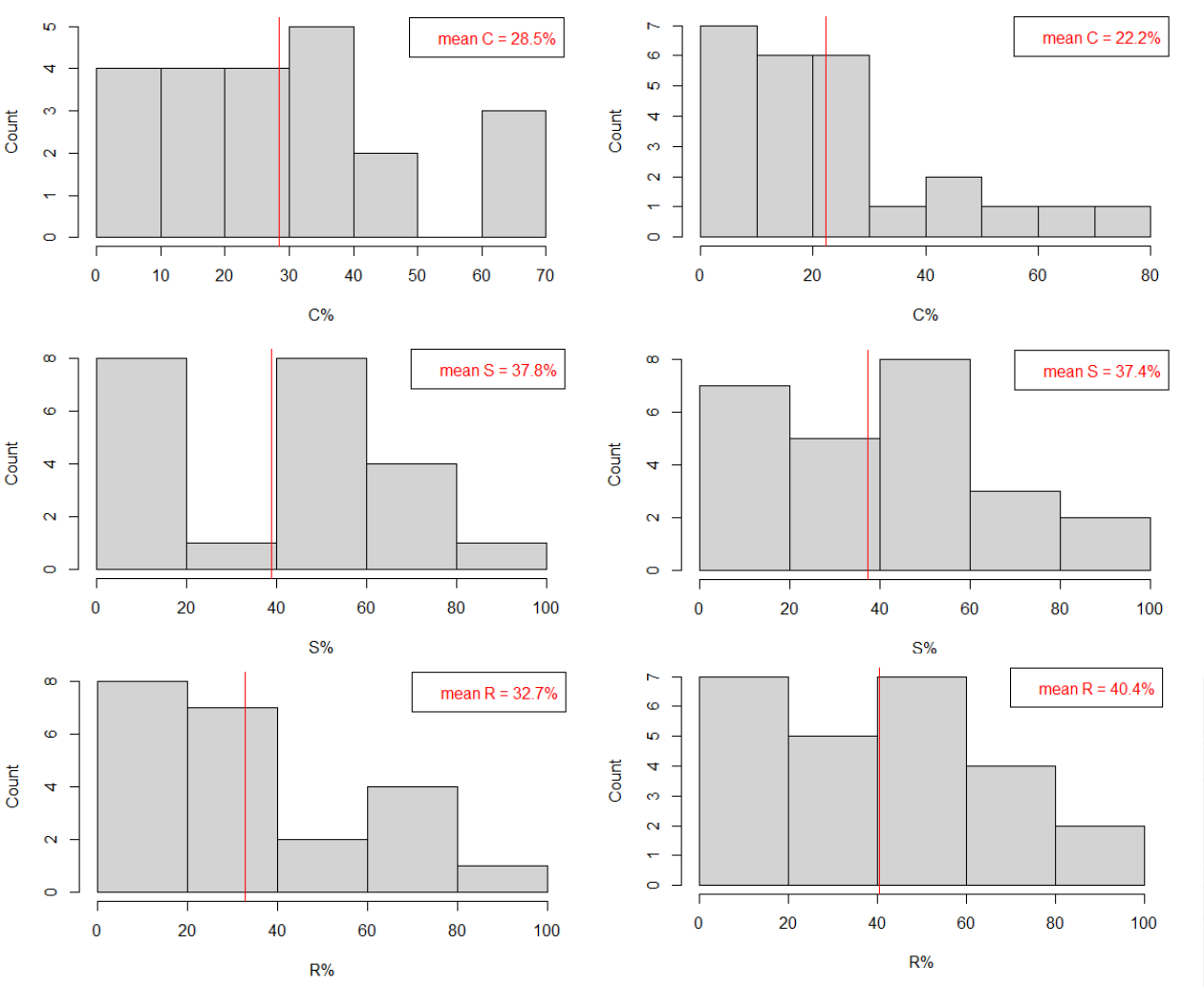
Results

1. South Sound prairies have undergone a 51% reduction in species richness in the last 100 years. Invasive species today contribute roughly 44% of total species richness. Although most species within the community remain native, only 27% of historical native species remain in the community.

Timeline	Past	Present
All species	84	41
Native species	84	23
Exotic species	0	18

Results: Overall changes over time

Past Community



Present Community

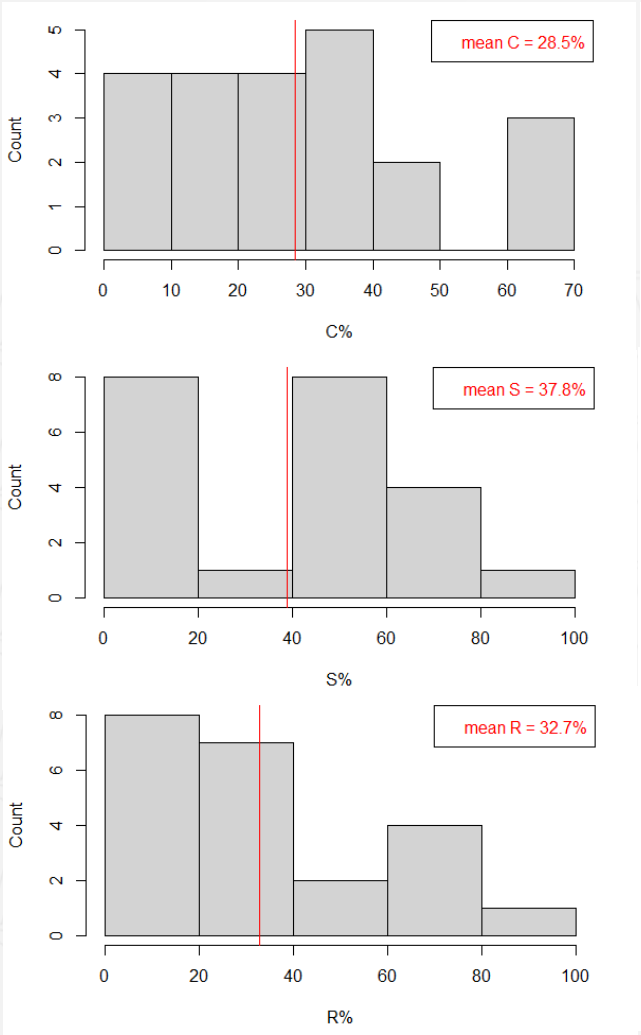
Reduction (-6.3%) in mean competitive (C) investment over time.

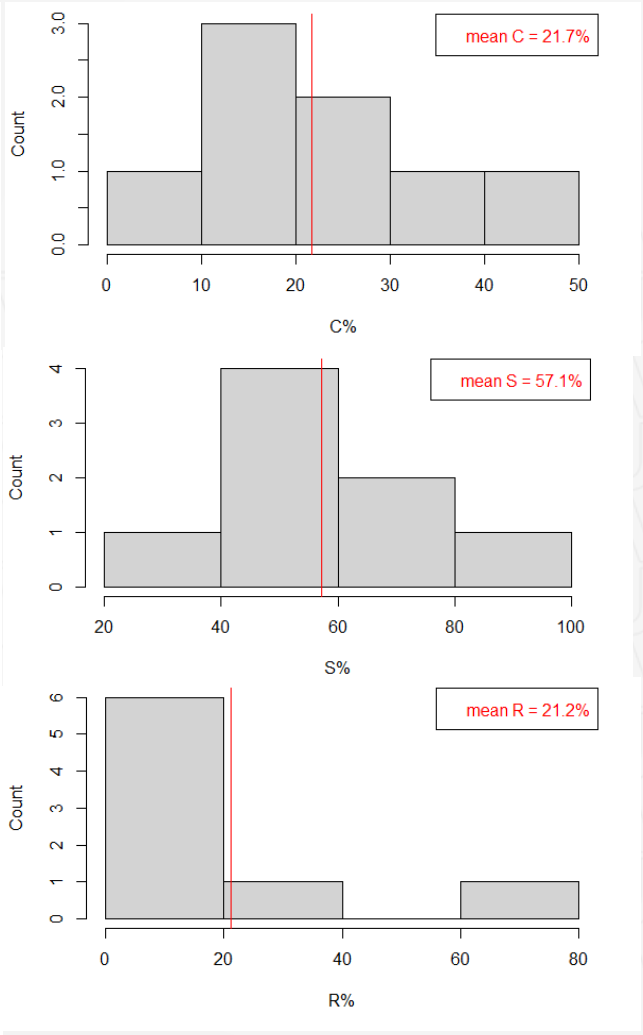
Stagnation (-0.4%) in mean stress tolerance (S) investment over time.

Increase (+7.7%) in mean ruderality (R) investment over time.

Native functional roles over time

Historical Natives





Extant Natives

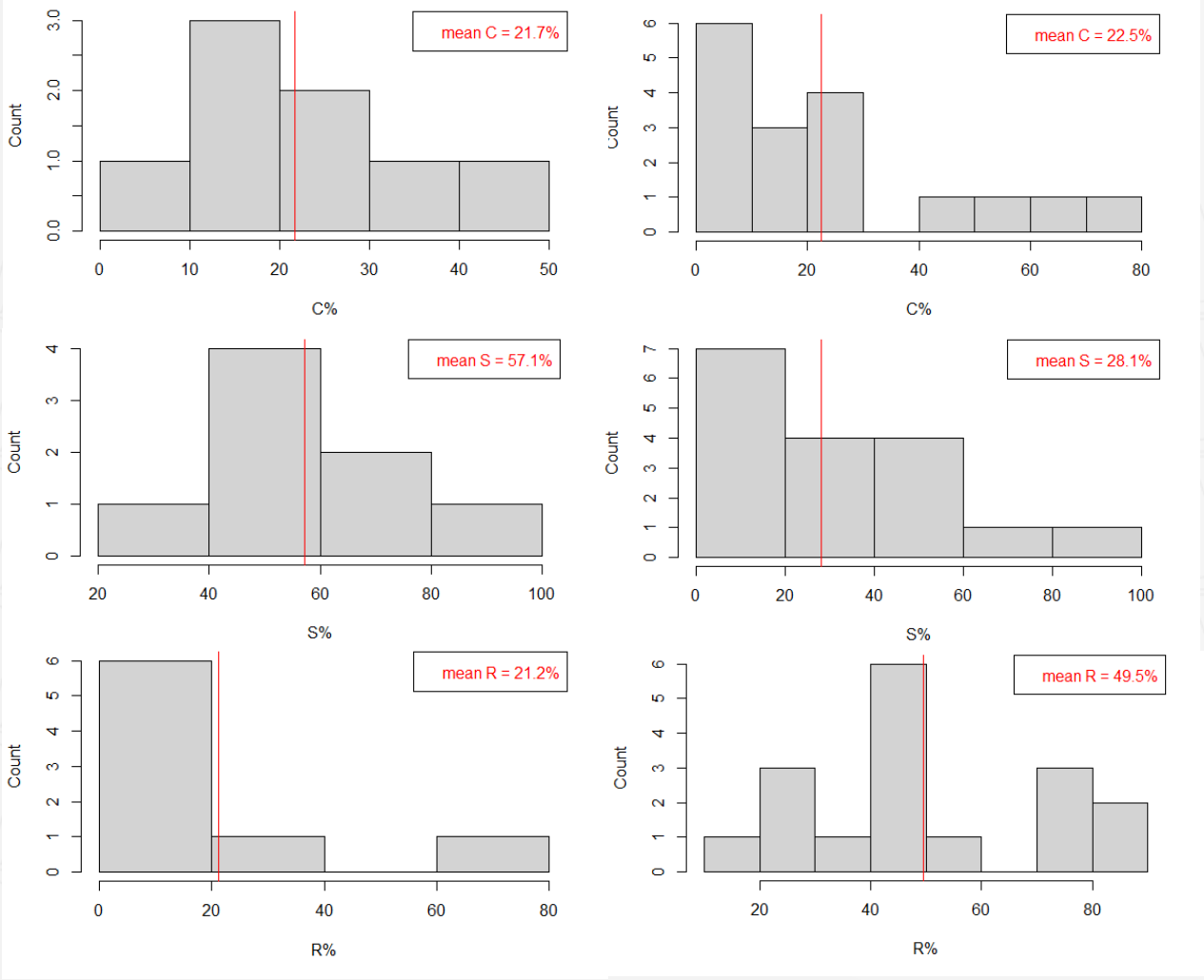
Reduction (-6.8%) in mean competitive (C) investment over time.

Increase (+19.3%) in mean stress tolerance (S) investment over time.

Reduction (-11.5%) in mean ruderality (R) investment over time.

Functional roles of Natives vs. Exotics

Extant Natives



Exotics

Similar (+0.8%) mean competitive (C) investment for exotics compared to natives.

Lower (-29%) mean stress tolerance (S) investment for exotics compared to natives.

Higher (+28.3%) mean ruderality (R) investment for exotics compared to natives.

Conclusions

1. Species diversity has decreased significantly over the last 100 years.
2. Functional analysis suggests community assembly filters have shifted to a higher disturbance regime over time.
3. Current high disturbance regime favors the recruitment of ruderal exotics into the community.

Conclusions

Peter W. Dunwiddie[1], Center for Natural Lands Management, 120 Union Ave. SE, Olympia, Washington 98501

Edward R. Alverson, 501 Irving Rd., Eugene, Oregon 97404

R. Adam Martin, Center for Natural Lands Management, 120 Union Ave. SE, Olympia, Washington 98501

and

Rod Gilbert, Fish and Wildlife Program, Joint-Base Lewis-McChord, Tacoma, Washington 98433

Annual Species in Native Prairies of South Puget Sound, Washington

Abstract

Although it is well documented that the vast majority of native prairies in western Washington have disappeared, it is less clear to what extent the remaining fragments have been modified by the loss of native taxa. In this study, we focus on one group of plants—native annuals—that are notably lacking in prairies today. Based on current and historical records, we compiled a list of 190 native herbaceous plant taxa (species, subspecies, and varieties) with high or moderate fidelity to prairie and oak habitats that have been recorded in upland prairies in the South Puget Sound region. Eighty (42%) of these are annuals, a proportion that is considerably higher than what occurs in these prairies today (average 18%). In addition, most native annuals (75) are forbs. These data suggest that in the past, native annual forbs may have comprised a significantly greater proportion of the diversity in the prairies. Although it is impossible to determine how widespread these species were historically, several measures suggest significant declines have occurred. Of the 80 total native annuals observed, 39% have not been recorded in recent inventories of the floras in any prairies in the region, and another 21% are known from only one site. Data from recently burned prairies suggest that both cover and species richness of annuals may double after a single fire. To avoid further loss of native annuals, we urge the inclusion of species from this functional group in future prairie restoration in this region.

Keywords: Extinction debt, shifting baseline, restoration, floristic composition

Future work

A more representative sample can be produced by collecting leaf trait data in the field and estimating CSR coordinates for the remainder of the prairie species pool.

	Phylogenetic Sample Size	Functional Sample Size Used
Contemporary community	41 species	25 species (61%)
Historical community	84 species	22 species (26%)

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Thank you!