Making ecological restoration climate-smart

Thomas Gardali, 15 December 2016, Sacramento State University

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Conservation science
for a healthy planet.

Outline for this presentation

1. Restoration Ecology
2. Climate-smart ecological restoration defined
3. Climate-smart ecological restoration principles
4. Principles to practice

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Restoration

THE PAST

NOW

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Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

Society for Ecological Restoration (2004)

SER SOCIETY FOR ECOLOGICAL RESTORATION

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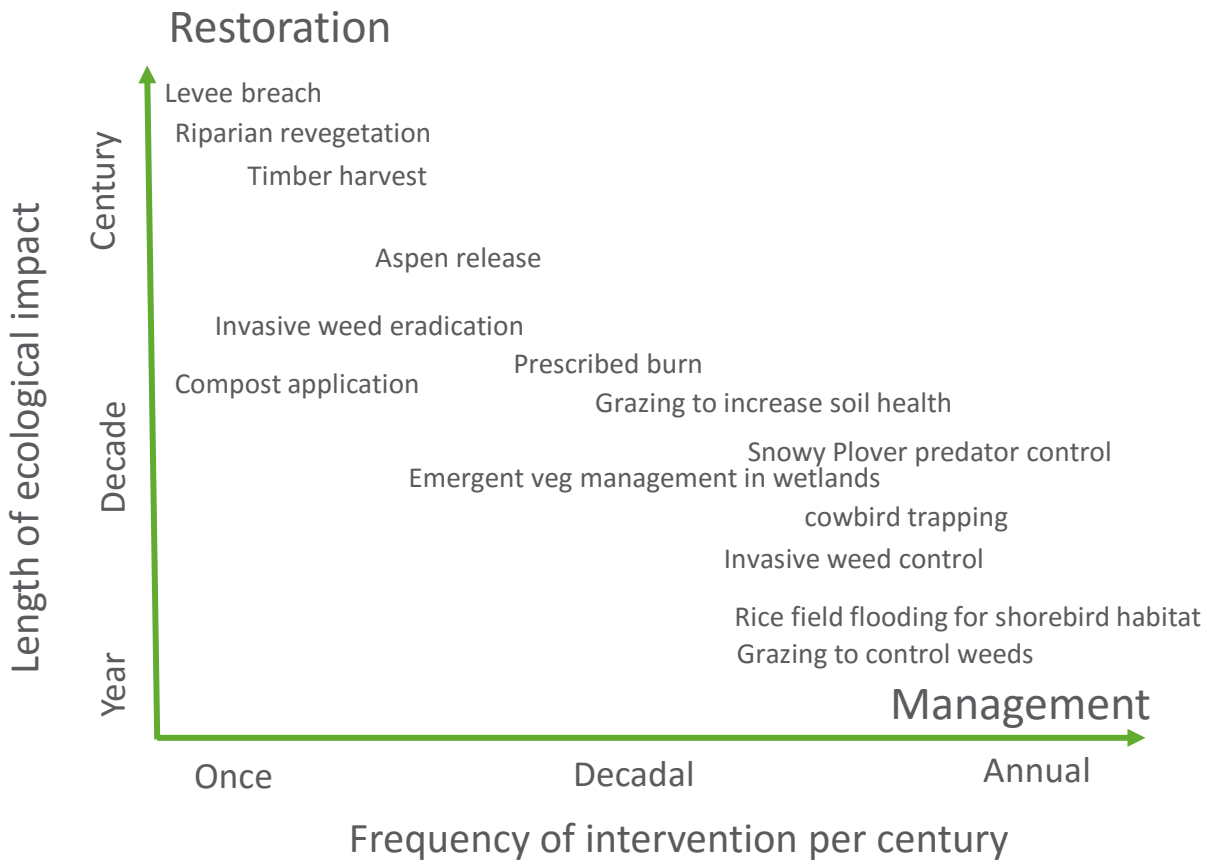
Contrasting Restoration and Management



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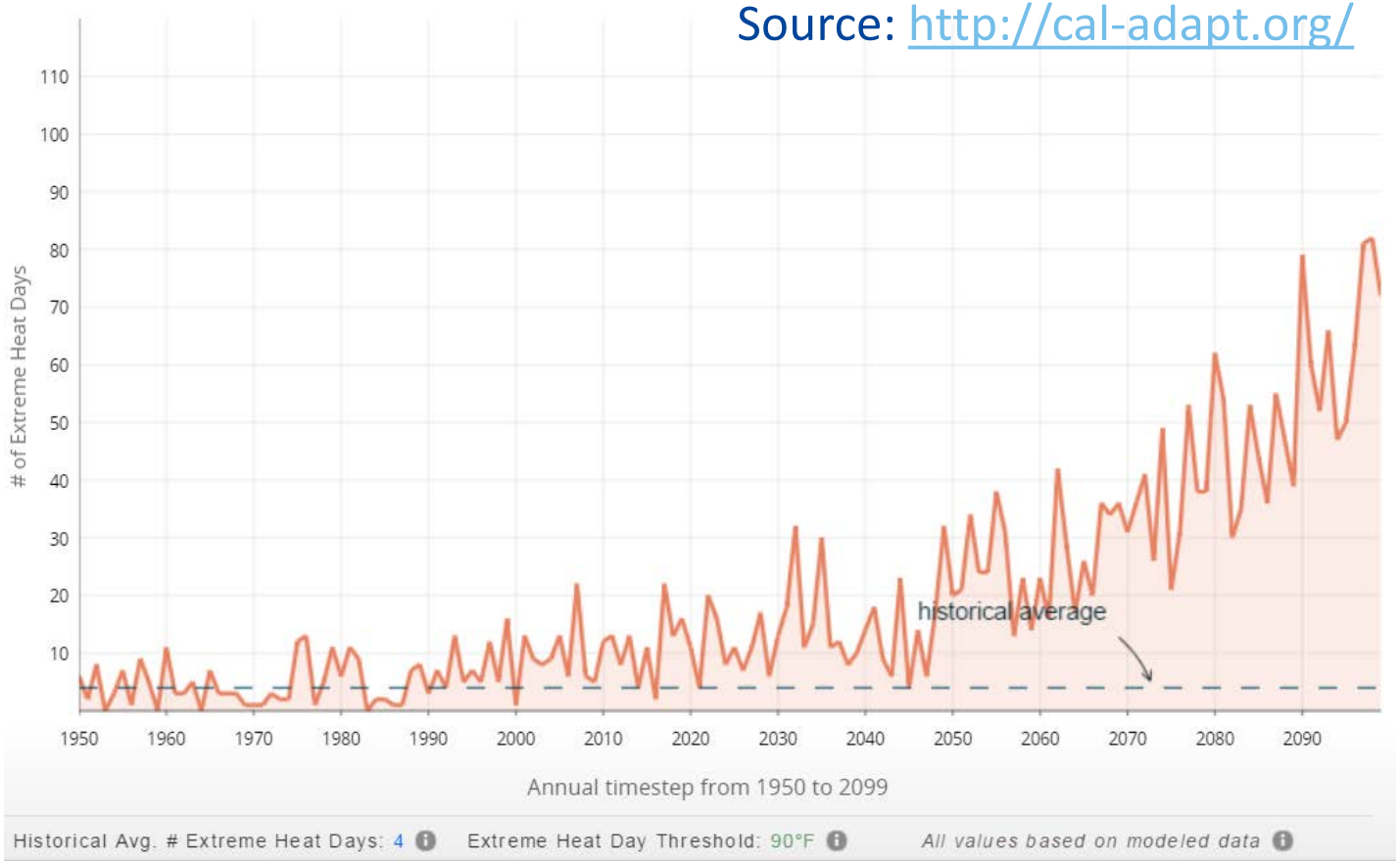
Climate change: Restoration game changer

Number of extreme heat days by year

Source: http://cal-adapt.org/



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Climate-smart ecological restoration is the process of enhancing ecological function of degraded or destroyed areas in a manner that prepares them for the consequences of climate change.

Gardali et al., In prep

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Climate-smart principles

1. Show your work
2. Look forward but don't ignore the past
3. Consider the broader context
4. Build ecological insurance
5. Build evolutionary resilience
6. Include the human community
7. Monitor and Experiment

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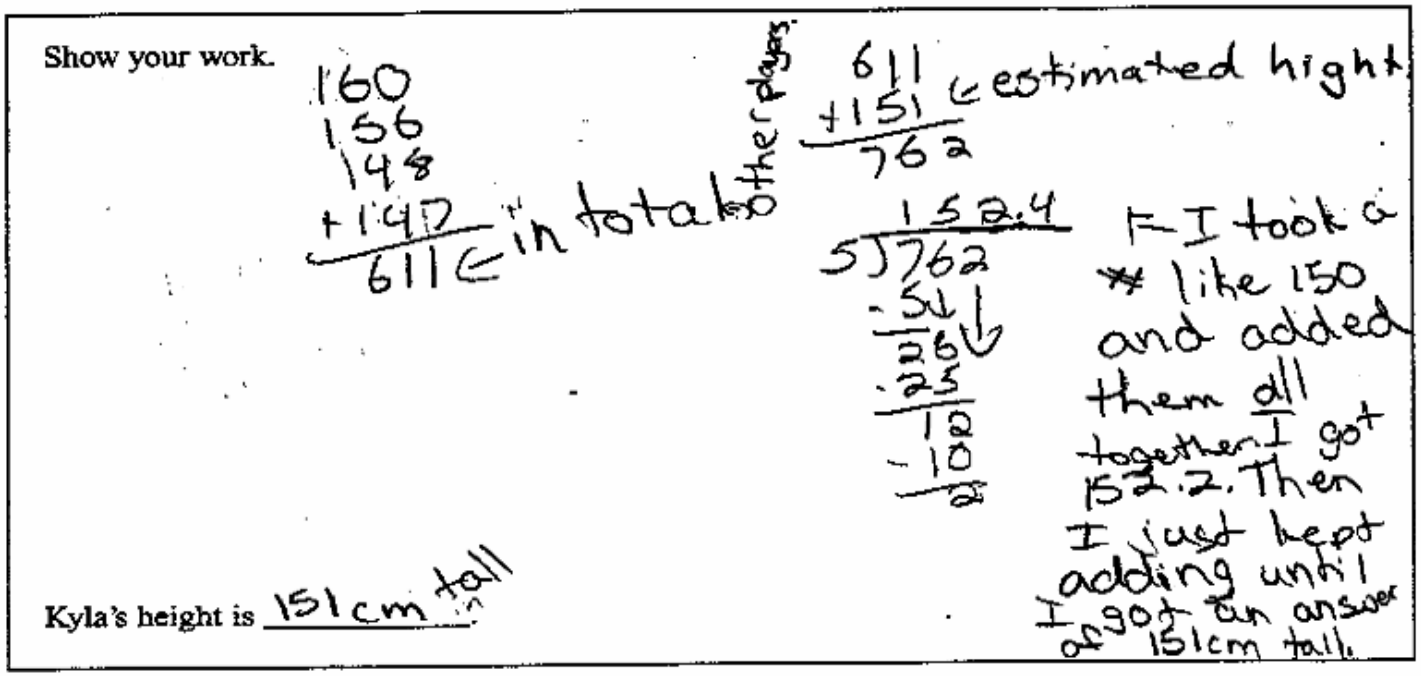
Adapted from: http://www.nwf.org/, Palmer Est. & Coasts 32, Hansen et al. Con. Bio. 24

1. Show your work

Kyla is a member of the starting lineup of the school's basketball team. The heights of the other starting players are shown below.

160 cm, 156 cm, 148 cm, 147 cm

The mean height of the starting lineup is 152.4 cm. What is Kyla's height?



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2. Look forward but don't ignore the past

- Use best available climate projections and summarize for project region
  - Make comparisons to current conditions
- Use information on past conditions if available
- Identify **climate-change vulnerabilities**

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More on Vulnerability

Vulnerability is the susceptibility or amount of risk of a population to negative impacts

A **Vulnerability Assessment** seeks to determine how susceptible a species or a system is to the negative impacts of climate change

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Sources: Smit et al. 2000. *Climatic Change* 45
Williams et al. 2008. *PloS Biology* 6

Components of a vulnerability assessment

Sensitivity refers to the intrinsic traits of organisms that make them vulnerable to climate change (such as physiological tolerances)

Exposure refers to the extrinsic factors that are driven by climate change (such as habitat loss)

Adaptive capacity addresses the ability of a species or system to accommodate or cope with climate change impacts.

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Developing actions to address vulnerabilities

Goal	Climate vulnerability	Action
Protect water quality by slowing run-off	More extreme events (drought, floods) kill vegetation and create bare ground	Plant species that can survive extreme events
Provide wildlife habitat	Changes in timing cause mismatches in animal/plant phenology	Increasing the number of months that resources (cover, food) are available

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3. Consider the broader context

- Identify **other stressors to the system** that could be addressed by the project
- Other logistical constraints
- Importance of project to the region and beyond

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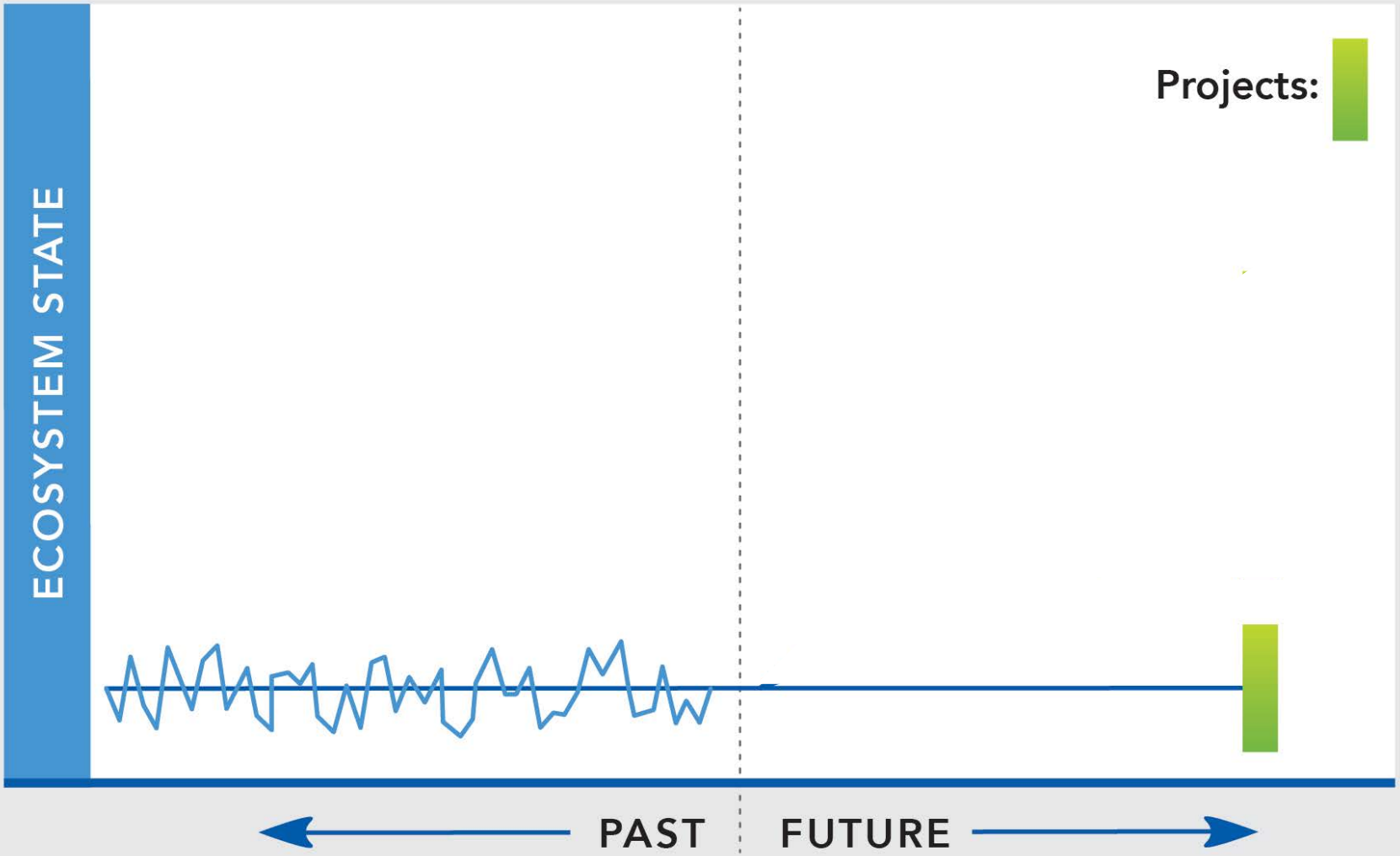

Point Blue Conservation Science

Projects should be designed to succeed under multiple scenarios.

4. Build Ecological Insurance -Redundancy

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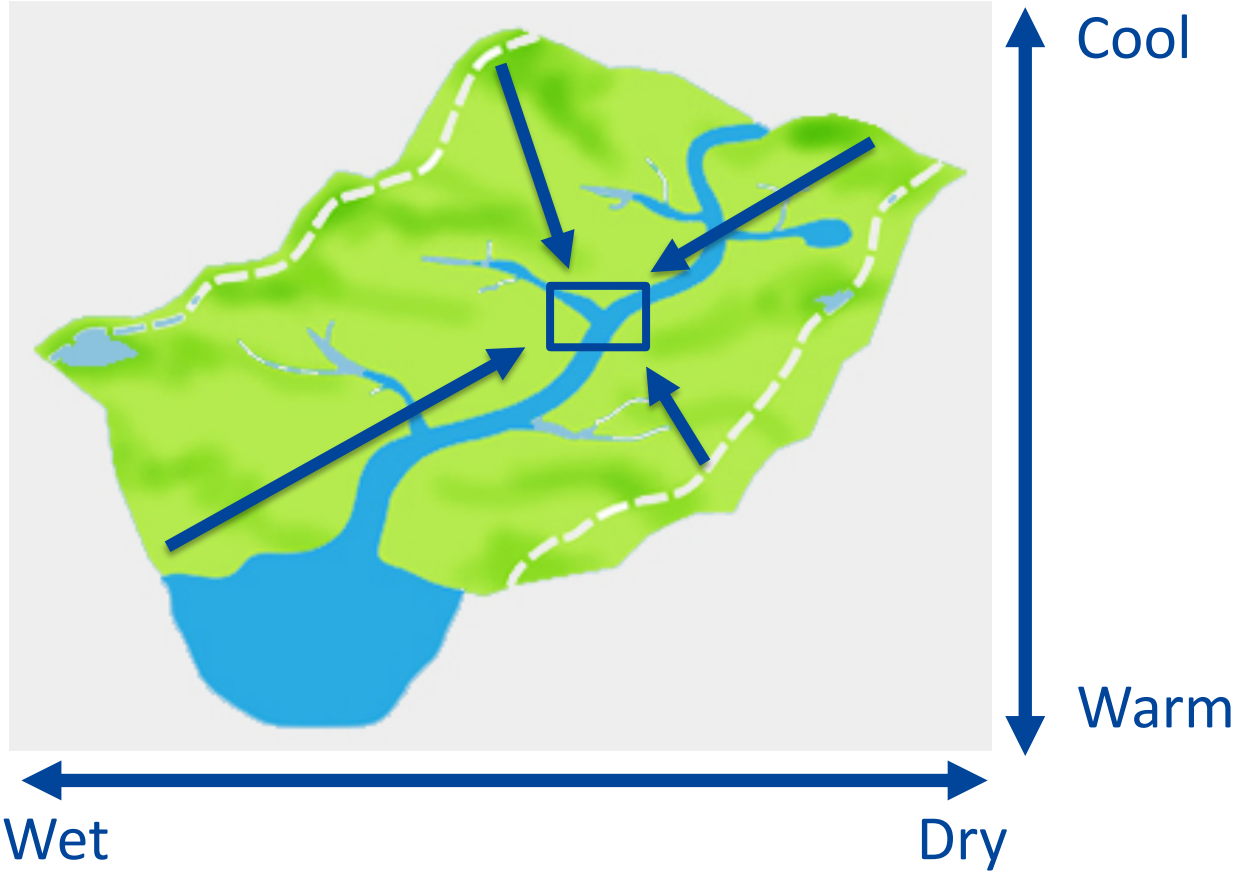
Dunwiddie et al., Ecol. Rest. v27

5. Build Evolutionary Resilience



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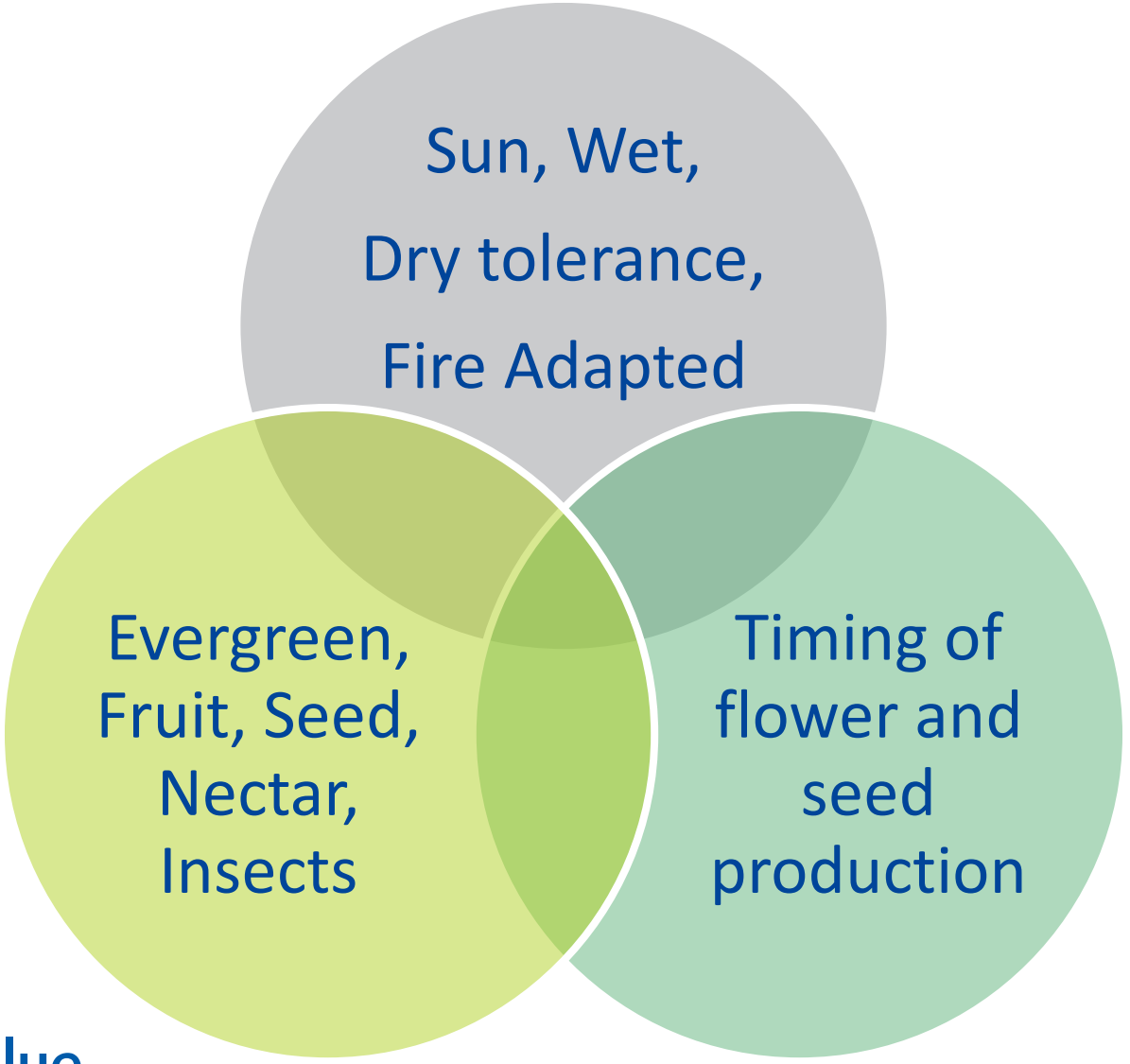
Seavy et al., Ecol. Rest. v27

Simple planting tool



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Developed planning matrix

We created a tool to evaluate appropriate plant species and their environmental qualities

	A	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Climate-Smart Planting: Trees			Climate-related traits						Resources for wildlife						
2		Vegetation species		(Y = yes, N = no, ? = undetermined)						(Y = yes, N = no, ? = undetermined)						
3	In planting design?	Common Name	*Scientific Name*	Tolerates full or partial sun	Tolerates clay soil	Tolerates wet conditions	Tolerates dry conditions	Evergreen	Fire Adapted	Wildlife fruit source	Wildlife Nectar source	Wildlife Seed Source	Insectary Plant	Jan	Feb	Mar
4		Total species		0	0	0	0	0	0	0	0	0	0	0	0	0
5		big leaf maple	*Acer macrophyllum*	Y	Y	Y	Y	N	Y	N	N	Y	N			
6		boxelder	*Acer negundo*	Y	Y	Y	Y	N	N	N	?	Y	Y			F
7		California buckeye	*Aesculus californica*	Y	Y	Y	Y	N	Y	N	Y	N	Y			
8		white alder	*Alnus rhombifolia*	Y	Y	Y	N	N	N	N	?	Y	Y	F	F	F
9		red alder (coastal)	*Alnus rubrifolia*	Y	Y	Y	N	N	N	N	?	Y	Y	S	S	F
10		madrone	*Arbutus menziesii*	Y	Y	N	Y	Y	Y	N	Y	?	Y			F
11		Oregon ash	*Fraxinus latifolia*	Y	Y	Y	N	N	Y	?	Y	Y	Y			F
12		coast silk tassle	*Garrya elliptica*	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	F	F	F
13		California black walnut	*Juglans hindsii*	Y	Y	Y	Y	N	Y	N	?	Y	?			
14		tan oak	*Lithocarpus densiflorus*	Y	?	N	N	Y	Y	N	?	y	?			
15		wax myrtle	*Myrica californica*	Y	Y	Y	Y	Y	N	Y	N	?	?			F
16		western choke cherry	*Prunus virginiana demissa*	Y	Y	Y	Y	N	Y	Y	Y	?	Y			
17		coast live oak	*Quercus agrifolia*	Y	Y	N	Y	Y	Y	N	N	Y	Y			F
18		black oak	*Quercus kelloggii*	Y	Y	N	Y	N	Y	N	N	Y	Y			
19		valley oak	*Quercus lobata*	Y	Y	Y	Y	N	Y	N	N	Y	Y			F
20		sandbar willow	*Salix exigua*	Y	Y	Y	N	N	Y	N	Y	?	Y			F
21		coastal or Hooker's willow	*Salix hookeriana*	Y	Y	Y	?	N	Y	N	Y	?	Y			
22		red willow	*Salix laevigata*	Y	Y	Y	N	N	Y	N	Y	?	Y			F

Start Here | Plant Selection | Climate-Smart Performance | Plant Shopping List | **Trees** | Shrubs | Grasses & Forbs

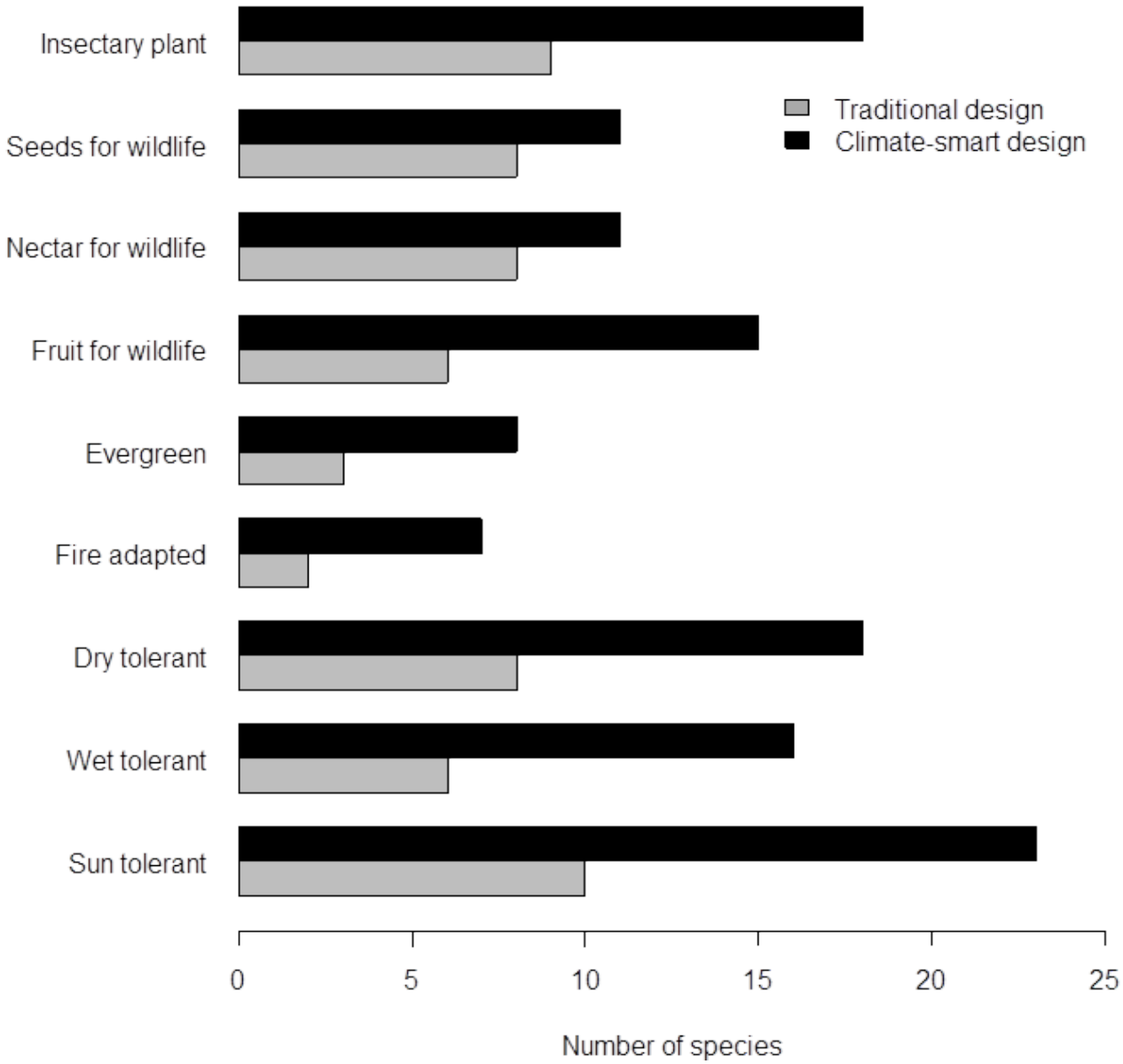
Developed planning matrix

And evaluated timing of flowering/seeding to maximize the number of months that resources (food) are available for wildlife

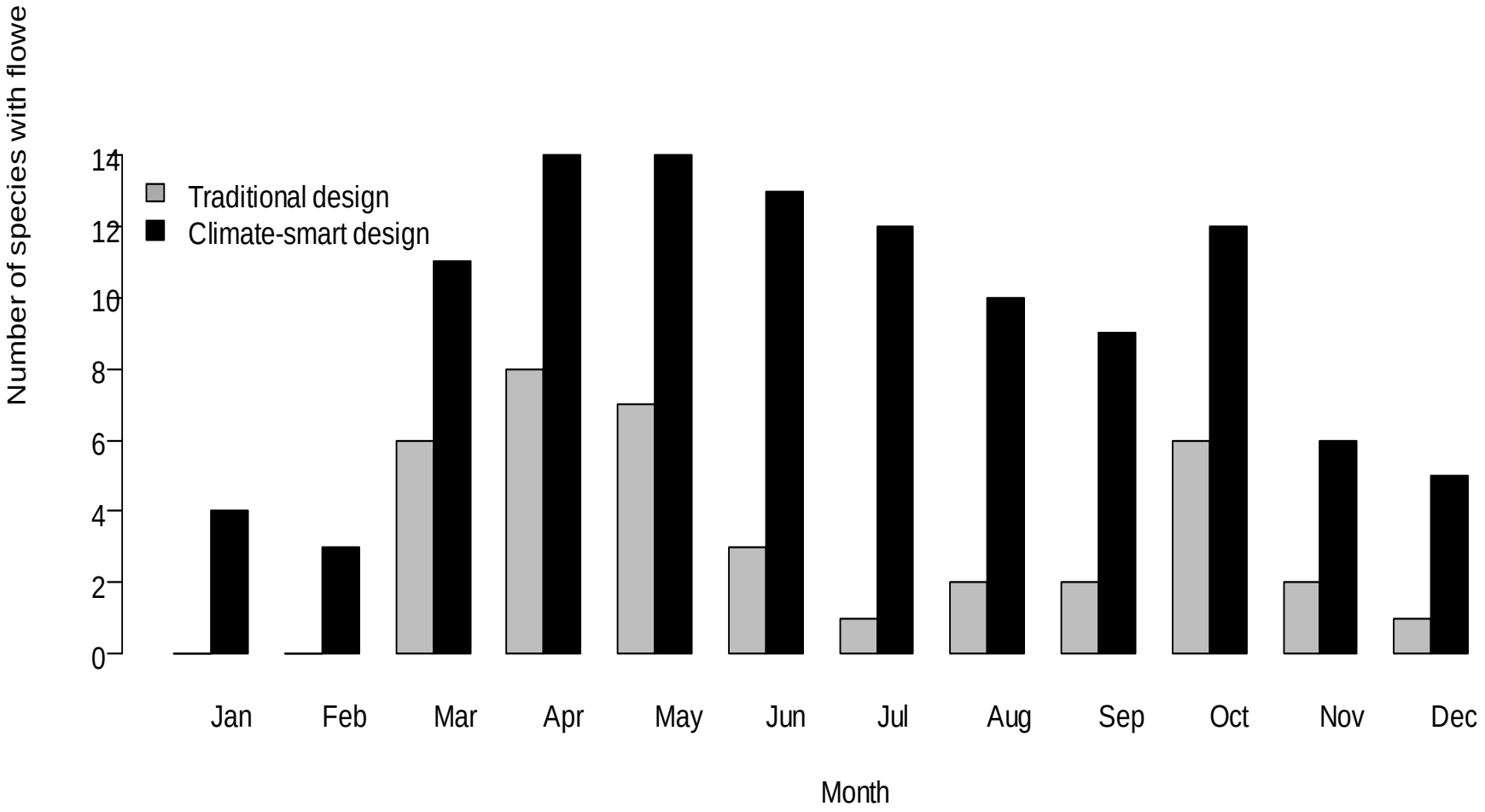
	A	C	D	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
1	Climate-Smart Planting: Trees			Resource phenology												Nc
2		Vegetation species		(F = flower, S = seeds)												
3	In planting design?	Common Name	*Scientific Name*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
4		Total species		0	0	0	0	0	0	0	0	0	0	0	0	
5		big leaf maple	*Acer macrophyllum*				F	F			S	S	S	S		birds eat seeds, buds, flowers
6		boxelder	*Acer negundo*			F	F				S	S	S	S		birds eat seeds, buds, flowers
7		California buckeye	*Aesculus californica*					F	F					S	S	pollen and nectar poisonous to european honeybees, butterfl
8		white alder	*Alnus rhombifolia*	F	F	F	F								F	Birds eat seeds buds, cover and nesting materials, located in s
9		red alder (coastal)	*Alnus rubrifolia*	S	S	F	F								S	Birds eat seeds buds, cover and nesting materials
10		madrone	*Arbutus menziesii*			F	F	F					S	S	S	butterfly host plant, fruit for birds
11		Oregon ash	*Fraxinus latifolia*			F	F	F					S			
12		coast silk tassle	*Garrya elliptica*	F	F	F										Fruit eaten by birds
13		California black walnut	*Juglans hindsii*				F	F			S	S	S			oak are larval food plants for 7 species of butterflies
14		tan oak	*Lithocarpus densiflorus*						F	F	F	F	F			nuts for birds
15		wax myrtle	*Myrica californica*			F	F	F					S	S		
16		western choke cherry	*Prunus virginiana demissa*				F	F	F				S	S		butterfly host plant- Lorquin's Admiral
17		coast live oak	*Quercus agrifolia*			F	F						S			Birds eat nuts, leaf galls, nesting sites, insects
18		black oak	*Quercus kelloggii*				F	F					S			Birds eat nuts, leaf galls, nesting sites, insects
19		valley oak	*Quercus lobata*			F	F						S			Birds eat nuts, leaf galls, nesting sites, insects
20		sandbar willow	*Salix exigua*			F	F	F								Mourning Cloak
21		coastal or Hooker's willow	*Salix hookeriana*													salix species are important early spring pollen source
22		red willow	*Salix laevigata*			F	F	F								

Start Here | Plant Selection | Climate-Smart Performance | Plant Shopping List | **Trees** | Shrubs | Grasses & Forbs

Traditional vs Climate-Smart



Traditional vs Climate-Smart



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6. Include the Human Community

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Risk

- The probability of an outcome (usually negative) in a specified period of time

- An estimate of risk can help provide the evidence (show your work!) to:
    - make restoration decisions
    - allocate scarce resources

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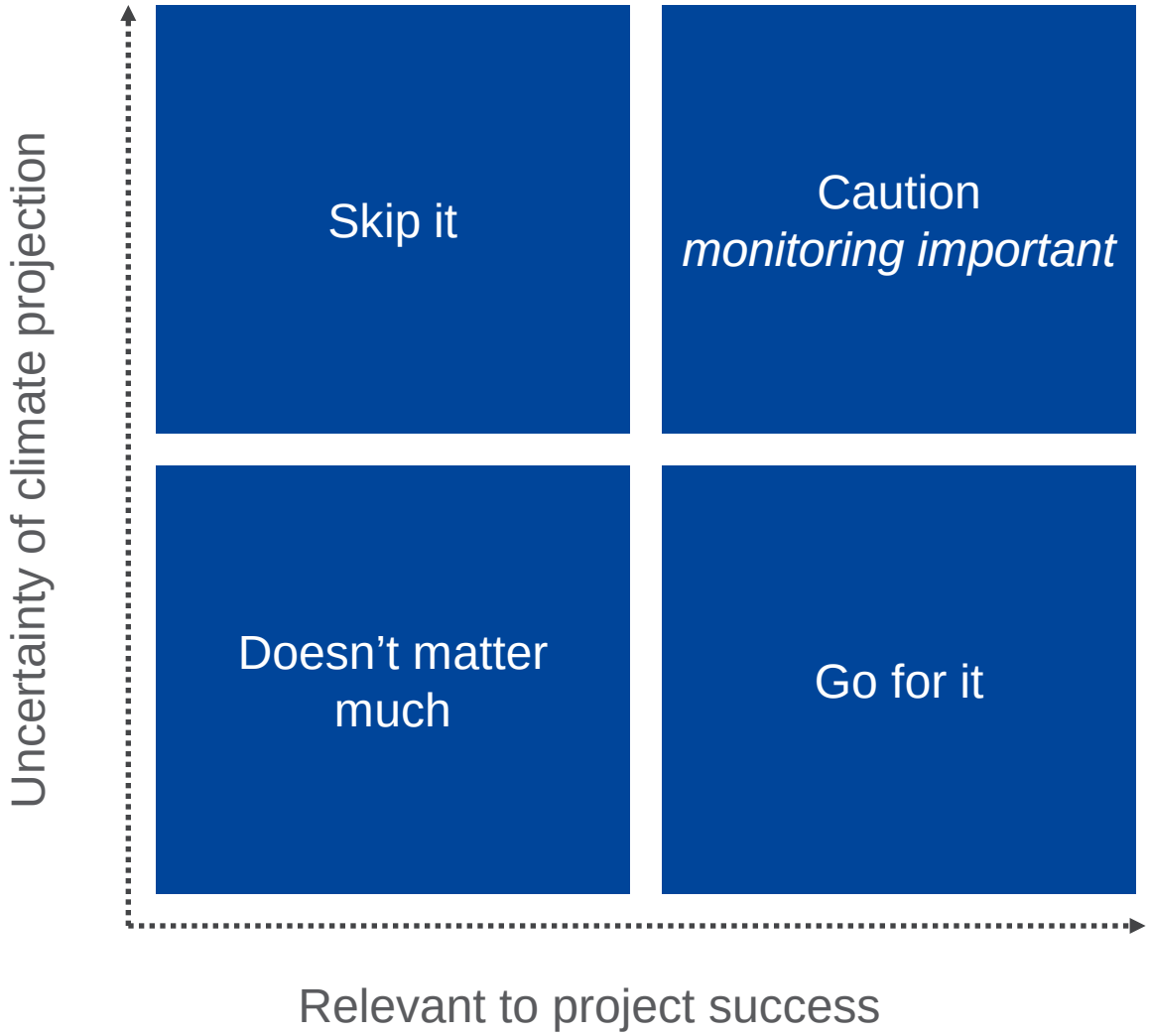
Risk



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7. Research and Monitoring

Given the great **uncertainties** around how climate change will impact ecosystems and how society will respond, it is important to **conduct ecological monitoring to manage adaptively**.

Restoration experiments can help provide **answer to key uncertainties**, provide **tools to access key information**, and help **evaluate effectiveness**.

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Thank you

California LCC
Marin Community Foundation
Fledgling Fund
The Nature Conservancy
Wildlife Conservation Society

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Conservation
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