Effect of Winter and Summer Prescribed Fires on Pine Rockland Vegetation, Big Pine Key, Florida

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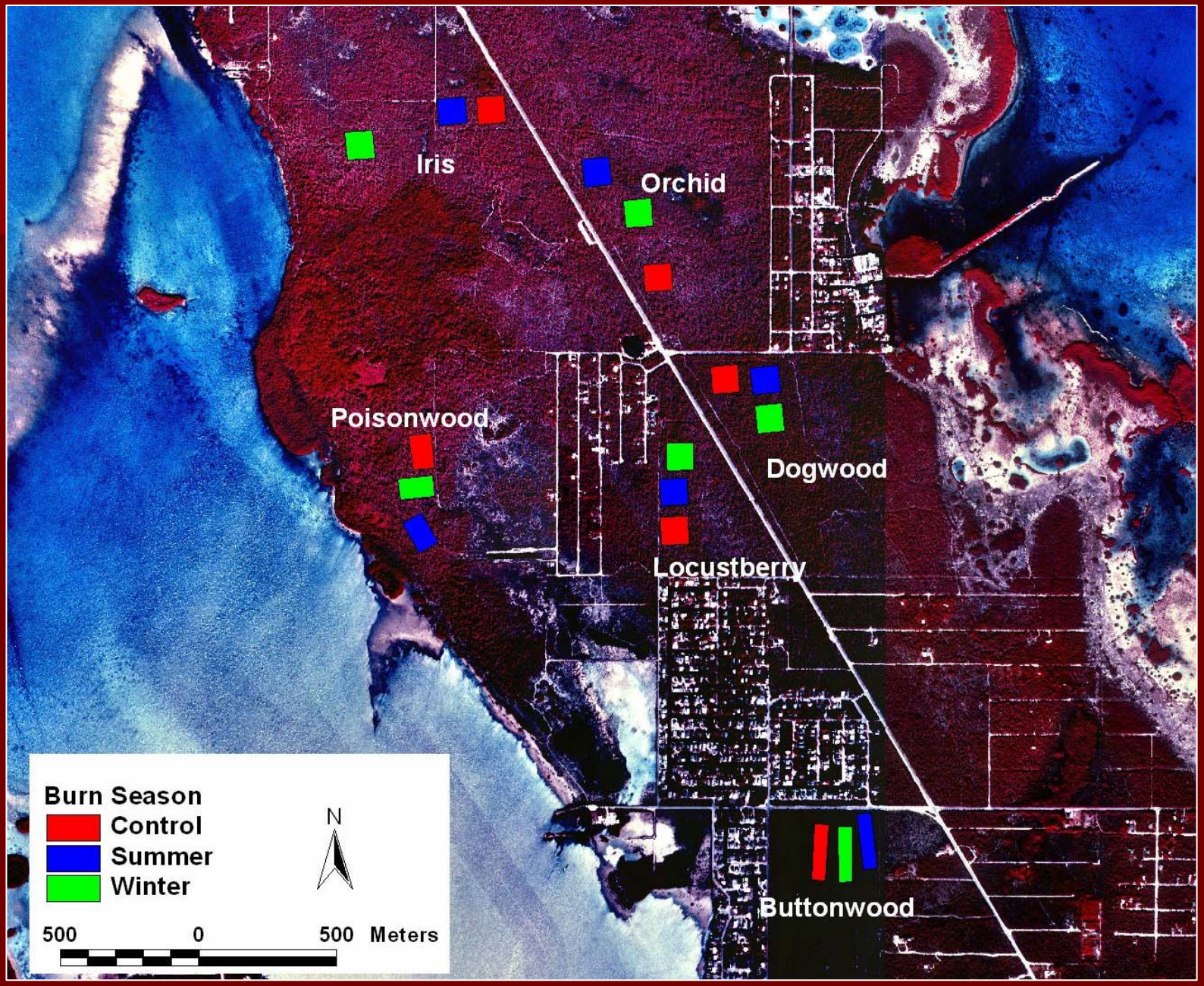
Original Design

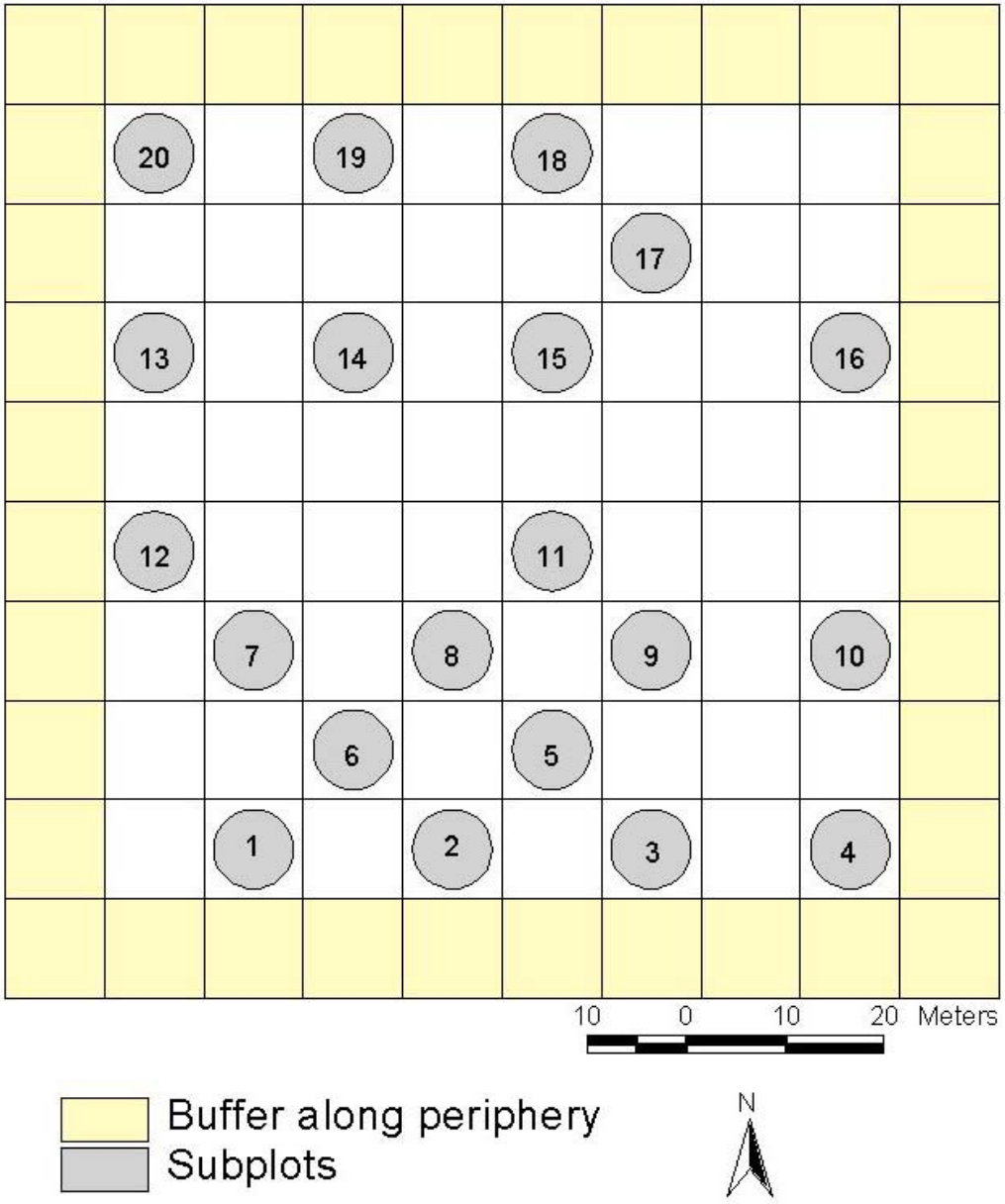
- Two seasons
  - Summer
  - Winter
- Two pineland types
  - Open
  - Shrubby
- One replicate of each type burned per year for 3 years

Site	Pineland type	Year	Treatment	Plot code
Orchid	Open	One		
			Control	OC
			Summer burn	OS
			Winter burn	OW
Poisonwood	Shrubby			
			Control	PC
			Summer burn	PS
			Winter burn	PW
Iris	Open	Two		
			Control	IC
			Summer burn	IS
			Winter burn	IW
Dogwood	Shrubby			
			Control	DC
			Summer burn	DS
			Winter burn	DW
Locustberry	Open	Three		
			Control	LC
			Summer burn	LS
			Winter burn	LW
Buttonwood	Shrubby			
			Control	BC
			Summer burn	BS
			Winter burn	BW


Iris
Orchid
Poisonwood
Dogwood
Locustberry
Buttonwood
Burn Season
Control
Summer
Winter
N
500
0
500 Meters

Vegetation Sampling

- 1.0 ha permanent plots
- Trees in entire plot
  - Tagged and mapped
- Shrubs in 20 circular 50-m^2 subplots
- Herbs in 4 circular 1-m^2 subplots in each shrub subplot for total of 80 per plot
- Sampled before burns and periodically afterwards

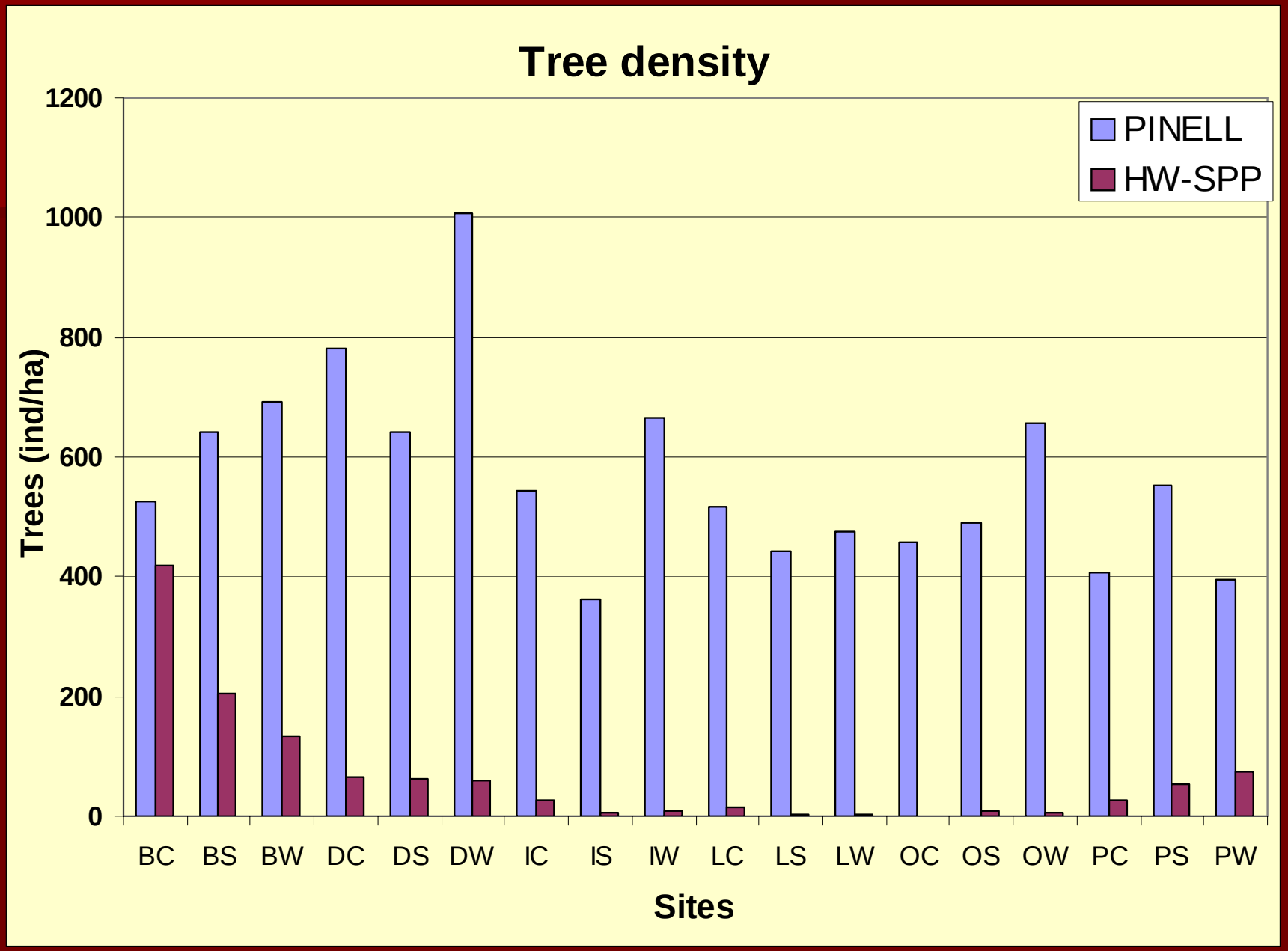

20
19
18
17
13
14
15
16
12
11
7
8
9
10
6
5
1
2
3
4
10 0 10 20 Meters
Buffer along periphery
Subplots
N

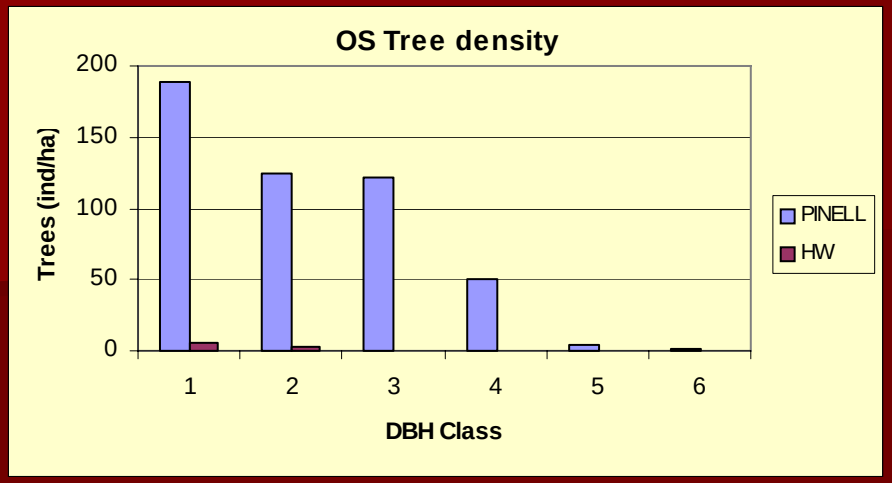
Site	Pineland type	Treatment	Plot code	Burn date
Orchid	Open			
		Summer	OS	8/16/1998
		Winter	OW	12/15/1998
Poisonwood	Shrubby			
		Summer	PS	8/17/1998
		Winter	PW	12/15/1998
Iris	Open			
		Summer	IS	6/22/1999
		Winter	IW	12/12/2000
Dogwood	Shrubby			
		Summer	DS	7/18/1999
		Winter	DW	not burned
Locustberry	Open			
		Summer	LS	7/19/2001
		Winter	LW	7/19/2001
Buttonwood	Shrubby			
		Summer	BS	7/18/2001
		Winter	BW	7/18/2001

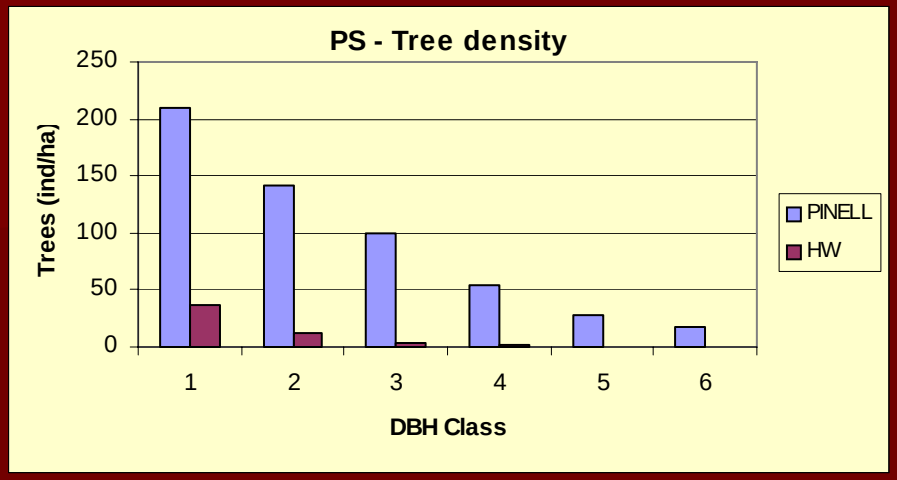
Plot	Years since last fire	Scorch (%)	Char ht. (m)	Fire temp. (°F)	Fine litter consumed (g/m^2)	Fine litter consumed (%)
OS	8	62	2.5	—	1080	71
OW	8	46	1.7	—	894	65
PS	12	66	3.0	—	1408	64
PW	12	22	1.3	—	876	52
IS	8	55	2.1	444	626	47
IW	14	39	1.3	371	—	—
DS	11	84	2.8	489	1097	74
LS	14	58	2.0	511	288	37
LW(S)	14	84	3.4	538	516	56
BS	>30	66	2.6	483	742	44
BW(S)	>30	74	2.7	523	1132	63

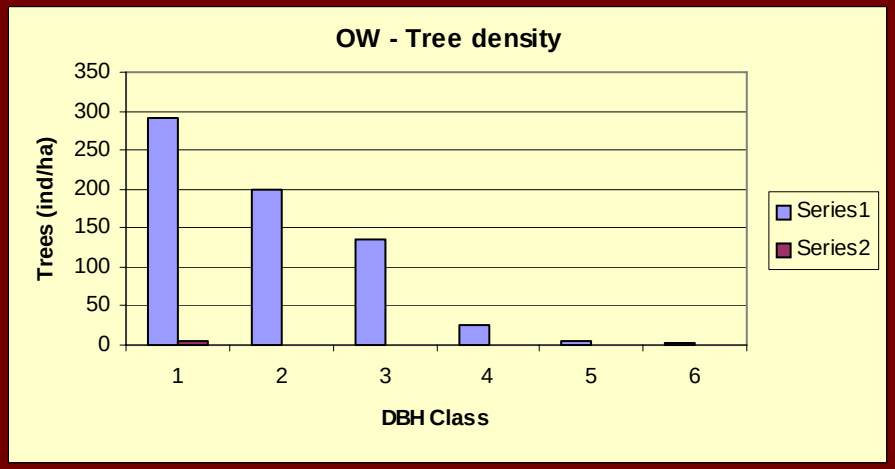
Trees

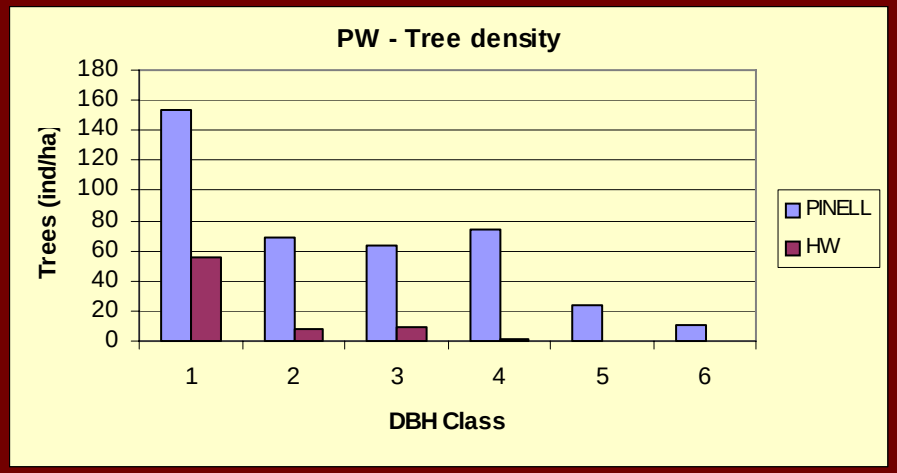
- Pine density from 361 to 1006/ha
- *Metopium toxiferum*, poisonwood, is the dominant hardwood
  - Found in 17 of 18 plots
  - 75% of all hardwood stems
  - Minor hardwoods include *Conocarpus erectus*, *Myrica cerifera*, *Piscidia piscipula*
  - Hardwood density 122 ± 41 trees/ha in shrubby plots, 8 ± 3 trees/ha in open plots


Tree density
PINELL
HW-SPP
Trees (ind/ha)
1200
1000
800
600
400
200
0
BC
BS
BW
DC
DS
DW
IC
IS
IW
LC
LS
LW
OC
OS
OW
PC
PS
PW
Sites


OS Tree density
Trees (ind/ha)
200
150
100
50
0
1
2
3
4
5
6
DBH Class
PINELL
HW


PS - Tree density
Trees (ind/ha)
250
200
150
100
50
0
1
2
3
4
5
6
DBH Class
PINELL
HW


OW - Tree density
Trees (ind/ha)
350
300
250
200
150
100
50
0
1
2
3
4
5
6
DBH Class
Series1
Series2


PW - Tree density
Trees (ind/ha)
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
DBH Class
PINELL
HW

Percent mortality of trees after experimental burns. In many cases, hardwood species resprouted from the base of the tree.

Site	Burn	Pine	Hardwoods
Orchid	Summer	17.6	37.5*
	Winter	16.0	50.0*
Poisonwood	Summer	28.4	21.2
	Winter	7.8	29.4
Iris	Summer	5.6	60.0*
	Winter	1.8	0*
Dogwood	Summer	57.1	96.8

* <10 stems preburn

Mean DBH, scorch, and char height of surviving pine trees and trees killed by burns in seven of the experimental plots, with ANOVA p-value.

	DBH (cm)			Scorch %			Char height (m)		
	Live	Dead	p-value	Live	Dead	p-value	Live	Dead	p-value
OS	13.00	10.53	<0.001	55.1	90.1	<0.001	2.33	3.22	<0.001
OW	11.93	9.49	<0.001	37.4	91.6	<0.001	1.56	2.24	<0.001
PS	13.45	12.66	0.238	55.5	93.1	<0.001	2.57	3.77	<0.001
PW	13.43	14.96	0.289	19.1	52.7	<0.001	1.29	1.48	0.361
IS	15.17	13.42	0.229	53.2	85.0	<0.001	2.05	2.50	0.164
IW	11.18	10.87	0.847	38.4	86.5	<0.001	1.30	1.55	0.421
DS	10.95	9.80	0.002	64.2	99.1	<0.001	1.81	3.60	<0.001

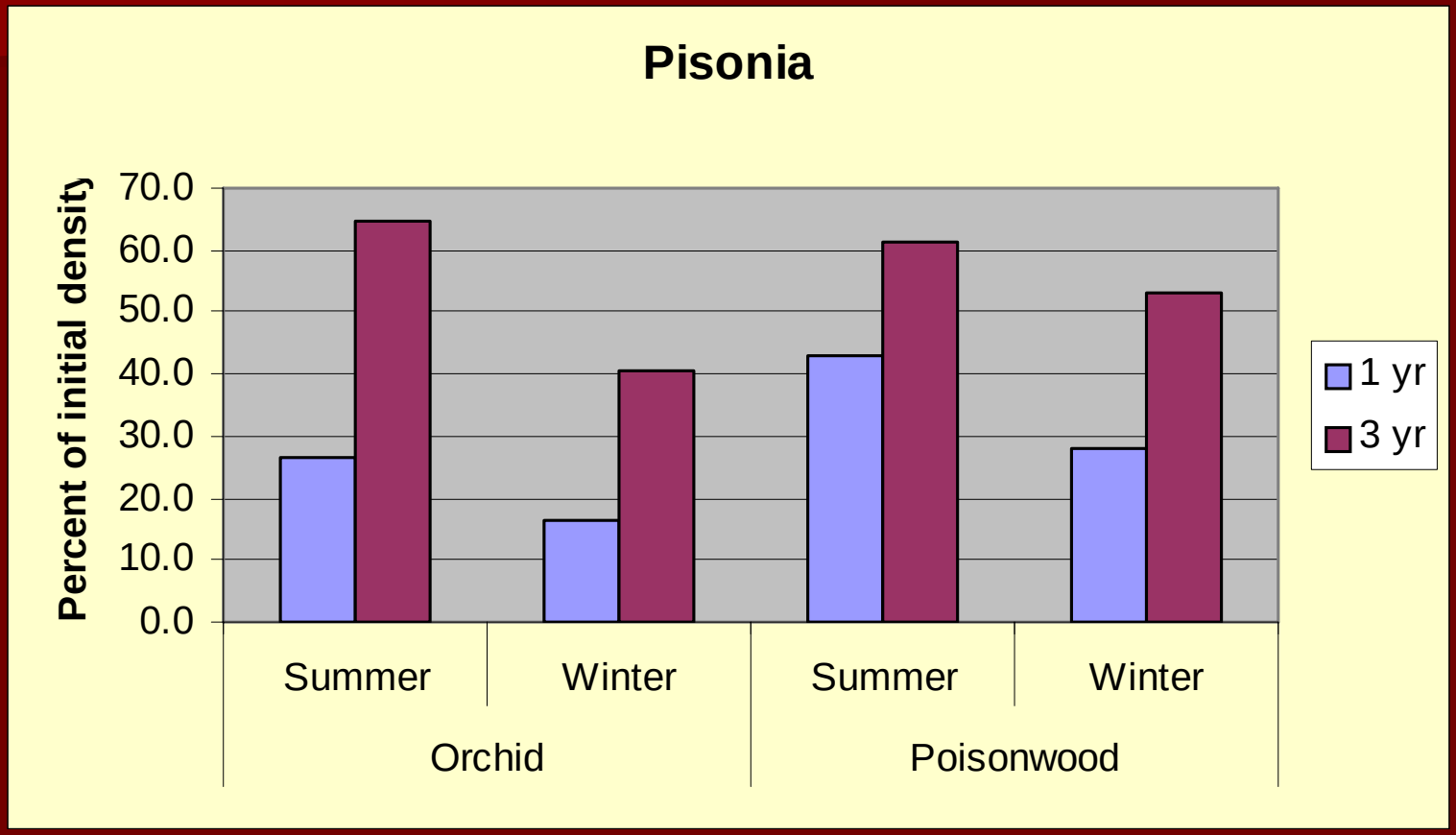
Hardwood shrubs

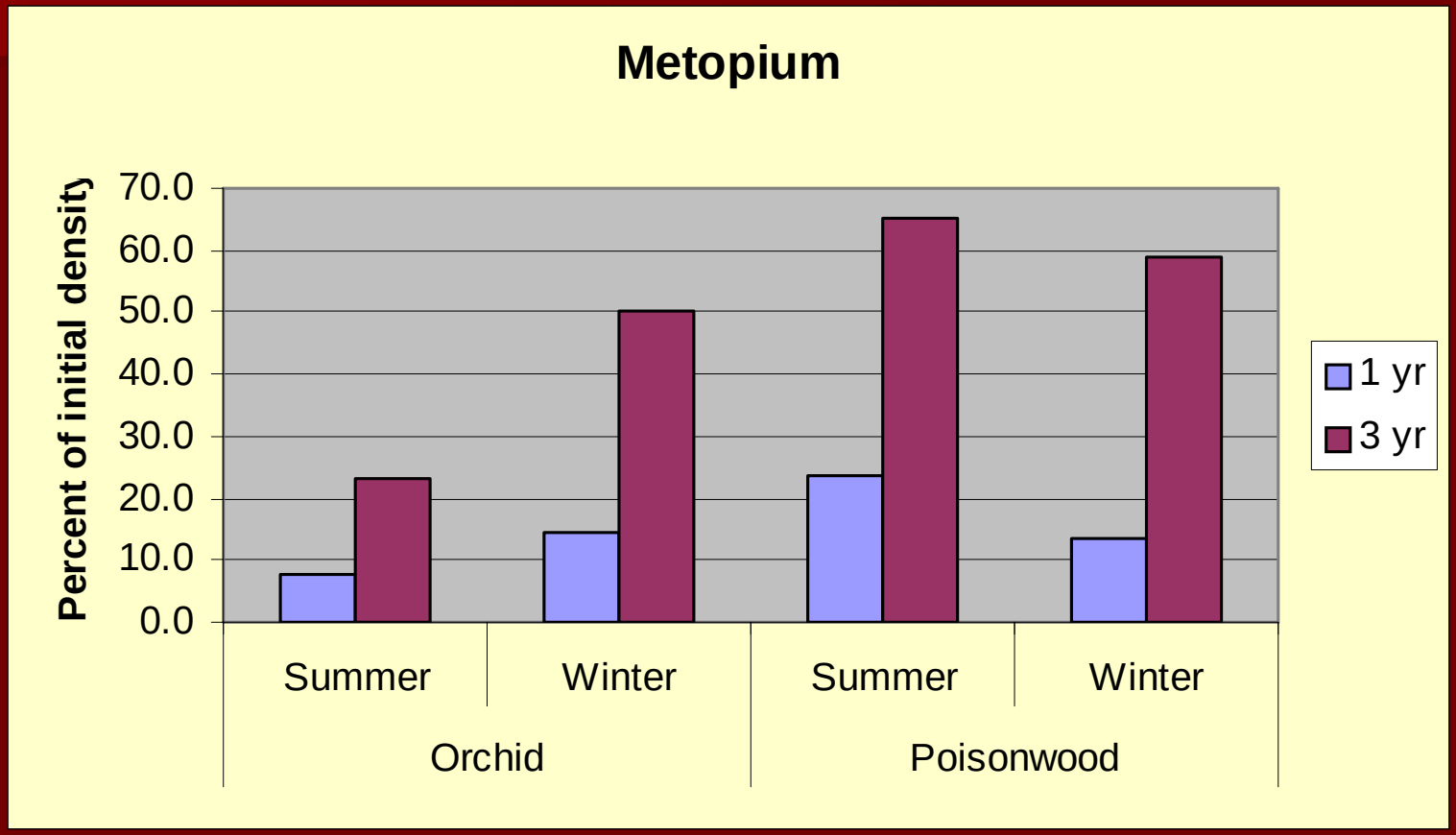
- 34 species
- *Pithecellobium guadelupense*, *Pisonia rotundata*, *Metopium toxiferum*, and *Psidium longipes* found in all plots
- All resprouters
- Sampled preburn and annually postburn
- Stem density 5170 ± 570/ha in shrubby plots, 2050 ± 230/ha in open plots

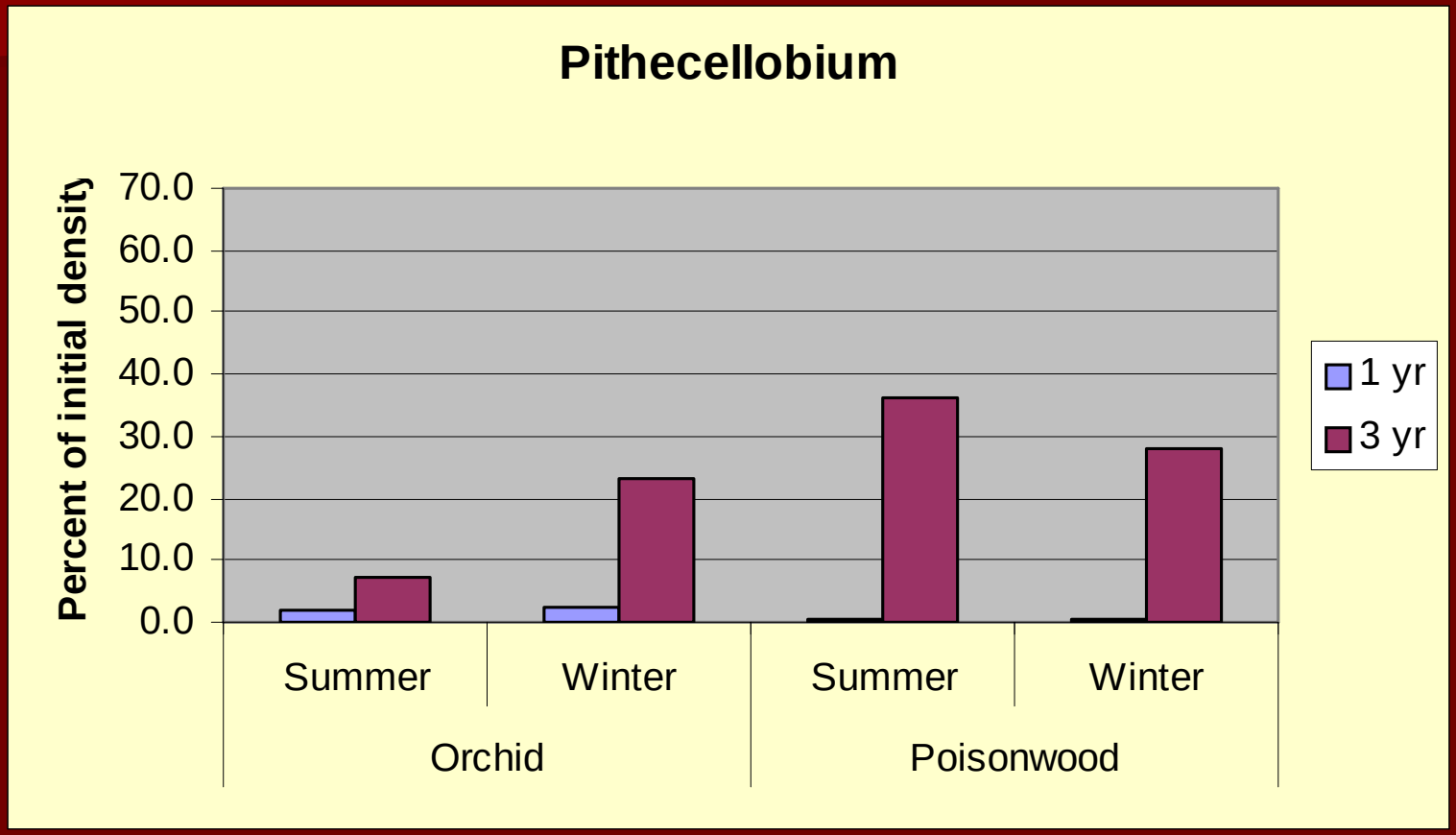
Pisonia rotundata

Pithecellobium guadelupense

Metopium toxiferum


Pisonia
Percent of initial density
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Summer
Winter
Summer
Winter
Orchid
Poisonwood
1 yr
3 yr


Metopium
Percent of initial density
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Summer
Winter
Summer
Winter
Orchid
Poisonwood
1 yr
3 yr

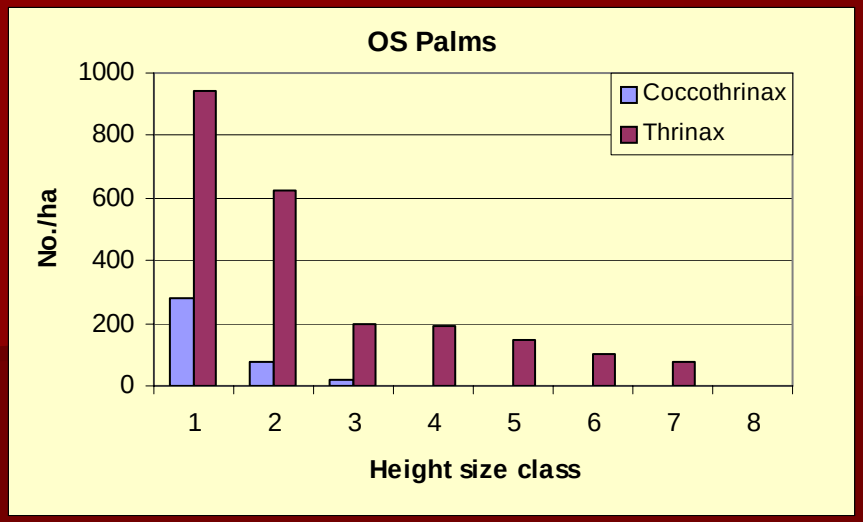

Pithecellobium
Percent of initial density
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Summer
Winter
Summer
Winter
Orchid
Poisonwood
1 yr
3 yr

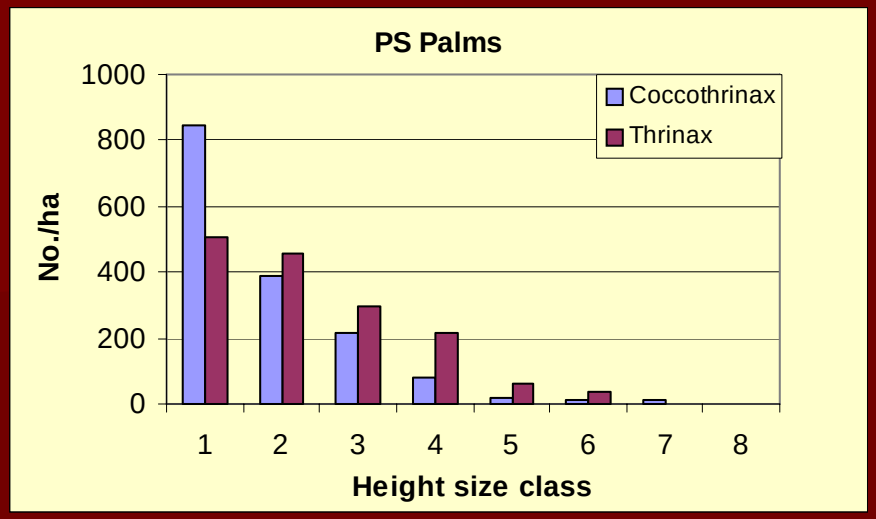
Palms

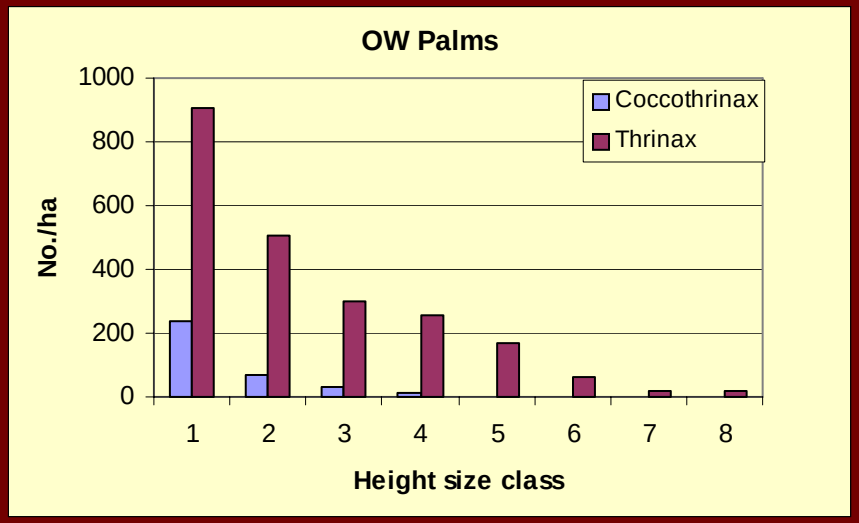
- Four species
  - *Thrinax morrissii*
  - *Coccothrinax argentata*
  - *Serenoa repens*
  - *Sabal palmetto*
- Density of 1880 to 5160/ha

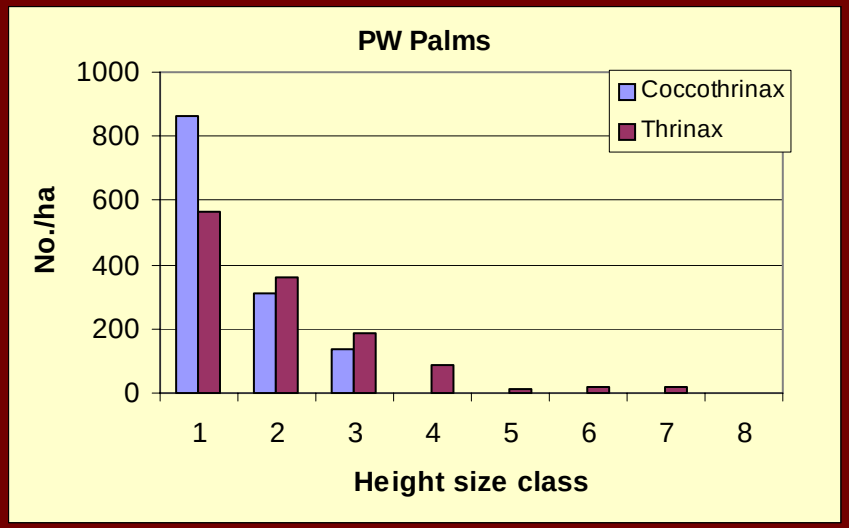
Coccothrinax argentata

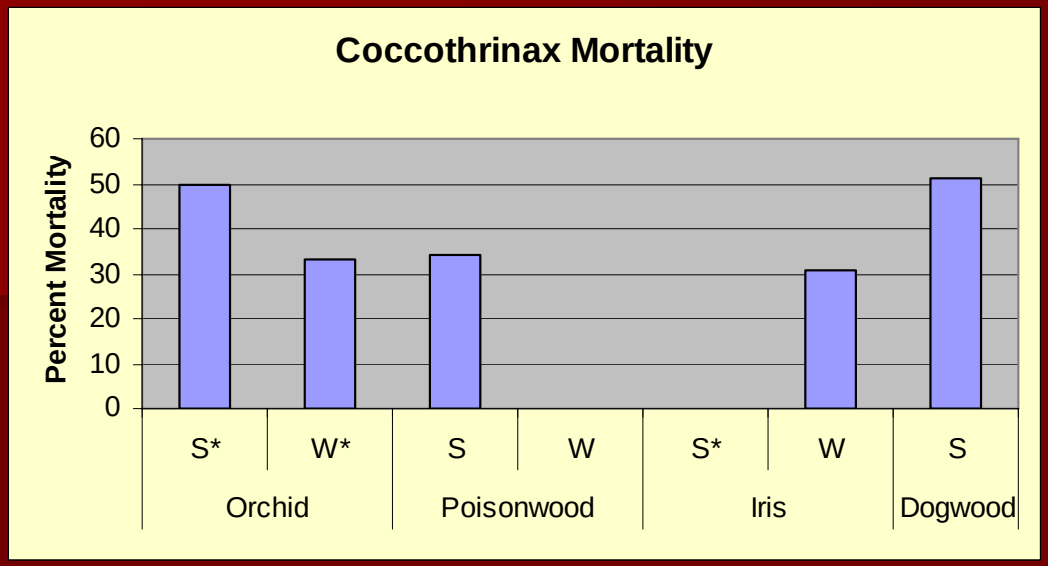
Thrinax morrissii

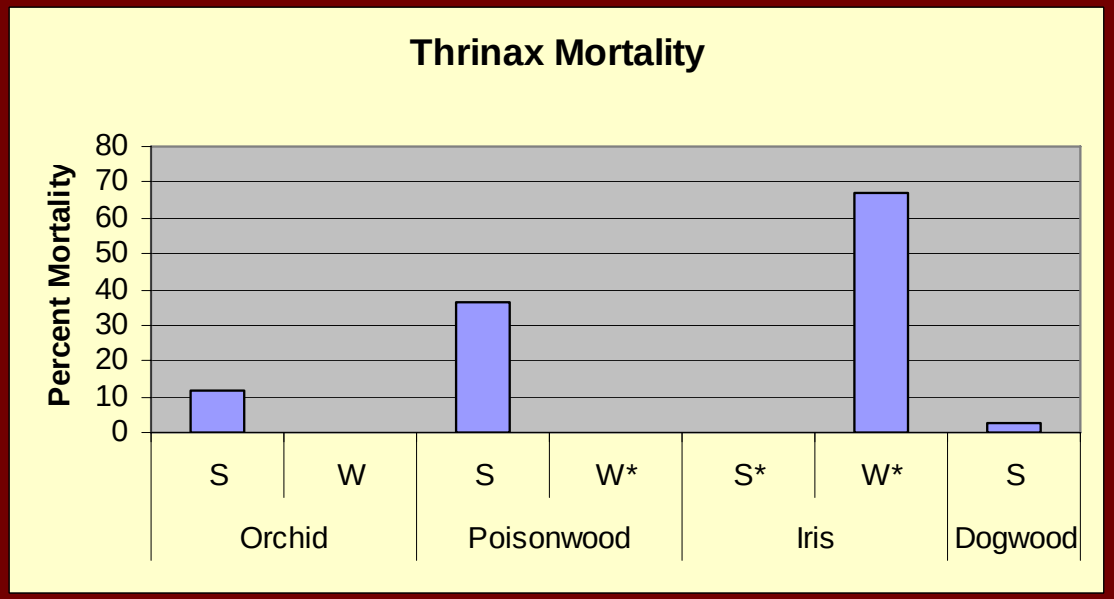

OS Palms
No./ha
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
Height size class
Coccothrinax
Thrinax


PS Palms
No./ha
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
Height size class
Coccothrinax
Thrinax


OW Palms
No./ha
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
Height size class
Coccothrinax
Thrinax

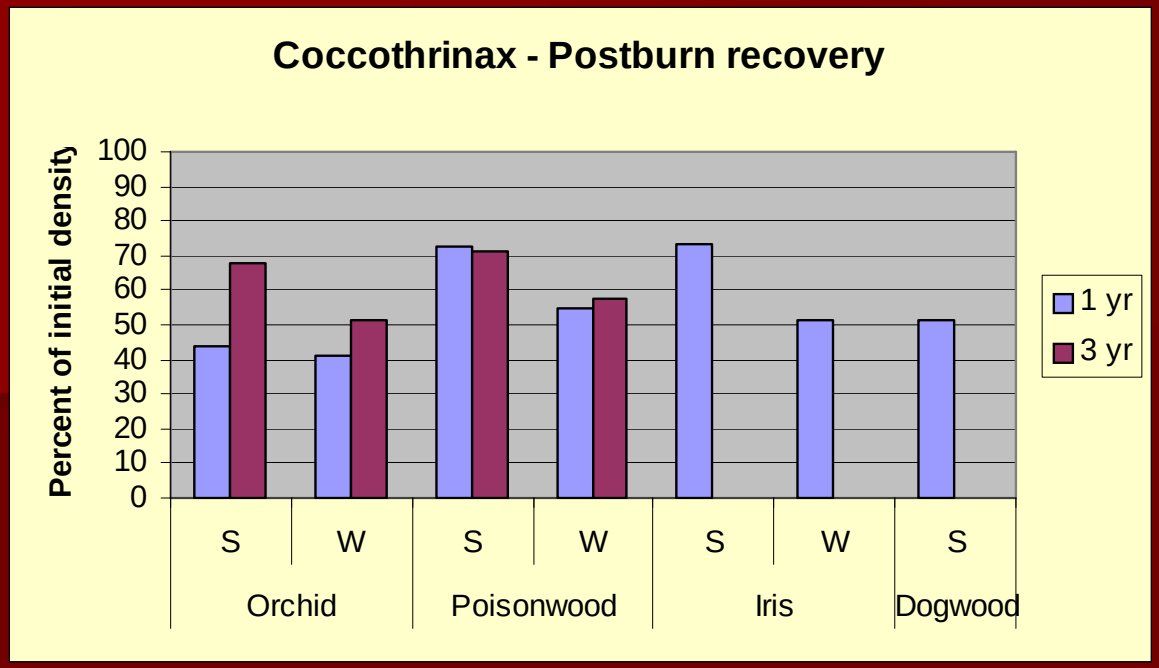

PW Palms
No./ha
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
Height size class
Coccothrinax
Thrinax

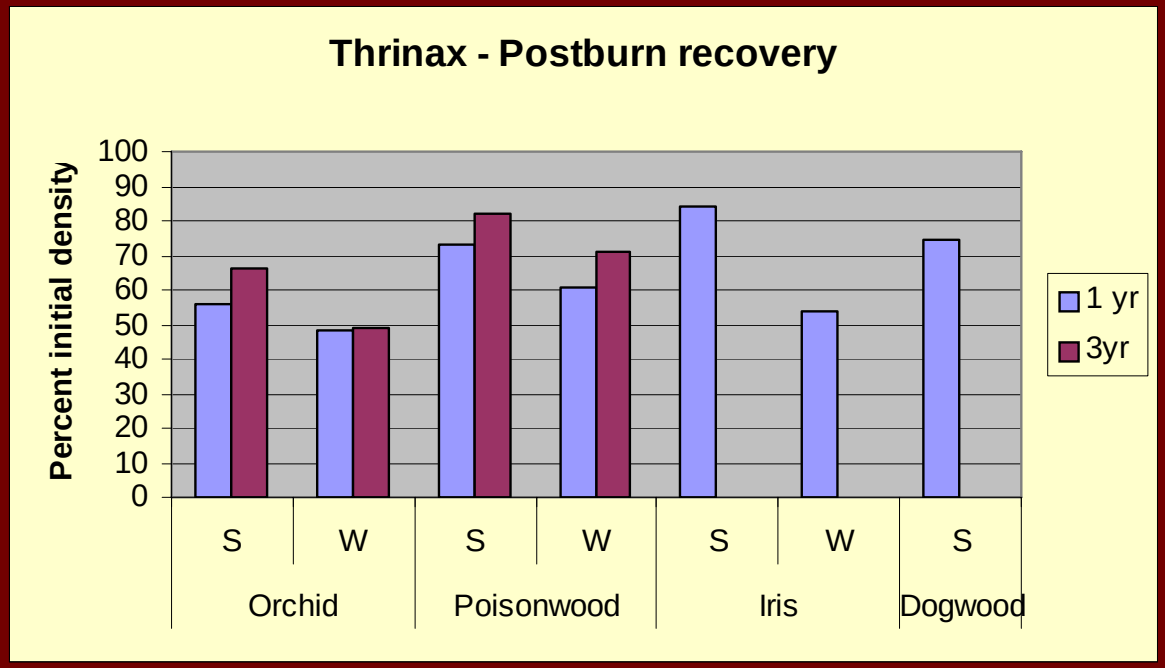

Coccothrinax Mortality
Percent Mortality
60
50
40
30
20
10
0
S*
W*
S
W
S*
W
S
Orchid
Poisonwood
Iris
Dogwood

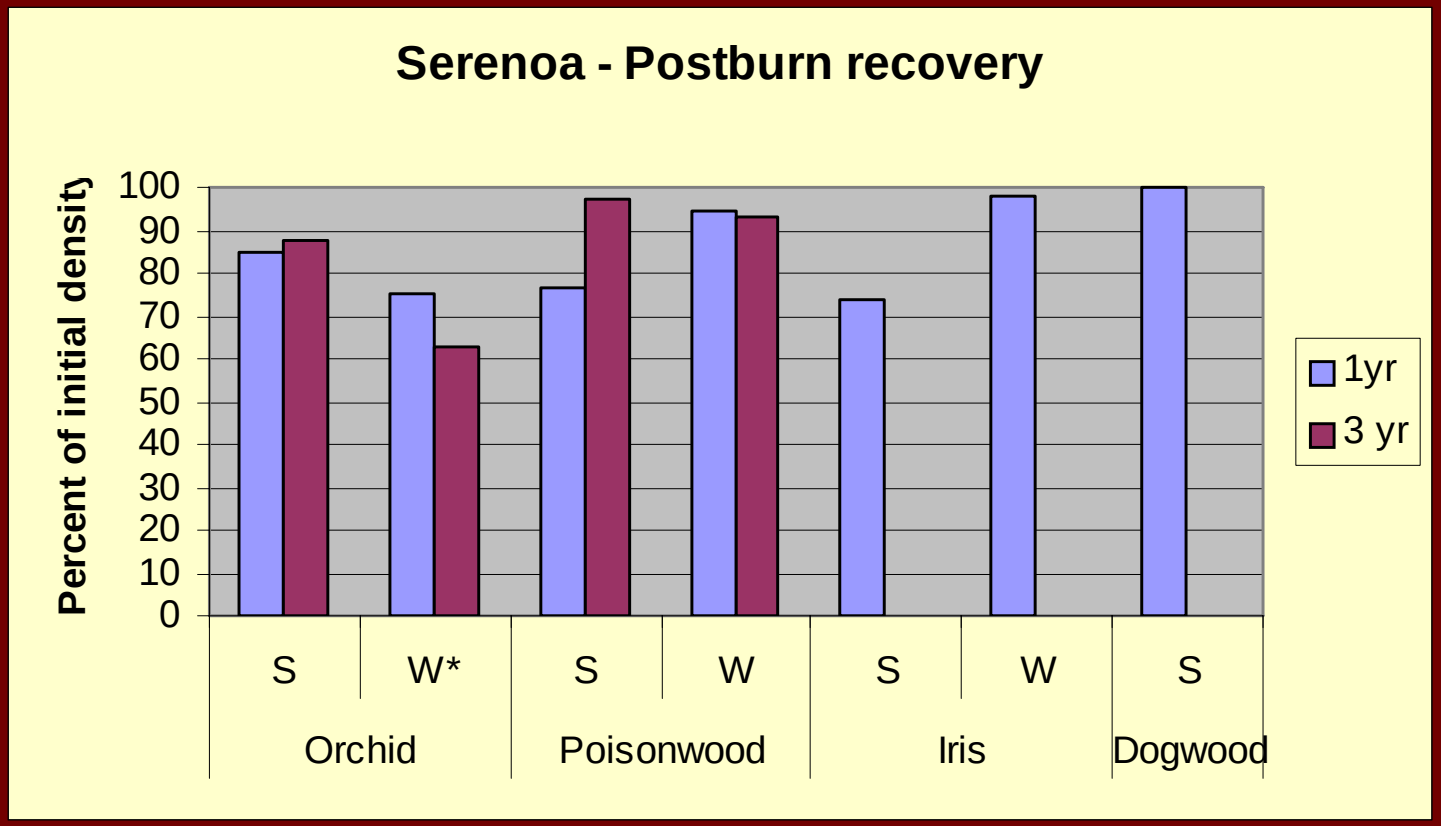

Thrinax Mortality
Percent Mortality
80
70
60
50
40
30
20
10
0
S
W
S
W*
S*
W*
S
Orchid
Poisonwood
Iris
Dogwood

Mortality (%) of palms with stems at least 1 m tall.

	Summer burns	Winter burns	All burns
Thrinax	10.8	9.3	10.3
Coccothrinax	41.0	15.0	32.5

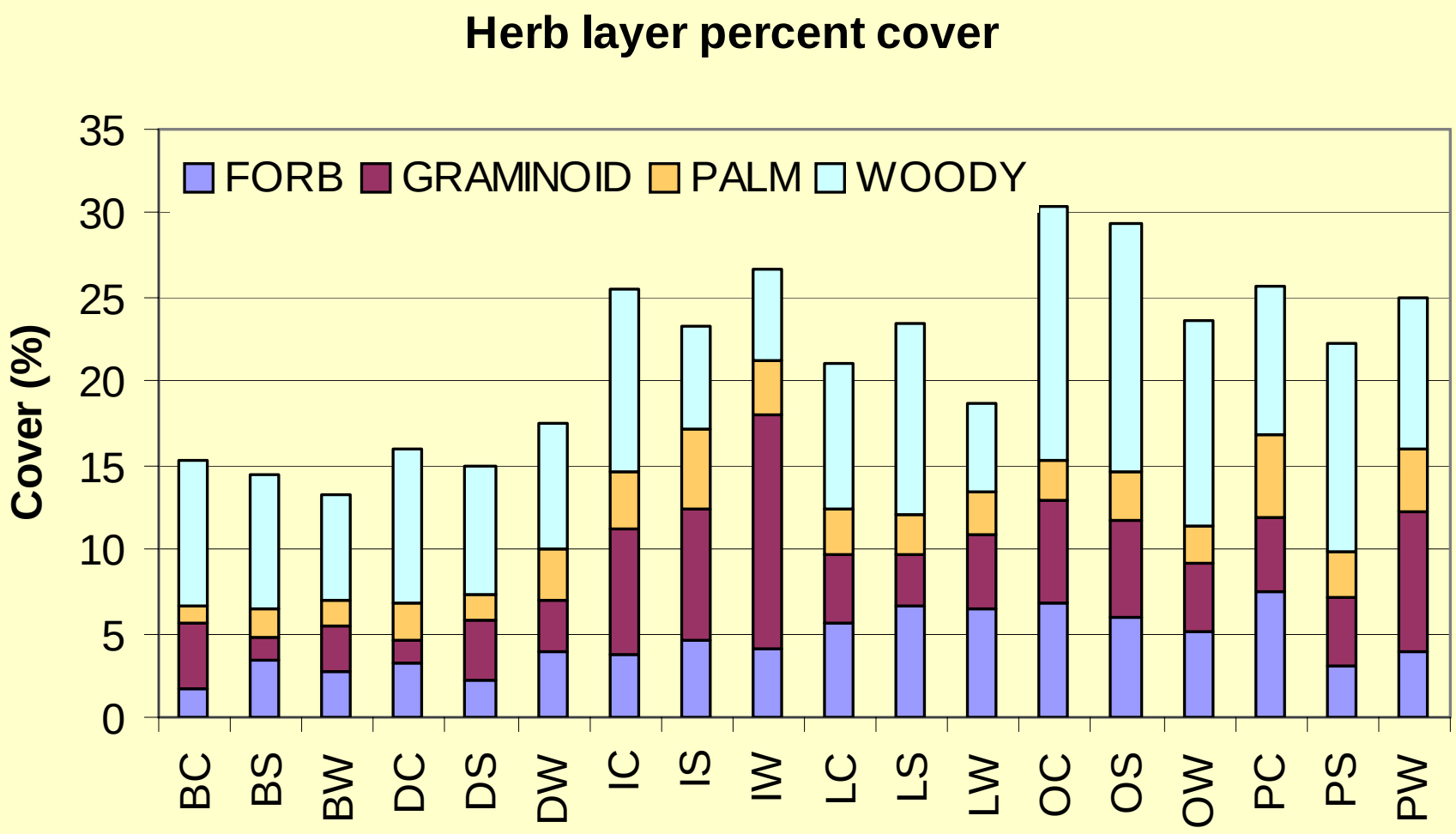

Coccothrinax - Postburn recovery
Percent of initial density
100
90
80
70
60
50
40
30
20
10
0
S
W
S
W
S
W
S
Orchid
Poisonwood
Iris
Dogwood
1 yr
3 yr

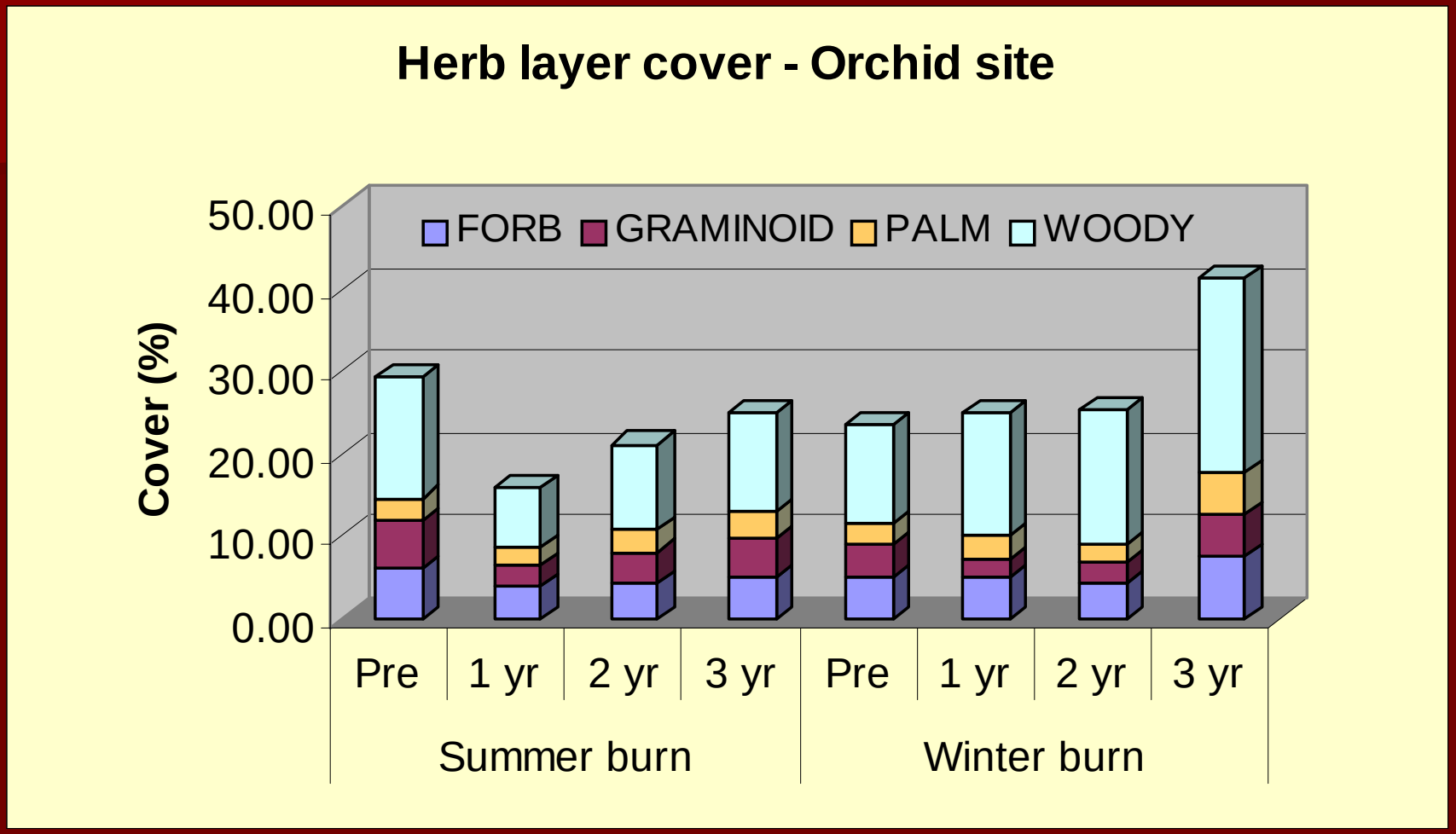

Thrinax - Postburn recovery
Percent initial density
100
90
80
70
60
50
40
30
20
10
0
S
W
S
W
S
W
S
Orchid
Poisonwood
Iris
Dogwood
1 yr
3yr

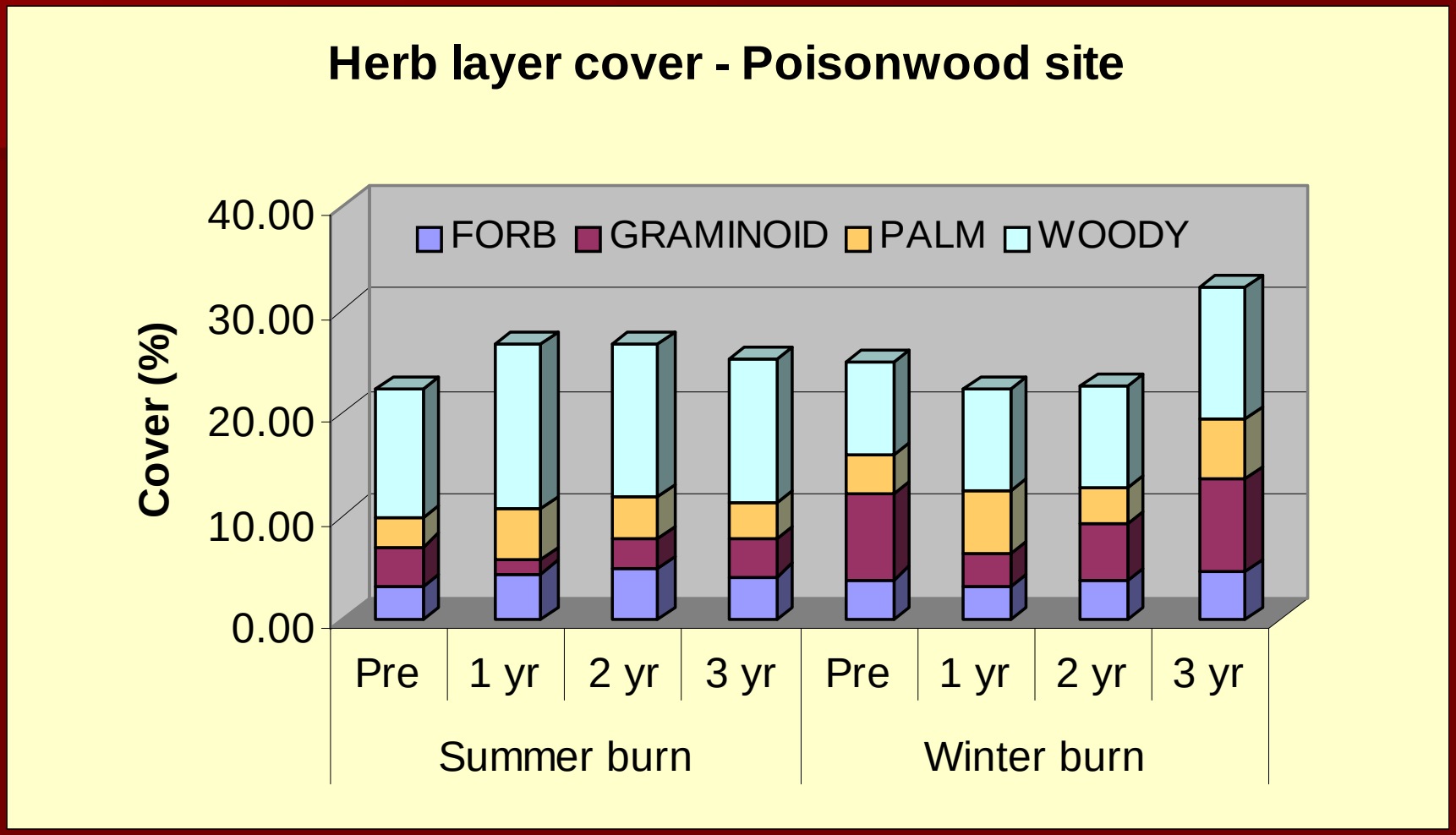

Serenoa - Postburn recovery
Percent of initial density
100
90
80
70
60
50
40
30
20
10
0
S
W*
S
W
S
W
S
Orchid
Poisonwood
Iris
Dogwood
1yr
3 yr

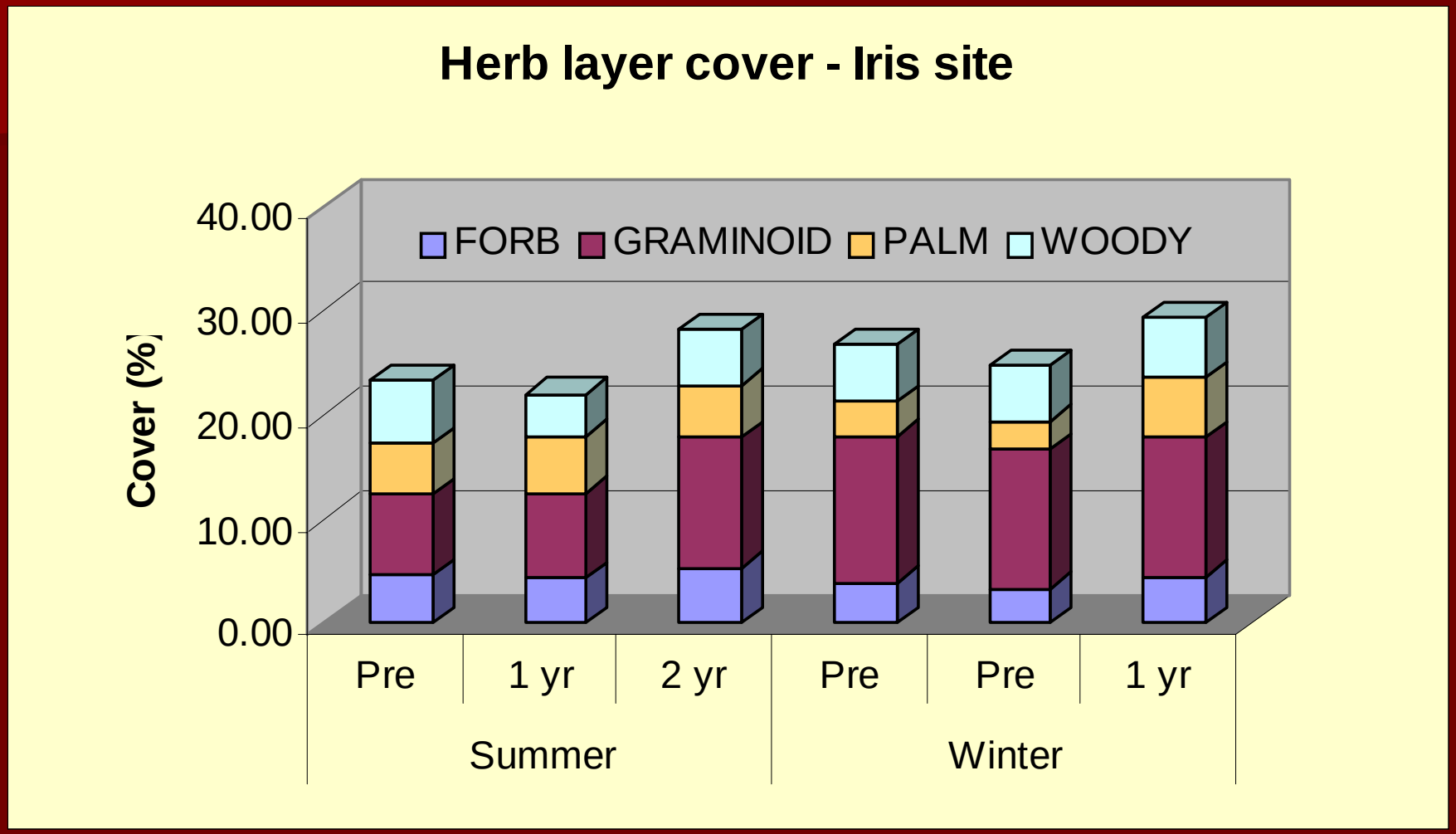
Herb layer

- Total of 163 taxa
  - 5 ferns and fern allies
  - 77 forbs
  - 33 graminoids
  - 4 palms and 44 woody species
- Species diversity higher in open plots than shrubby plots (mean of 75.0 vs. 61.4)


Herb layer percent cover
Cover (%)
35
30
25
20
15
10
5
0
FORB
GRAMINOID
PALM
WOODY
BC
BS
BW
DC
DS
DW
IC
IS
IW
LC
LS
LW
OC
OS
OW
PC
PS
PW


Herb layer cover - Orchid site
FORB
GRAMINOID
PALM
WOODY
Cover (%)
50.00
40.00
30.00
20.00
10.00
0.00
Pre
1 yr
2 yr
3 yr
Pre
1 yr
2 yr
3 yr
Summer burn
Winter burn


Herb layer cover - Poisonwood site
Cover (%)
40.00
30.00
20.00
10.00
0.00
FORB
GRAMINOID
PALM
WOODY
Pre
1 yr
2 yr
3 yr
Pre
1 yr
2 yr
3 yr
Summer burn
Winter burn


Herb layer cover - Iris site
FORB
GRAMINOID
PALM
WOODY
Cover (%)
40.00
30.00
20.00
10.00
0.00
Pre
1 yr
2 yr
Pre
Pre
1 yr
Summer
Winter

Jacquemontia pentanthos

Frequency and mean cover of *Jacquemontia pentanthos* at the Poisonwood site before and after experimental burns. *Jacquemontia* did not appear in the control plot.

	Summer burn plot				Winter burn plot				
	Pre	1 yr post	2 yr post	3 yr post	Pre (May)	Pre (Dec.)	1 yr post	2 yr post	3 yr post
Frequency (%)	0	45	50	45	0	0	20	20	15
Cover (%)	0	1.62	1.43	0.86	0	0	0.06	0.15	0.08

Chamaecrista keyensis

- Studied by Hong Liu
- Higher mortality after summer burns

Summary

- Difficulties with prescribed fire
- Summer fires hotter and often more stressful
  - Pine mortality greater after summer fires
  - Shrub response mixed
  - Adult palm mortality greater after summer fires
  - Small palm recovery better after summer fires
  - Herbs don’t show strong seasonal response

- 18 permanent plots available to follow longer-term responses
- Final report available

Acknowledgements

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