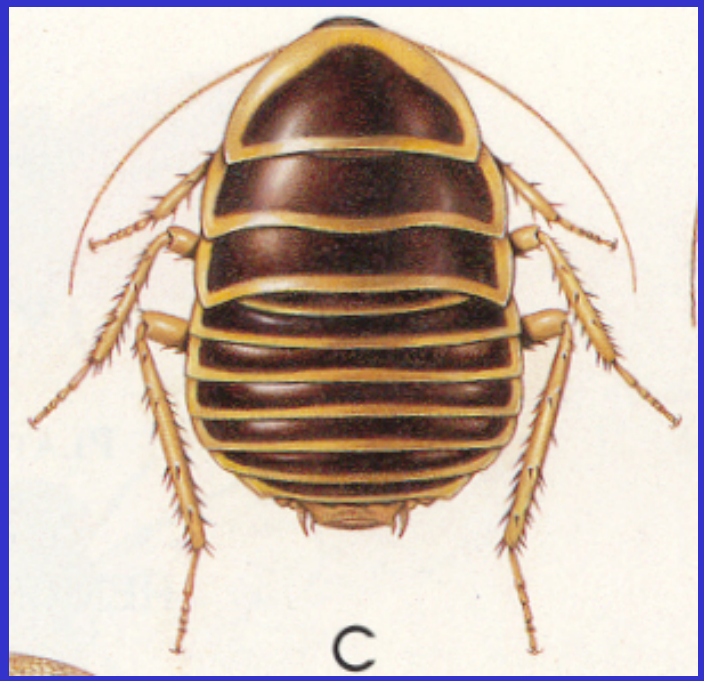
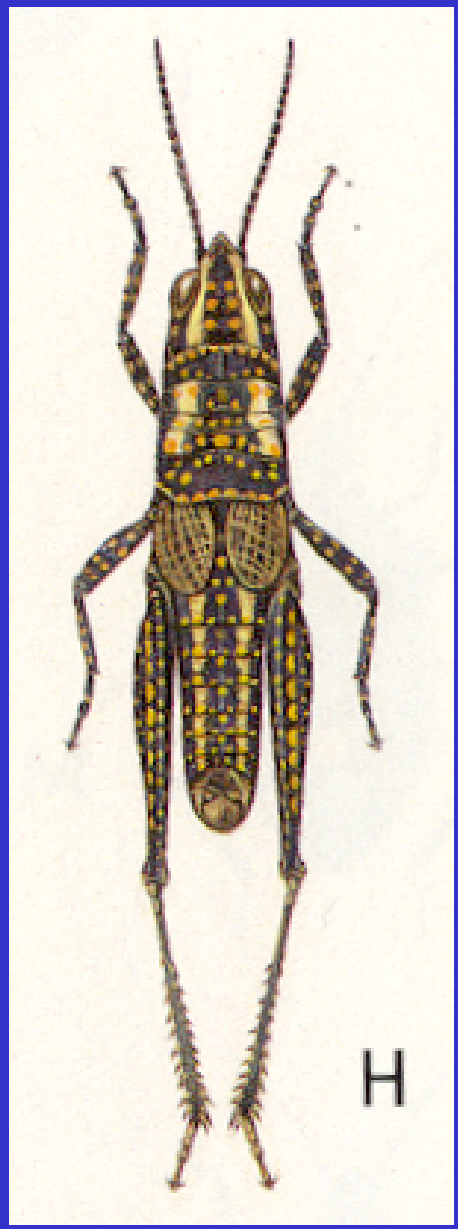

C


H

Logging and burning impacts on cockroaches, crickets & grasshoppers, and spiders in Jarrah forest, Western Australia

Ian **Abbott**[+], Tom **Burbidge**[+], Karin **Strehlow***, Amanda **Mellican**[+], Allan **Wills**[+]

[+]**Department of Conservation and Land Management**

***Murdoch University**

Invertebrates and fungi = 99% of global biodiversity

Their taxonomy & ecology poorly studied

In Australian forests, most studies have been of pest insects or responses of orders/families to anthropogenic disturbance

1990s: species-level studies initiated

Bradshaw method of more intensive logging in jarrah forest initiated in 1985

Necessitated a new round of longitudinal impact studies

Integrated at a common subset of sites, centred on Kingston forest block, 25 km NE of Manjimup

AIMS:

- To examine the impact of logging and the subsequent fire on species richness and abundance of cockroaches, crickets & grasshoppers, and spiders

- To document ongoing recovery of these faunal components

- To examine change in community composition following these imposed disturbances

Field methods

- Before/After Control/Impact design
- Plots established 12/94
- Logged 1995/6
- 2 logging intensities -

  Gap release residual BA 6
  Shelterwood 13
  Coupe buffer 35 (TEAs)
  External controls 35

- In K1 & 5, 78% of forest harvested by Gap release method
- Burnt

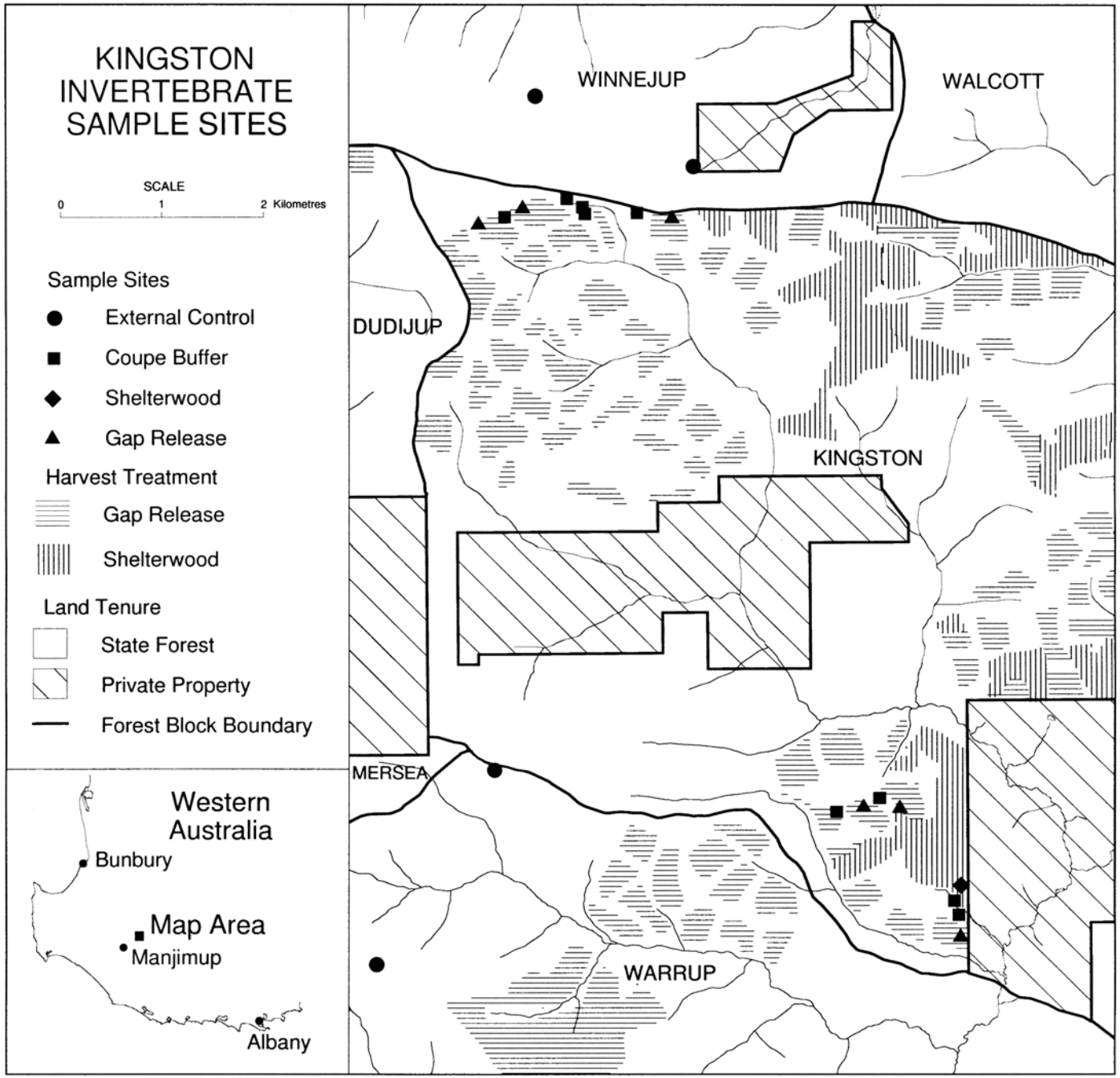

KINGSTON
INVERTEBRATE
SAMPLE SITES
SCALE
0
1
2 Kilometres
Sample Sites
External Control
Coupe Buffer
Shelterwood
Gap Release
Harvest Treatment
Gap Release
Shelterwood
Land Tenure
State Forest
Private Property
Forest Block Boundary
Western
Australia
Bunbury
Map Area
Manjimup
Albany
WINNEJUP
WALCOTT
DUDIJUP
KINGSTON
MERSEA
WARRUP

Table 1.
Post- treatment allocation of sites to treatments within blocks. Blocks are defined by pre-treatment disturbance histories.

	Block					
	1	2	3	4	5	6
Sites						
External control	C1, C2	C3	C4			
Coupe buffer				K1.2, K1.3[a], K1.4, K1.5, K1.7	K5.2, K5.3	K5.6, K5.8[b]
Shelterwood					K5.4	
Gap release				K1.1, K1.6, K1.8	K5.1	K5.5, K5.7[c]
Treatment silviculture	None	None	None	Coupes cut to Gap release in 1995	Coupes cut to Gap release or Shelterwood in 1995	Coupes cut to Gap release in 1995
Last fire	>12 years unburnt from records	Autumn 1986	Autumn 1986	1996	1996	1996
Prior logging	1940s and 1960s selective cuts	1940s and 1960s selective cuts	Virgin stand of c. 1 ha within forest selectively cut in 1940s and 1960s	1940s and 1960s selective cuts	1940s and 1960s selective cuts	1940s and 1960s selective cuts
Nearby disturbance			Within 100 m of cleared farmland		Within 100 m of cleared farmland	

[a] Within 13 m of an access track.
[b] Immediately adjoining a Gap release coupe.
[c] Immediately adjoining a compacted log landing.

- Each sampling site = grid of 16 pitfall traps (90 mm diameter, 110 mm depth)
- Set out in a 4 x 4 array at 5 m spacing, thus covering an area of 20 x 20 m
- Pitfalls left open for 10 days
- Each set of 4 traps combined

- Pre-treatment sampling every 2 months from 5/94 to 9/94, then every month until 2/95

- Post-treatment sampling every month from 5/95 to 3/96 [Strehlow], then March & September 1998, 1999

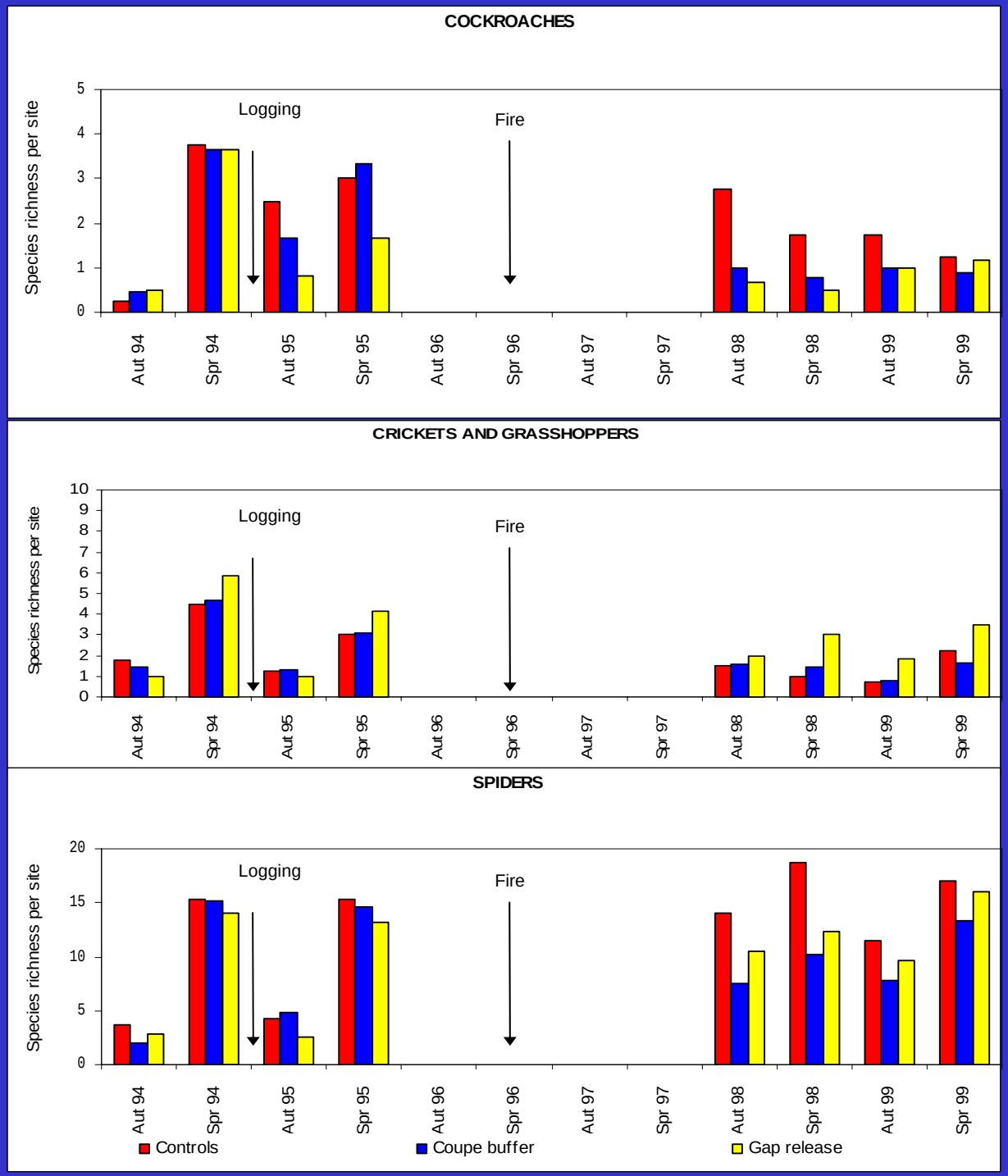
Statistical methods

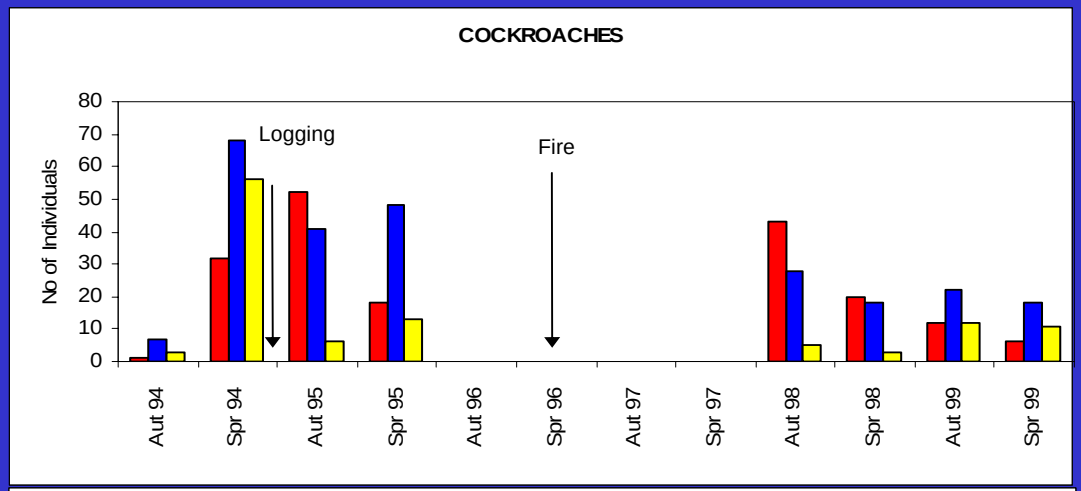
- ANOVA
- Power analysis
- NMDS

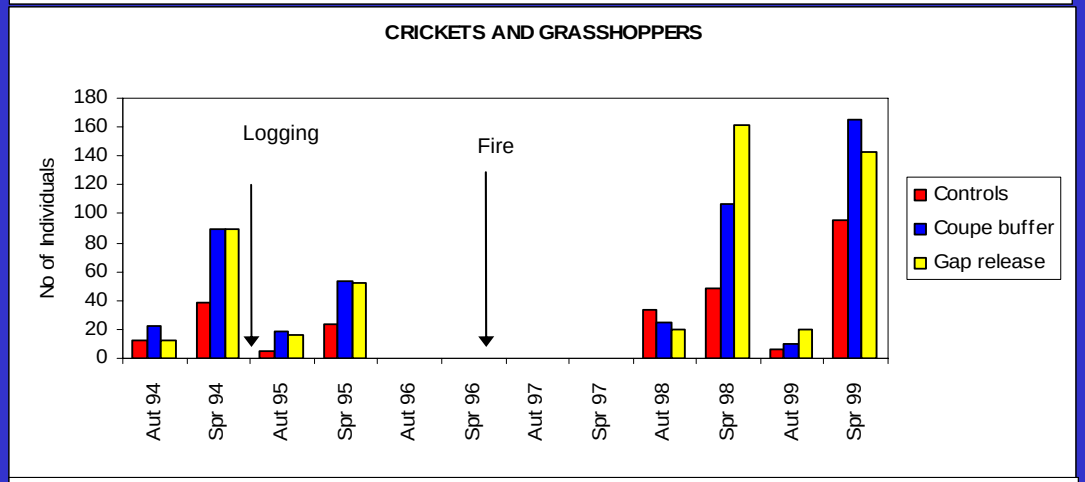
RESULTS

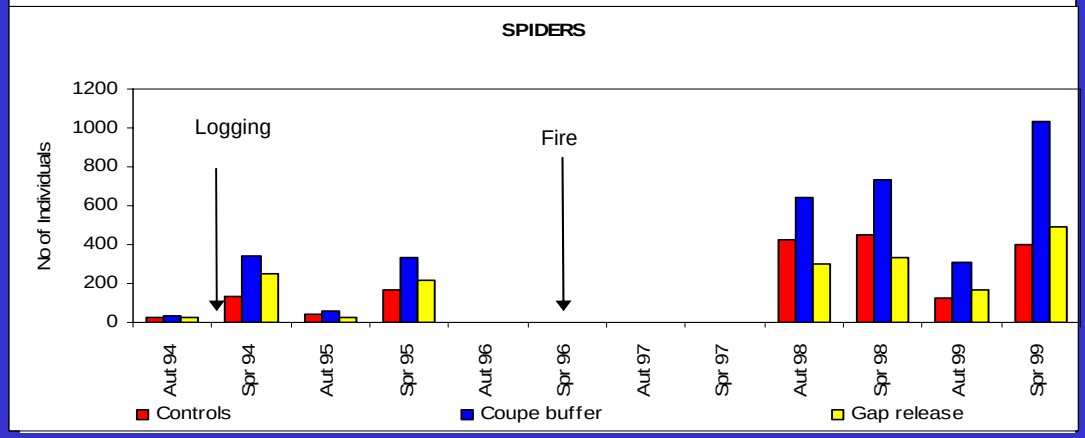
- No. individuals sorted = 600 cockroaches, 1500 crickets & grasshoppers, and 8000 spiders

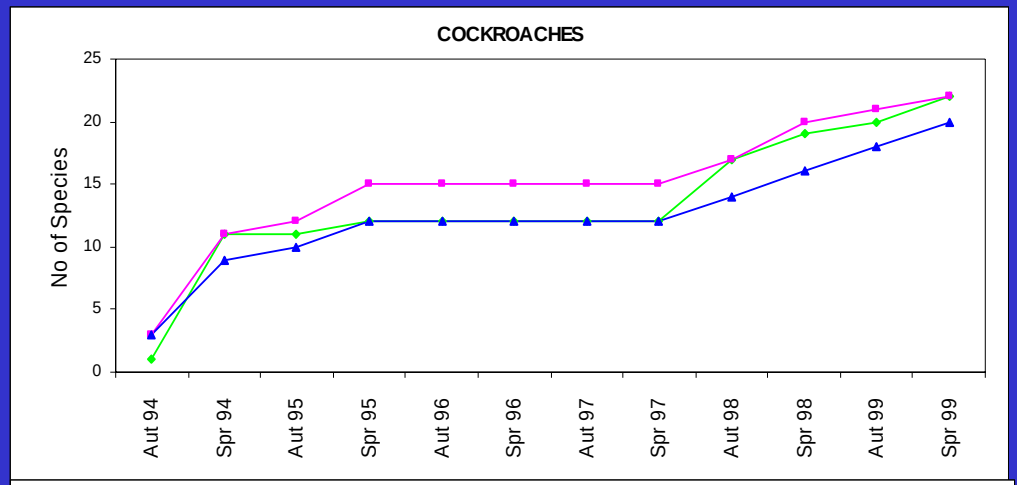
- No. species discriminated = 27 cockroaches, 68 crickets & grasshoppers, and 330 spiders

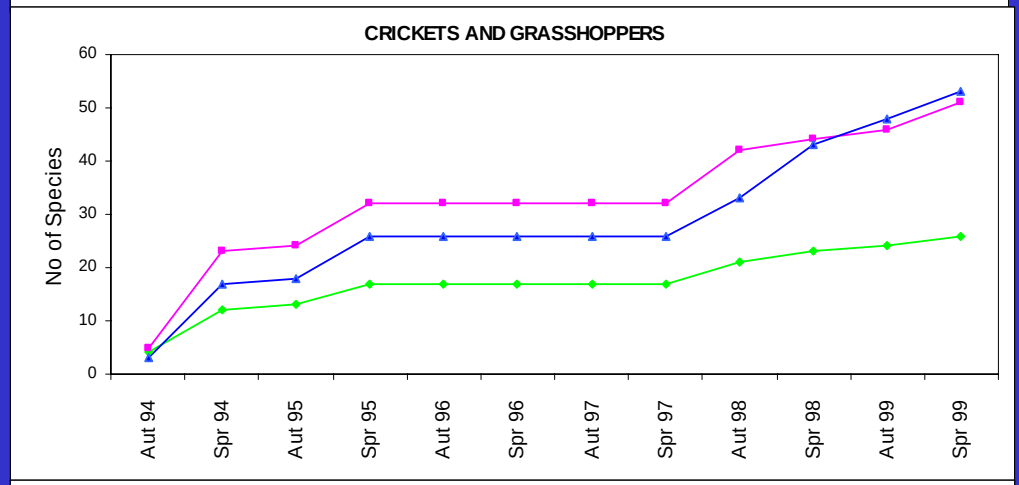

COCKROACHES
Species richness per site
0
1
2
3
4
5
Logging
Fire
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99
CRICKETS AND GRASSHOPPERS
Species richness per site
0
1
2
3
4
5
6
7
8
9
10
Logging
Fire
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99
SPIDERS
Species richness per site
0
5
10
15
20
Logging
Fire
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99
Controls
Coupe buffer
Gap release

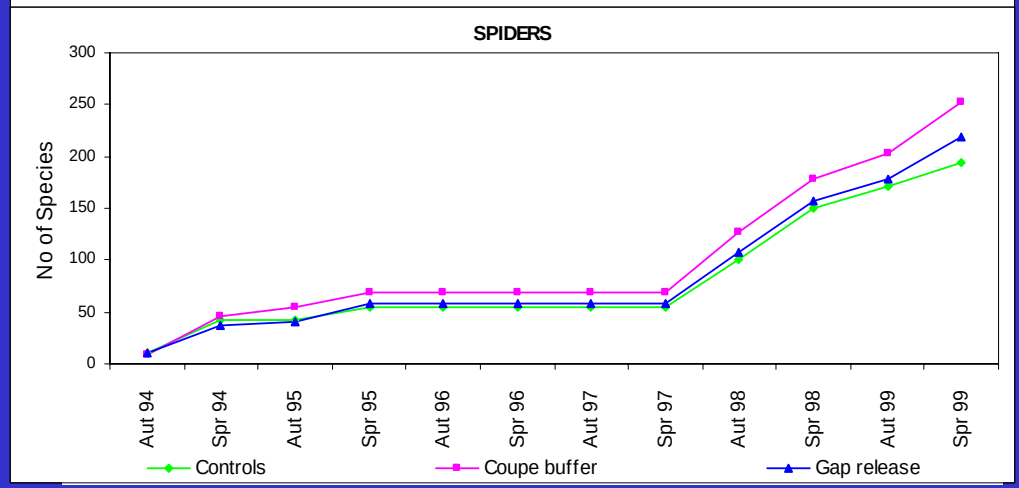

COCKROACHES
No of Individuals
80
70
60
50
40
30
20
10
0
Logging
Fire
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99

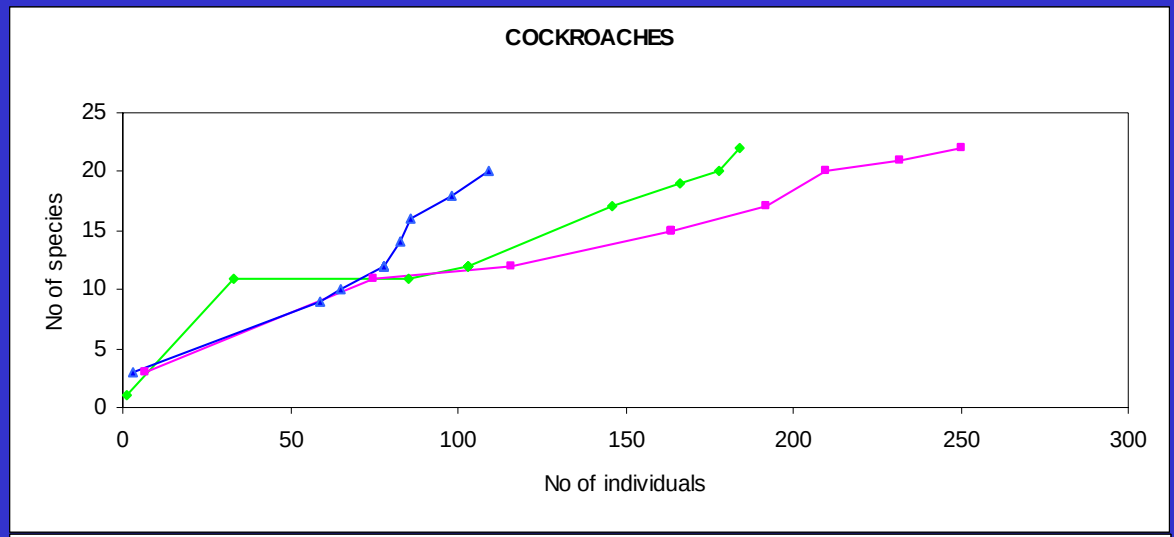

CRICKETS AND GRASSHOPPERS
No of Individuals
180
160
140
120
100
80
60
40
20
0
Logging
Fire
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99
Controls
Coupe buffer
Gap release

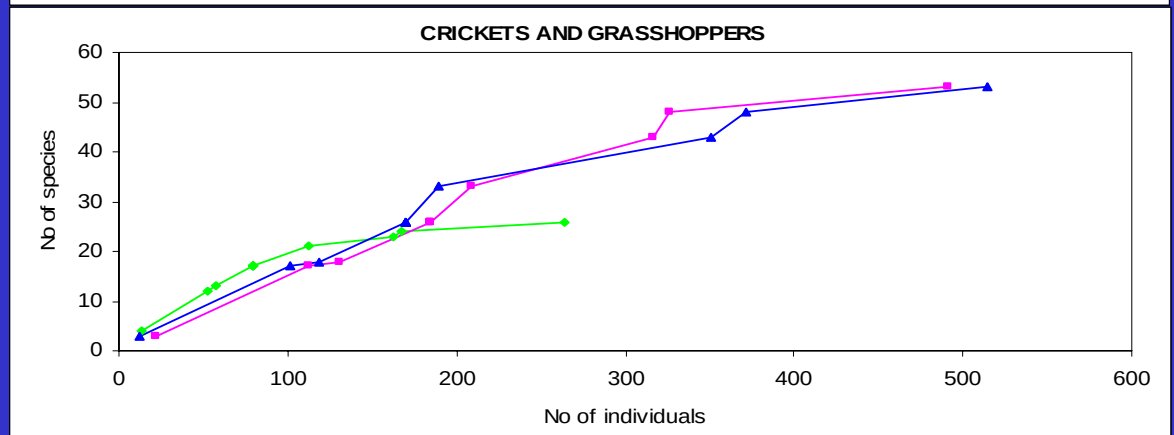

SPIDERS
No of Individuals
1200
1000
800
600
400
200
0
Logging
Fire
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99
Controls
Coupe buffer
Gap release


COCKROACHES
No of Species
0
5
10
15
20
25
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99


CRICKETS AND GRASSHOPPERS
No of Species
0
10
20
30
40
50
60
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99


SPIDERS
No of Species
0
50
100
150
200
250
300
Aut 94
Spr 94
Aut 95
Spr 95
Aut 96
Spr 96
Aut 97
Spr 97
Aut 98
Spr 98
Aut 99
Spr 99
Controls
Coupe buffer
Gap release


COCKROACHES
No of species
No of individuals
0
5
10
15
20
25
0
50
100
150
200
250
300


CRICKETS AND GRASSHOPPERS
No of species
No of individuals
0
10
20
30
40
50
60
0
100
200
300
400
500
600

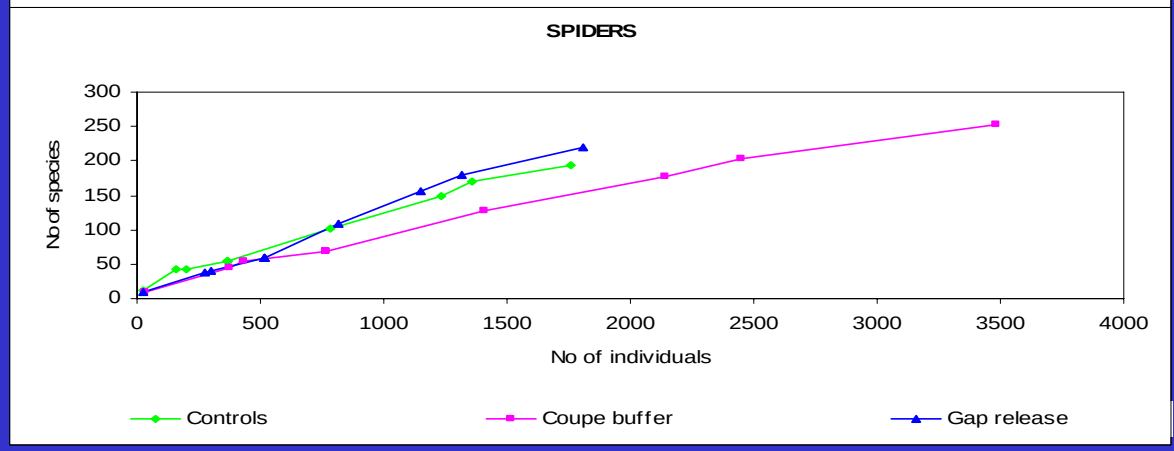
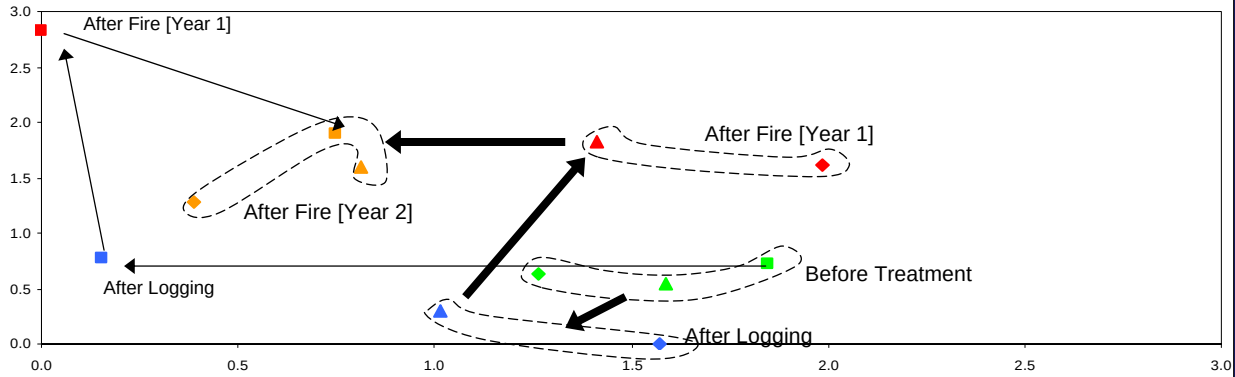

SPIDERS
No of species
No of individuals
0
50
100
150
200
250
300
0
500
1000
1500
2000
2500
3000
3500
4000
Controls
Coupe buffer
Gap release

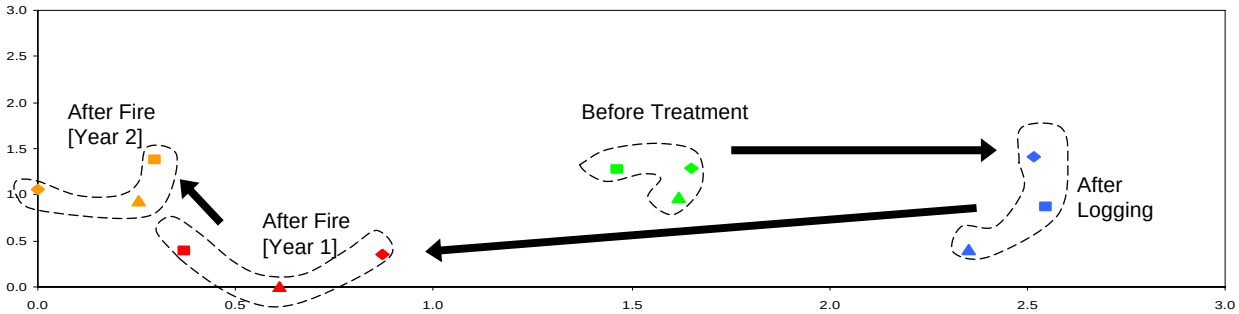
Table 2.
Synopsis of presence/absence of all species in relation to silvicultural treatments (listed as before logging, after logging, after fire). + = present; – = absent.

Group	Treatment	+ + +	+ + –	+ – +	+ – –	– + +	– + –	– – +
Cockroaches	External control	6	2	3	0	0	1	10
	Coupe buffer	6	1	4	0	2	2	7
	Gap release	4	1	1	3	0	3	8
Crickets & grasshoppers	External control	1	3	4	4	2	3	9
	Coupe buffer	4	5	9	5	4	5	19
	Gap release	1	4	7	5	5	4	27
Spiders	External control	18	8	12	4	6	5	140
	Coupe buffer	22	9	9	6	11	11	184
	Gap release	18	2	11	6	12	9	161

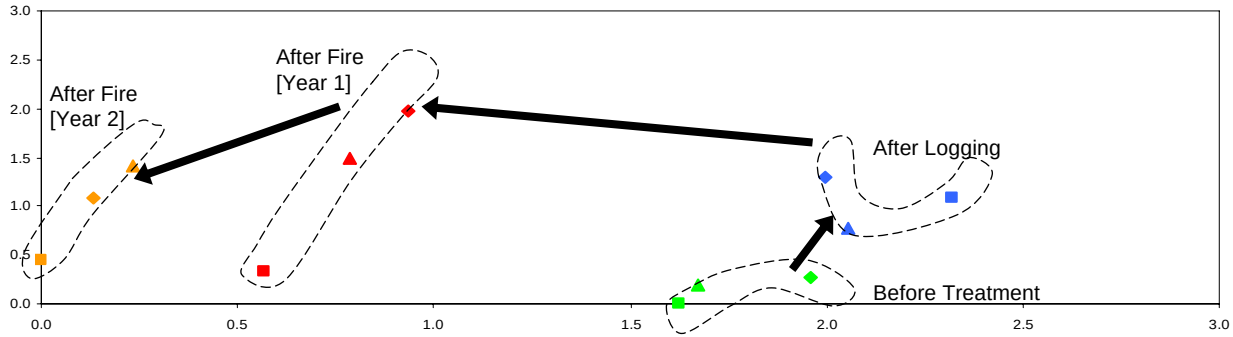
COCKROACHES

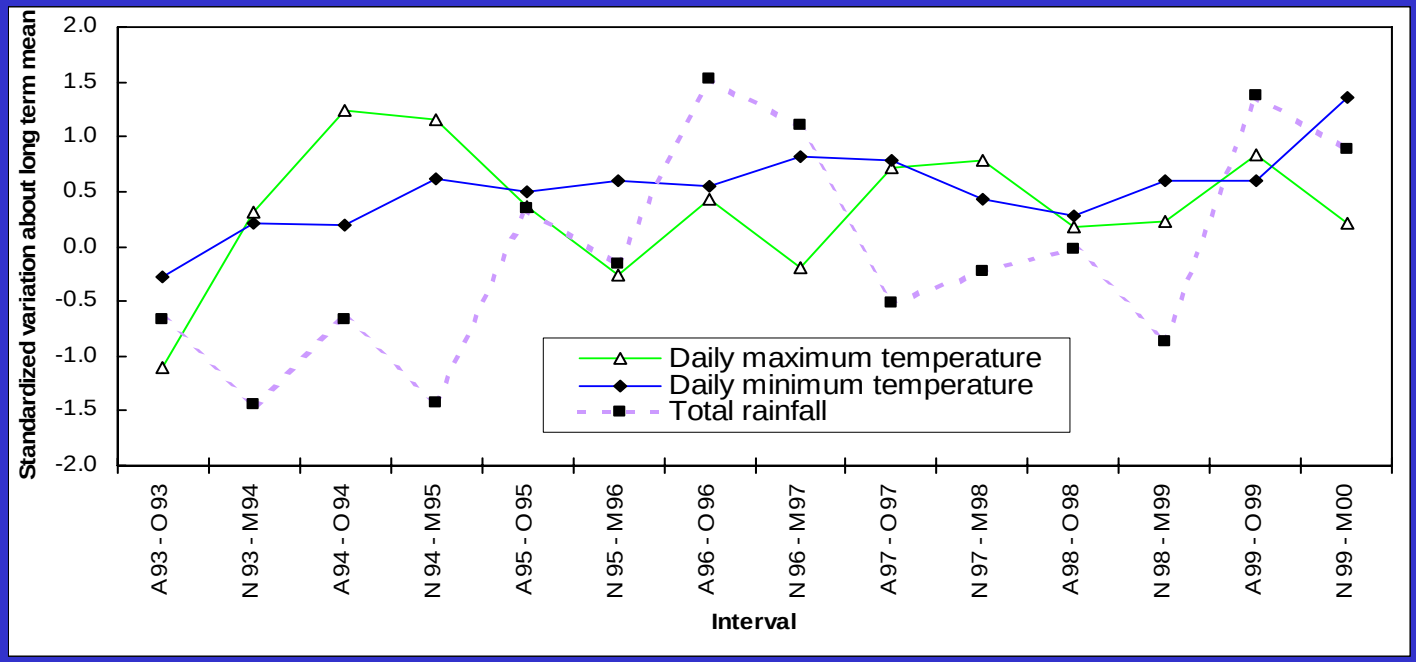


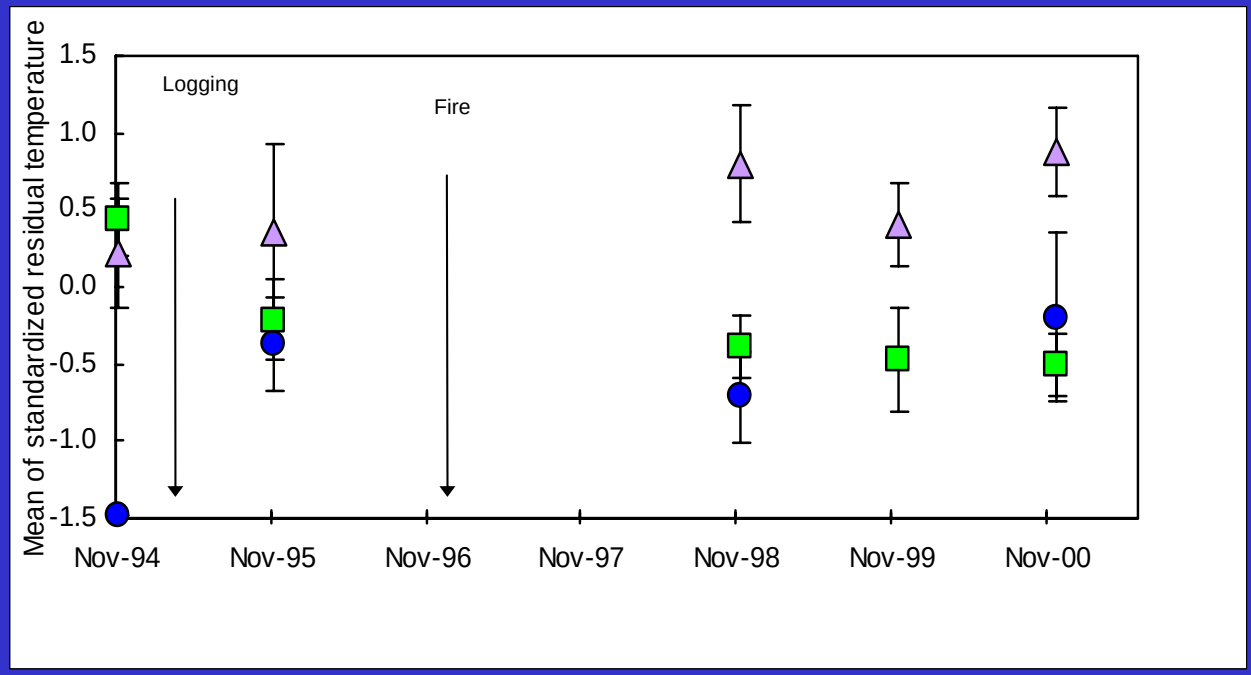
CRICKETS AND GRASSHOPPERS

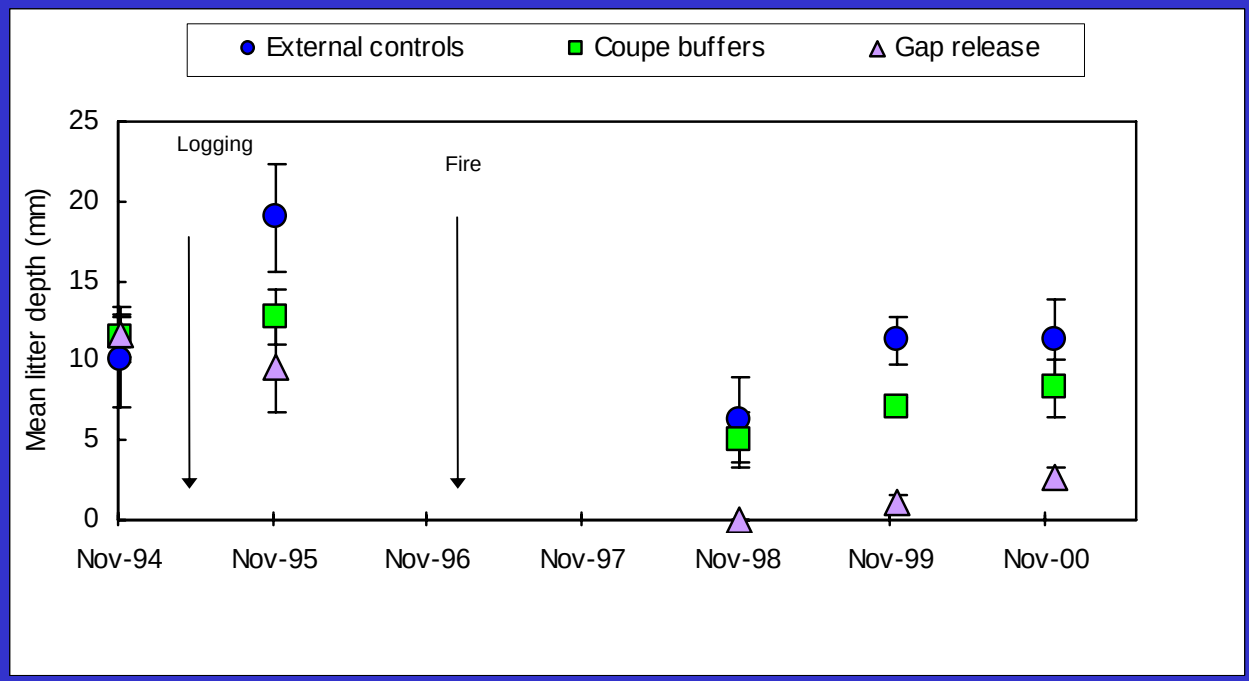


SPIDERS




Standardized variation about long term mean
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Daily maximum temperature
Daily minimum temperature
Total rainfall
A93 - O93
N93 - M94
A94 - O94
N94 - M95
A95 - O95
N95 - M96
A96 - O96
N96 - M97
A97 - O97
N97 - M98
A98 - O98
N98 - M99
A99 - O99
N99 - M00
Interval


Mean of standardized residual temperature
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Logging
Fire
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00


External controls
Coupe buffers
Gap release
Mean litter depth (mm)
25
20
15
10
5
0
Logging
Fire
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00

INTERPRETATION OF THE DATA COLLECTED

- Impacts of logging and burning were of short duration
- Cockroaches were most heavily impacted, but short-term
- Results are consistent with Van Heurck's study in Jarrah forest at Batalling
- Long history of seasonal aridity and fires in SW Aust

FUTURE WORK

Monitor changes in species richness in the face of decreasing frequency of burning and enhanced global warning

Monitoring to indicate if and when the number of species present stabilizes