3.6. Fire

Julia Wayne, Adrian Wayne and Ian Wilson

Department of Environment and Conservation.

Abstract

A number of fire history attributes were analysed in relation to woylie capture rates and extent of decline along the 11 Upper Warren Fauna Monitoring transects.

Corporate fire history data and District and Science Division fauna monitoring data were used in the analyses.

No relationships were found during these or previous analyses of fire history data and woylie capture rates and declines.

These are preliminary analyses only, and more sophisticated and rigorous analysis of the data is required to verify whether any temporal patterns or relationships exist.

3.6.1. Introduction

It is possible that fire may be a potential contributing factor in the recent rapid and substantial declines in woylie populations in the south-west.

Attributes of fire history which may impact on fauna populations include fire frequency and interval, fire intensity, fire size, time since last fire, proximity to fire edges and diversity of times since last fire (fire age) (e.g. Friend and Wayne, 2003).

Impacts of fire on fauna populations may include direct loss of individuals, interruptions to breeding cycles, loss and regeneration of habitat (shelter and vulnerability to predation), and disruption and change to food resources.

Fire history can be very complicated as multiple variables need to be considered. 'Fire units' describe the patches or areas of similar recent fire history that result from the management of fire in discrete units or areas, which at the landscape-regional scale result in a mosaic of different fire histories. Fire units can change over time and the fauna monitoring transects (~10 km long) typically intersect several different fire units. Over the last 50 years up to eight or more fire events may have taken place at each fire unit and therefore the combination of fire history variables can be numerous.

A previous analysis of fire history data was conducted by Adrian Wayne for the DEC workshop on 'Recent mammal declines' held at Perup on 16th and 17th February 2006. No significant relationships were found between fire history attributes and woylie abundances (measured by capture rates) during this earlier analysis (Wayne, 2006). (Volume 2 Appendix 1) This analysis provides an update using current woylie capture rates and decline figures. It should be noted that these are preliminary analyses, which look at a single point in time. More rigorous and sophisticated analyses, which look at fire history from a broader temporal perspective, are required to more completely address these issues.

3.6.2. Methods

Data from the 11 Upper Warren Fauna Monitoring transects (Chapter 2 UW Fauna Monitoring) were used in this investigation. Woylie capture rate data from March/April 2007 were used in these analyses. The percentage decline in woylie capture rates for each transect is derived from the woylie capture rate (%TS) in April 2007 divided by the average woylie capture rate immediately prior to decline along the same transect.

Attributes of fire history were analysed in relation to woylie capture rates for each of the 11 Upper Warren Fauna Monitoring transects. Fire history attributes were analysed in relation to percentage decline for only a sub-set of the Upper Warren Fauna Monitoring transects. This was due to limited or incomplete trapping histories for some transects (Keninup2, Corbal, Winnejup and Warrup2) that made determination of pre-decline woylie capture rates (and therefore percentage decline) and/or the year of commencement of decline impossible.

The attributes of fire which were analysed included:-

- The number of 'fire ages' (years since last burn) occurring along the length of the transect (fire age diversity)
- The proximity of the transect to the adjacent fire unit boundaries ('boundary' or 'core') – relative to the majority of the transect (proximity to fire units).
- The earliest year of last burn along the transect (oldest fire age)
- The latest year of last burn along the transect (youngest fire age)
- The predominant season of the most recent fire events adjacent to the transect (coarse season last burnt)
- The average number of times the area adjacent to the transect has burnt between 1953 and 2005 (fire frequency).

Corporate fire history data from 2005 (McCaw *et al.,* 2005) was used in the development of the dataset used for these analyses. This data was prepared by Adrian Wayne for an earlier analysis of the relationships between woylies and fire, presented at the Mammal declines workshop at Perup in February 2006. Given that there were minimal differences in the fire history between February 2006 and the time of this analysis, this pre-existing dataset was considered the most efficient means of further exploring the relationships between fire and woylies. Since 2005, fire history data has changed on two of the Upper Warren Fauna Monitoring transects (Moopinup and Warrup2). Moopinup transect is within the core of a burn conducted in spring 2006; however this burn was extremely mild and patchy with less than 30% of the area burnt. The majority (>90%) of the area immediately adjacent to the monitoring transect has remained unburnt. Due to the limited amount of the transect being affected by this burn and the timing of the burn being well after commencement of decline in woylies, this fire event has not been included in the analysis. Similarly, a burn was conducted adjacent to a section (approximately 15%) of the Warrup2 transect in spring 2006. The burn was conducted on one side of the road only. This fire event affects the 'youngest fire age' attribute only, and due to the limited amount of the transect being directly affected, this burn event has not been included in the analysis.

Statistical analyses principally involved regression analyses and single factor ANOVA tests.

3.6.3. Results

3.6.3.1. Summary of fire history

A summary of the data for the variables used in these analyses are provided in Table 3.6.1.

Table 3.6.1. Summary of woylie population characteristics and fire history for each of the 11 Upper Warren Fauna Monitoring transects.

TRANSECT	WOYLIE CAPTURE RATES APRIL 2007	DECLINE TO APRIL 2007	PROXIMITY TO FIRE UNITS	FIRE AGE DIVERSITY	OLDEST FIRE AGE	YOUNGEST FIRE AGE	SUMMARY OF SEASON LB	COARSE SEASON LB	FIRE FREQUENCY 1953-2005
Balban	21.0	69%	Core	1	2003	2003	Su	Au	5.4
Boyicup2	2.0	97%	Core	3	1985	1997	Au/Sp	Au	5.4
Camelar	0.0	100%	Boundary	2	2003	2004	Au/Sp	Au	7.2
Chariup	5.0	92%	Core	1	1997	1997	Sp	Sp	4.4
Corbal	8.0	~	Boundary	4	1992	2002	Sp	Sp	6.7
Keninup2	64.0	~	Core	3	1995	2003	Au	Au	5.3
Moopinup	3.0	95%	Core	2	1988	1995	Au	Au	6.2
Warrup2	33.0	33%	Boundary	6	1975	2003	Sp/Au	Sp	6.8
Winnejup	5.0	85%	Boundary	3	1985	2002	Au/Sp	Au	7.9
Yackelup	0.0	100%	Core	1	1999	1999	Au	Au	6.1
Yendicup2	3.0	95%	Core	2	1954	1968	Sp	Sp	3.3

Seven of the 11 Upper Warren Fauna Monitoring transects were situated predominantly within the core of fire units, with three of these situated entirely within one fire unit (i.e. only one fire age along the entire transect). The remaining four transects were located predominantly along the boundary of fire units with up to six different fire ages adjacent to a transect.

The year of last burn varied greatly between transects, and also within transects with greater fire age diversity. The average number of fire events (fire frequency) occurring adjacent to each transect over the 52 year period from 1953 to 2005 ranged from 3.3 to 7.9.

3.6.3.2. Fire history attributes in relation to woylie capture rates

No relationships were found between the capture rates of woylies and the fire history attributes of fire age diversity, fire frequency, oldest or youngest fire age (Figures 3.6.1-4).

No significant relationships were found between the extent or commencement of decline in woylie capture rates and the youngest fire age for those transects analysed in the Upper Warren region (Figure 3.6.5 and 3.6.9 respectively). Similarly, no relationships were evident between the extent of woylie capture rate decline and fire age diversity, oldest fire age or fire frequency (Figures 3.6.6-8).

No relationships were evident between either woylie capture rates or the extent of decline and either the proximity to fire units or the coarse season last burnt (p-value = >0.2 in all cases) (Table 3.6.2-5).

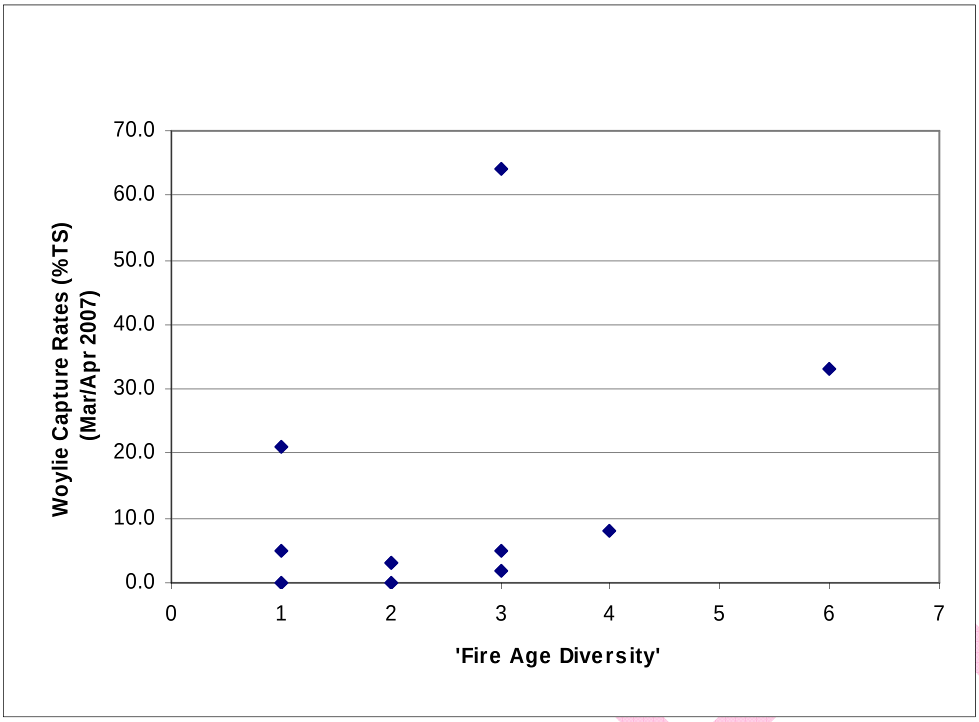

Figure 3.6.1. Relationship between fire age diversity and woylie capture rates along each of the Upper Warren Fauna Monitoring transects.

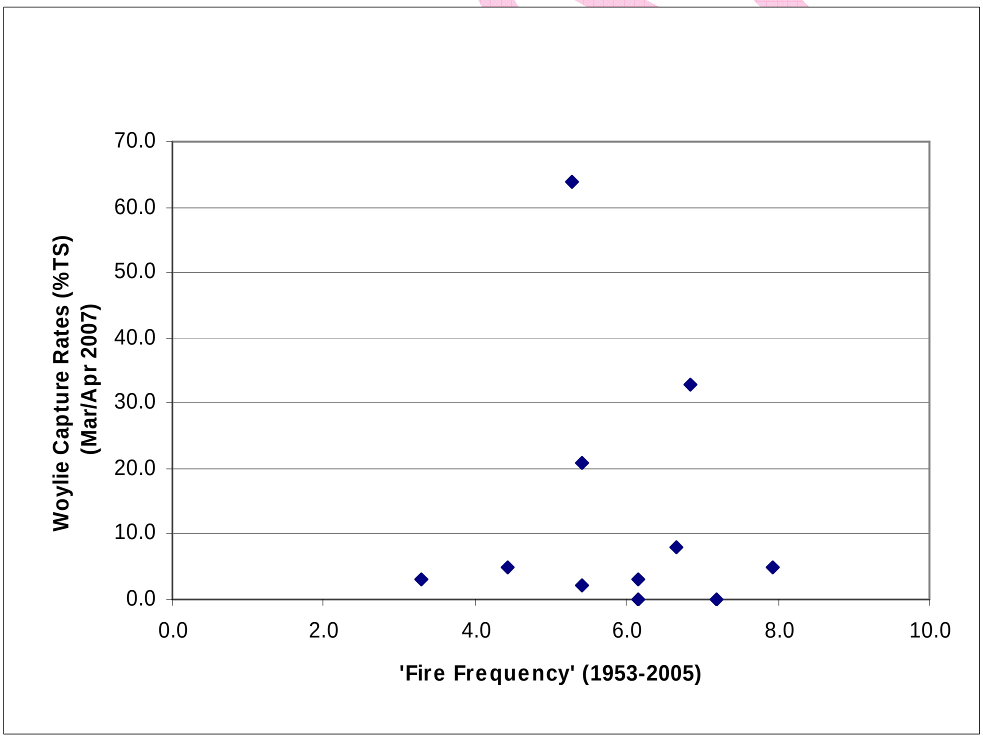

Figure 3.6.2. Relationship between fire frequency (average number of fire events from 1953-2005) and woylie capture rates along each of the Upper Warren Fauna Monitoring transects.

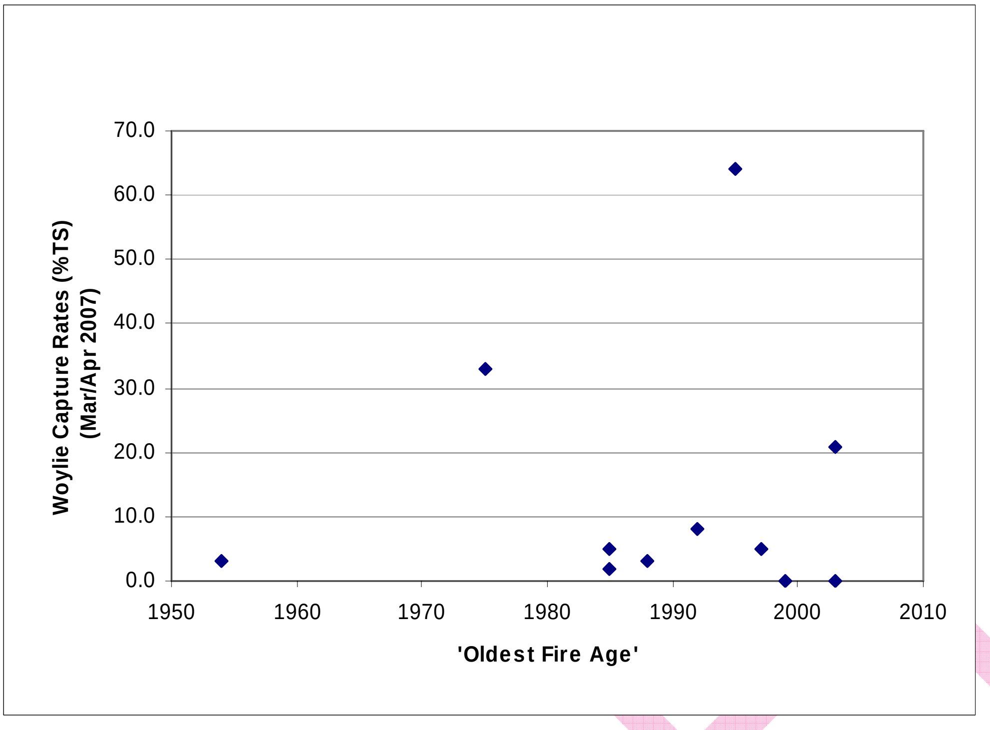

Figure 3.6.3. Relationship between oldest fire age (earliest year last burnt) and woylie capture rates along each of the Upper Warren Fauna Monitoring transects.

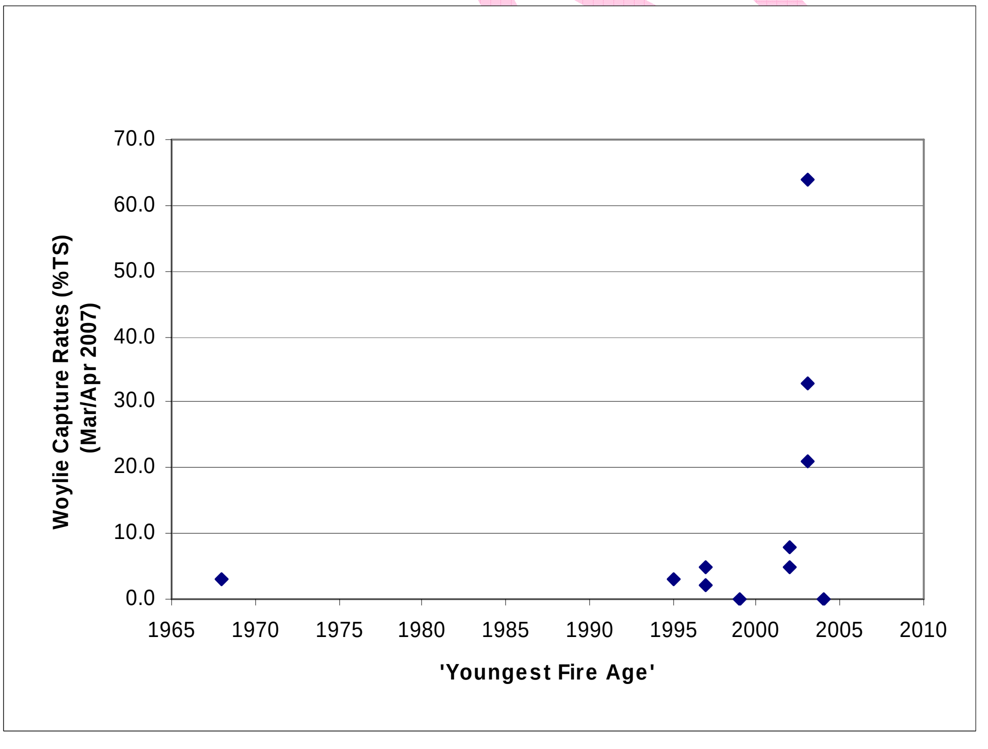

Figure 3.6.4. Relationship between youngest fire age (latest year last burnt) and woylie capture rates along each of the Upper Warren Fauna Monitoring transects.

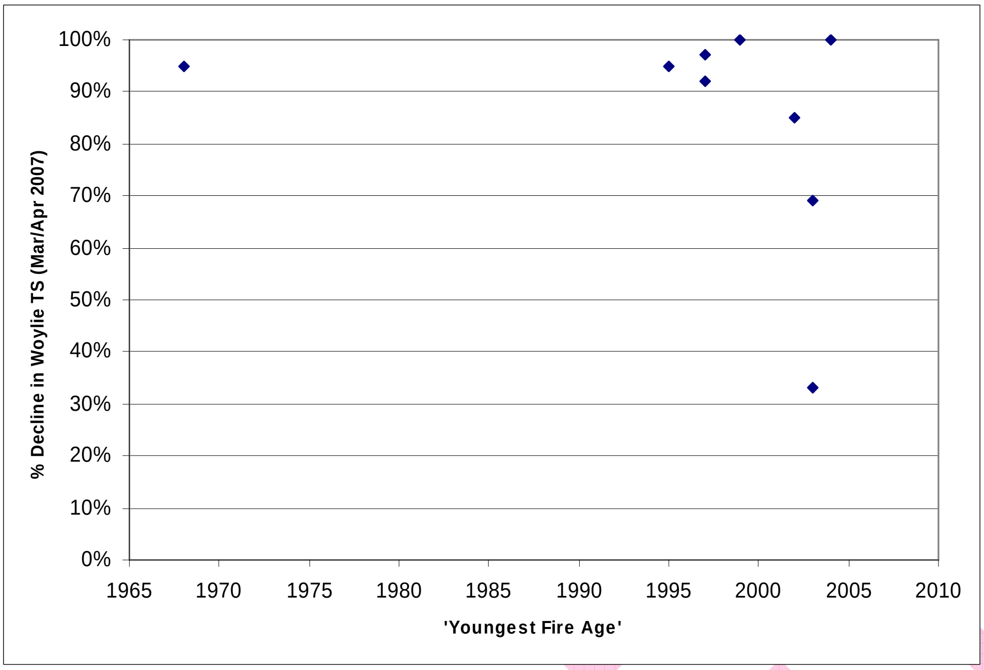

Figure 3.6.5. Relationship between youngest fire age and extent of decline in capture rates along nine of the Upper Warren Fauna Monitoring transects.

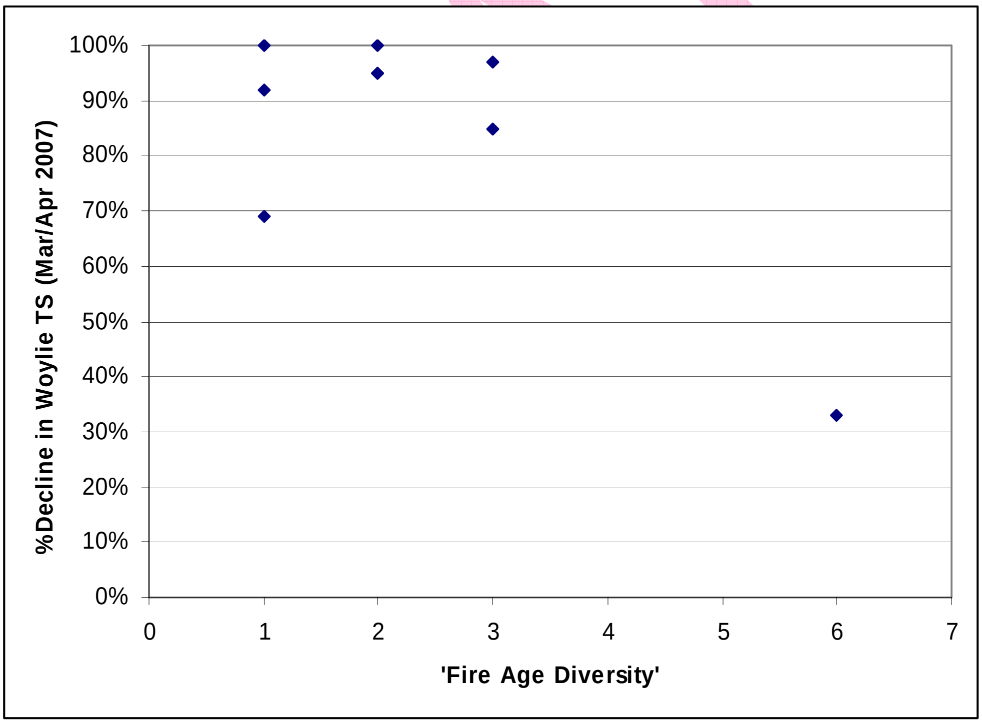

Figure 3.6.6. Relationship between fire age diversity (number of fire ages along the transect) and extent of decline in capture rates along nine of the Upper Warren Fauna Monitoring transects.

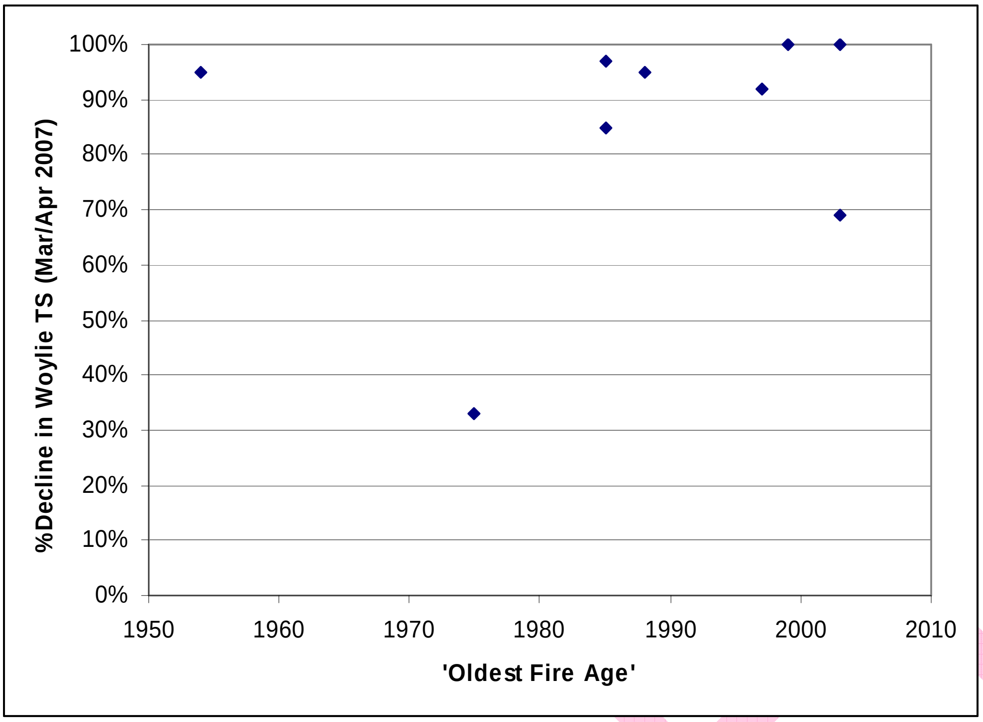

Figure 3.6.7. Relationship between oldest fire age and extent of decline in capture rates along nine of the Upper Warren Fauna Monitoring transects.

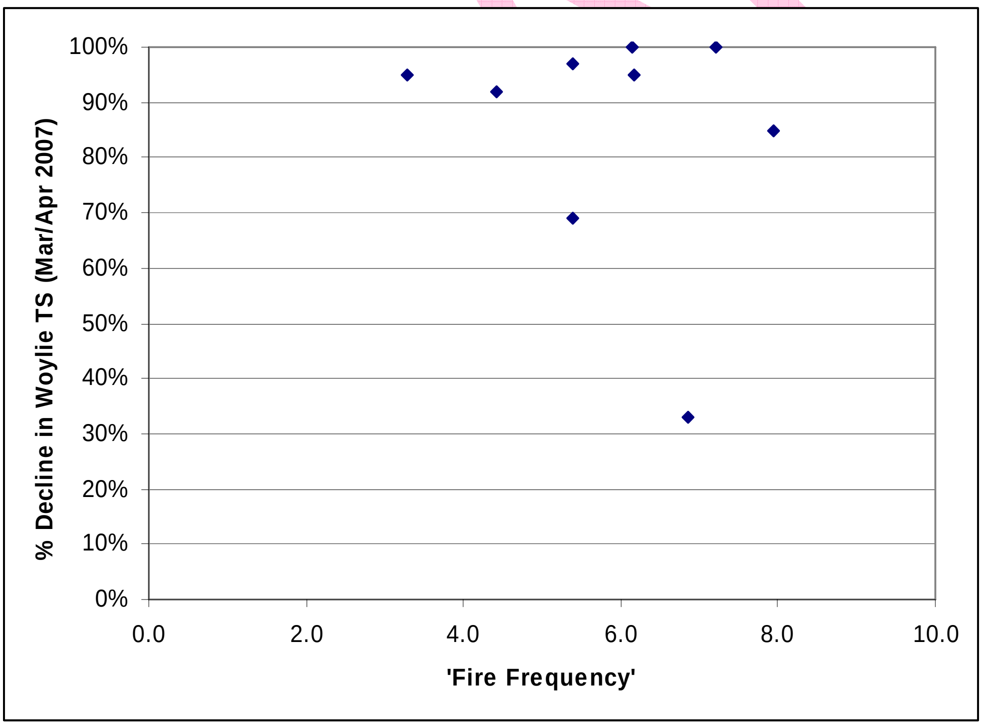

Figure 3.6.8. Relationship between fire frequency (average number of fire events between 1953 and 2005 along the transect) and extent of decline in capture rates along nine of the Upper Warren Fauna Monitoring transects.

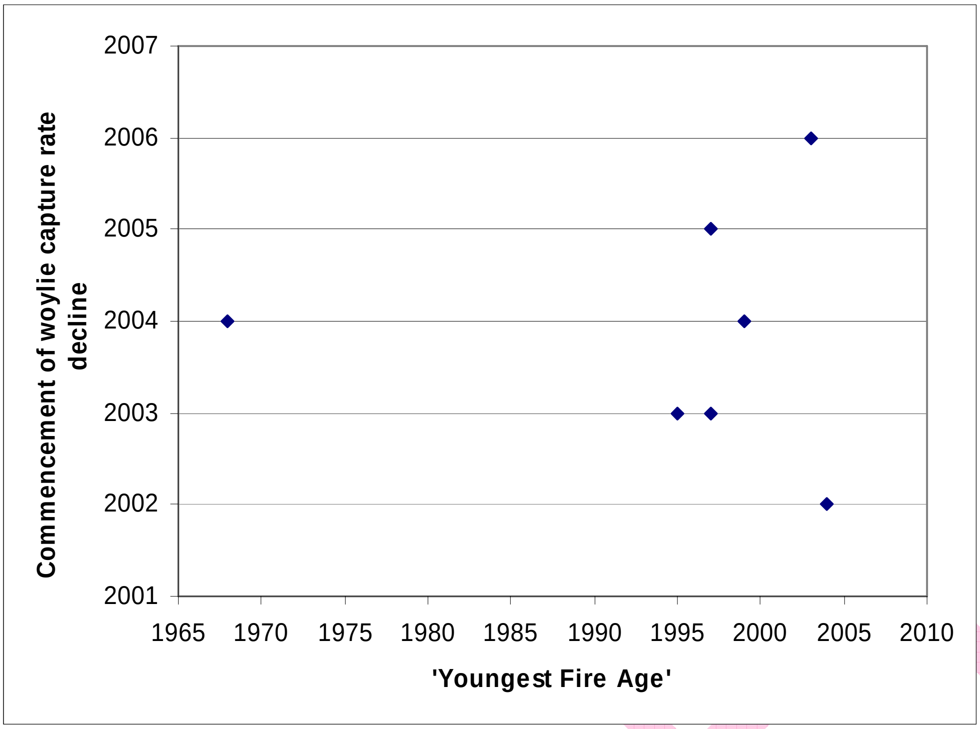

Figure 3.6.9. Relationship between youngest fire age and commencement of woylie capture rate decline along seven of the Upper Warren Fauna Monitoring transects.

Table 3.6.2. Relationship between proximity to fire units and woylie capture rates along nine of the Upper Warren Fauna Monitoring transects.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Core	7	98	14	535.3333
Boundary	4	46	11.5	216.3333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	15.90909	1	15.90909	0.037084	0.851569	5.117355
Within Groups	3861	9	429			
Total	3876.909	10				

Table 3.6.3. Relationship between proximity to fire units and extent of decline in capture rates along nine of the Upper Warren Fauna Monitoring transects.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Core	6	548	91.33333	126.6667
Boundary	3	218	72.66667	1236.333

ANOVA

Source of	SS	df	MS	F	P-value	F crit
Between Groups	696.8889	1	696.8889	1.57058	0.25036	5.591448
Within Groups	3106	7	443.7143			
Total	3802.889	8				

Table 3.6.4. Relationship between coarse season last burnt and woylie capture rates along nine of the Upper Warren Fauna Monitoring transects.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Au	7	95	13.57143	547.619
Sp	4	49	12.25	195.5833

ANOVA

Source of	SS	df	MS	F	P-value	F crit
Between Groups	4.444805	1	4.444805	0.01033	0.921273	5.117355
Within Groups	3872.464	9	430.2738			
Total	3876.909	10				

Table 3.6.5. Relationship between coarse season last burnt and extent of decline in woylie capture rates along nine of the Upper Warren Fauna Monitoring transects.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Au	6	546	91	146.8
Sp	3	220	73.33333	1222.333

ANOVA

Source of	SS	df	MS	F	P-value	F crit
Between Groups	624.2222	1	624.2222	1.37465	0.279366	5.591448
Within Groups	3178.667	7	454.0952			
Total	3802.889	8				

3.6.4. Discussion

The preliminary analyses indicate that no relationships were evident between various attributes of fire history and woylie capture rates or contemporary extent of decline.

Of particular note, youngest fire age (i.e. latest year of last burn) adjacent to the transect showed no relationship to woylie declines. The 'Yendicup2' transect, which last burnt in 1968, has undergone similar extent of decline as several other transects with considerably younger fire ages (Figure 3.6.5). Similarly, there were no trends evident between the timing of the commencement of woylie declines and the most recent fire event associated with the fauna monitoring transects (Figure 3.6.9).

The limited number of data points used to investigate the potential for fire history relationships with woylie decline is a substantial constraint of these preliminary analyses. More sophisticated analyses that can incorporate a much broader temporal context to the possible relationships are needed to more robustly address these questions. Having said this, there is no evidence yet that indicates that fire is involved in any way with the recent rapid and substantial woylie declines and it remains unlikely that such evidence might exist. For example, there is nothing remarkable about the nature and pattern of fire that has changed substantially between the 1990's and early 21st century that could account for the woylie declines in the Upper Warren. This includes factors such as fire interval, burn size, burn season rotation, and local- and landscape-scale fire heterogeneity, that have not altered substantially over the past decade or so (Rod Simmonds, pers. comm.).

Previous research suggests that there may be immediate and acute responses to fire by woylies, followed by rapid recovery within four to five years (Christensen, 1980). However, other research has found little or no evidence of this. For example Burrows and Christensen (2002) found 'no discernable impact of fire on capture rates of native mammals (including the woylie), with trends in capture rates being independent of the time since the last fire'. This also supports the findings of this analysis. Friend and Wayne (2003) provide further frameworks which may aid in understanding or predicting woylie responses to fire.

Fauna responses in other studies have often been more closely related to vegetation changes than to specific attributes of fire, such as fire age (Catling *et al.*, 2001; Fox, 1996; Monamy and Fox, 2000). On this basis it might be more instructive to investigate woylie responses to vegetation structure and floristics, to complement these direct investigations into fire. These relationships should be addressed as part of the ongoing work regarding the population comparison study of woylie resources. (Chapter 4 Population Comparison Study, Section 4.5 Resources)

Similar analyses of this fire history data were conducted by Adrian Wayne in 2006, with the same lack of relationships being observed.

3.6.5. Future work

Further analysis is required to determine whether there are any relationships between fire and recent woylie declines. Due to the multiple variables involved, this will require more sophisticated and rigorous analyses that incorporate the broader temporal context within these potential relationships. An analysis of the unpublished woylie data from the Batalling study (Friend and Wayne, 2003) that specifically examined the fauna responses to prescribed burning would also be directly relevant to these investigations.

3.6.6. Conclusion

The preliminary investigation described here, found that no relationships were evident between woylie capture rates or extent of decline and various fire history attributes, including fire age diversity, year of last burn (oldest and youngest fire age), coarse burn season, proximity to fire units and fire frequency. These results are consistent with an earlier examination of the same factors conducted in February 2006. Furthermore there is no evidence (either contemporary or published), or ecological basis that indicates that fire may have a substantial role in the recent rapid and substantial woylie declines observed in the Upper Warren, Dryandra, Batalling or elsewhere. More sophisticated and rigorous analyses are required to verify these preliminary findings.

3.6.7. Acknowledgements

We would like to thank Tom Hamilton and Lachie McCaw for the access to the Corporate fire history data set and their support in its use for this investigation.

3.6.8. References

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