Effect of fire on day-flying Lepidoptera in Koondoola Regional Bushland reserve

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Figure 1. Western jewel *Hypochrysops halyaetus* - photo: T. Lundstrom

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Introduction

Koondoola Regional Bushland is a 124 ha reserve of regionally significant remnant bushland located 13 km north of Perth. The reserve consists of *Banksia attenuata* woodland dominated by the Karrakatta Central and South vegetation complexes, with an unusually diverse understorey (Gibson et al. 1994; Wake 1995; Trudgen 1996). These complexes are poorly reserved and hence the Koondoola bushland, because of its relatively large size and low level of disturbance, has particularly high conservation value (Murray 1998). Four major roads bound the reserve, and development of surrounding areas for residential purposes has effectively rendered the reserve as a habitat island.

Koondoola Regional Bushland is also well known amongst naturalists as an area diverse in butterflies. About 20 species were recorded from the reserve prior to this report, of which three (western jewel *Hypochrysops halyaetus*, blue iris-skipper *Mesodina cyanophracta* and mallee ochre *Trapezites sciron*) are widely regarded as rare or under threat, particularly within the Swan Coastal Plain (Braby 2000). Previous studies in the reserve (Williams et al. 1992, Dover and Atkins in prep., Dover in prep.) have documented breeding populations of the western jewel (Fig. 1) and mallee ochre.

Dover (in prep.) identified and studied a large colony of western jewels adjacent to the north boundary of the reserve. In January 2001, a high-intensity fire burnt approximately 10ha in the north-west corner of the reserve, immediately adjacent to this jewel colony (Fig. 2). The effects of fire on Australian butterflies, and the dynamics of recolonisation after fire are poorly studied. This fire thus presented an opportunity to measure dispersal of the western jewel into the burnt area and to assess the time taken by each species to recolonise the burnt area.

Figure 2. North-west corner of Koondoola Regional Bushland reserve after the high intensity fire of January 2001. Photo taken 17 May 2001- photo: M. Williams

Methods

Mark-recapture study

On 36 days spread between 23 October and 20 December 2001, a mark-recapture study was undertaken in the 'jewel colony' area described by Dover (in prep.). Three species of butterflies were included in this study: the western jewel, blue iris-skipper and mallee ochre. Each day, between 1000 and 1200, two hours were spent within the colony area capturing and individually marking each butterfly encountered.

A standard procedure was used for each butterfly caught. First, the butterfly was removed from the net by holding the wings between thumb and index finger of the right hand. It was then transferred to the left hand and held by the thorax and base of the wings. Next, an individual identifying number was written on the left hind-wing with a Staedtler Lumocolor (Staedtler Mars GmbH & Co, Nurnberg, Germany) 318

fine-tipped permanent marker pen (Fig. 3). After releasing the marked butterfly at the point of capture, the sex of the individual and time were recorded. In the case of previously marked butterflies the identifying number, sex of the individual, colour of the mark and capture time were recorded.

Figure 3. A marked blue iris skipper *Mesodina cyanophracta* (number 141) immediately prior to release - photo: M. Williams

Track surveys

On the same days as the mark-recapture study, a fixed route was walked along the tracks within the northern section of the reserve. The route was divided into 40 individual sectors each 100m in length and assigned an identifying number 1-40 (Fig 4). The boundary of each sector was defined by a convenient feature such as a bend in the track, or by a conspicuous natural feature.

For each section, butterfly and sun moth abundance was measured using a modified version of the standard butterfly transect method developed by Pollard (1977). Each survey began between 1220 and 1300, and finished, typically, between 1430 and 1520, depending upon the number of insects seen and whether transects (see below) were included. The track survey was 4.5 km in length and on average took 2 h to complete. The direction of the survey (ie 1 to 40, or 40 to 1) was alternated to remove possible time-of-day bias from the counts in each sector. Counts were conducted under all weather conditions in order to determine what constituted suitable weather conditions for the local area: Pollard's standard method, developed in Europe, requires temperatures between 13° and 17° C and wind speeds below 5-6 m sec^{-1}, which are known to be unsuitable for this area.

Walking at a steady pace, all butterflies and sun moths present within 2.5m to each side of and 5m in front of the observer were recorded. Occasionally individuals were captured to enable identification and then immediately released. One species pair was recorded as twin species (the large and western brown skippers, *Motasingha trimaculata* and *Motasingha dirphia*), but the presence of both species was confirmed: females are indistinguishable in the field but males can be identified easily if captured. For taxa not previously recorded from the reserve individual voucher specimens were retained. Counts were converted to numbers of insects km^{-1} to facilitate comparisons between surveys.

Transects

On 10 of the 36 sampling occasions, six additional transects running through bush were included in the sampling regime (fig. 4). Three transects (A, B and C) were through the burnt area, transect D consisted of half burnt and half unburnt sections, and transects E and F were through unburnt bush. The total length of transects was 1.6 km, 850 m in the burnt area and 750 m in unburnt. Methodology used on each transect was the same as for the track survey.

Dispersal

On both the track surveys and transects, individuals of the three species studied in the mark-recapture experiment were captured and marked. To distinguish these individuals from those marked in the jewel colony area, marks were made with a black permanent marker in the jewel colony and with a red marker on the tracks and transects.

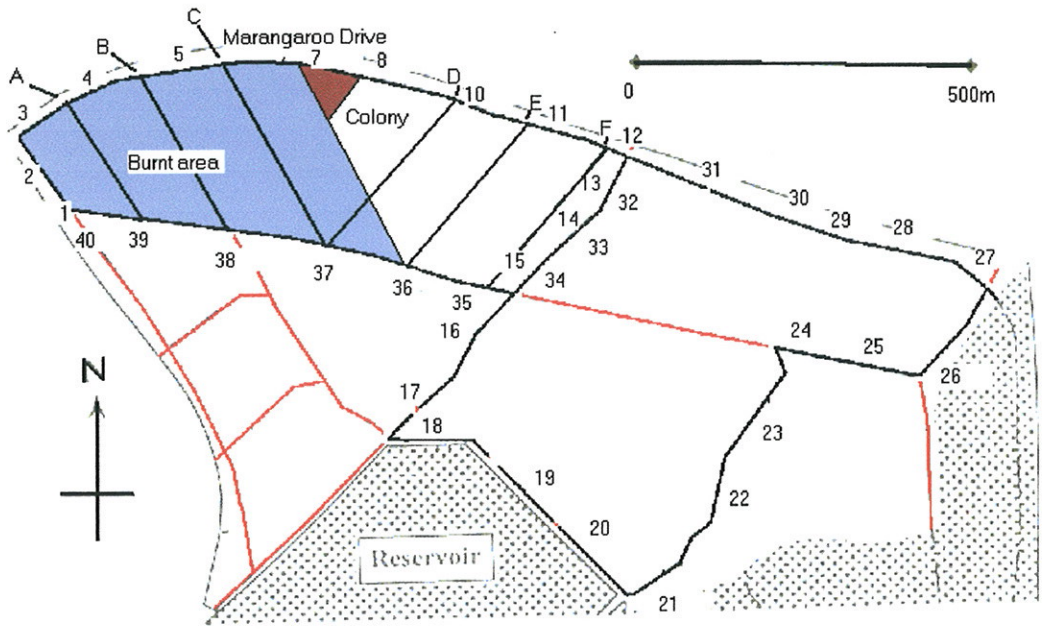

Figure 4. Northern section of Koondoola Regional Bushland reserve, showing extent of the January 2001 fire ('burnt area'), location of the western jewel colony area ('colony'), track survey sections (numbered 1-40) and bush transects (A-E).

Results

Mark-recapture study

Recapture rates were remarkably consistent for the three butterflies studied, although there were insufficient captures of the mallee ochre to permit further analysis (Table 1). A single individual of one additional butterfly species (saltbush blue *Theclinesthes serpentata*), not recorded on the tracks or transects, was recorded during the mark-

recapture study. The mark-recapture data will be analysed in more detail at a later date.

Table 1. Total captures and recapture rates in the mark-recapture study.

Species		Total number marked	Recapture rate (%)
Western jewel	*Hypochrysops halyaetus*	937	20
Blue iris-skipper	*Mesodina cyanophracta*	412	19
Mallee ochre	*Trapezites sciron*	20	25

Track surveys and transects

A total of 7524 day-flying Lepidoptera representing 19 species were recorded in the track surveys, at an average density of 46.4 km^{-1}. The transects recorded an additional 1446 individuals at an average density of 90.4 km^{-1}, but no additional taxa (Table 2). If the two species that were prolific within the burnt area (Australian painted lady and sun moth) are excluded, densities of all other species on tracks and transects was very similar (15.2 km^{-1} and 15.3 km^{-1} respectively).

Although two species were notably more abundant on transects (the sun moth *Synemon sophia* and Australian painted lady *Vanessa kershawi*), the track surveys gave a representative sample of the butterflies present in the reserve. Similarly, the western jewel and Australian painted lady were much more abundant on transects through the burnt area. A more detailed comparison of track surveys and transects, comparing the transects with adjacent sectors of track will be done later.

Dispersal

Only dispersal data for the western jewels have been collated so far. This can best be summarised by tabulating for each recaptured individual its marking location (colony or track) and recapture location (colony, track or transect) (Table 3). This demonstrates that the sex ratio was close to equal in the colony area and on transects, but heavily biased towards males along the tracks.

Table 2. Species list and total number of individuals, and density (number km^{-1}) on tracks and transects, Koondoola Regional Bushland reserve. (* = exotic taxa; [1] = not previously recorded from the reserve; [2] = known or believed to be breeding in the reserve; [3] = observed incidentally; [4] = previously recorded from the reserve but not during the present study).

Common name	Scientific name	Total number	Tracks	Burnt transects	Unburnt transects
Sun moth[2]	*Synemon sophia*	1 899	9.3	27.5	22.0
Australian painted lady[2]	*Vanessa kershawi*	4 356	21.9	81.9	18.6
Yellow admiral	*Vanessa itea*	2	0.01	0	0
Meadow argus	*Junonia villida*	1	0.01	0	0
Wanderer*	*Danaus plexippus*	1	0.01	0	0
Marbled xenica[2]	*Geitoneura klugii*	545	3.2	1.9	0.50
Western brown[2]	*Heteronympha merope*	3	0.02	0	
Western jewel[2]	*Hypochrysops halyaetus*	787	4.4	8.0	1.9
Fringed heath-blue[2]	*Neolucia agricola*	807	4.7	0.25	5.4
Large bronze azure[1, 2]	*Ogyris idmo*	4	0.02	0	0
Long-tailed pea-blue[2]	*Lampides boeticus*	192	1.1	0.25	0.88
Two-spotted line-blue[2]	*Nacaduba biocellata*	1	0.01	0	0
Common grass-blue[2]	*Zizina labrudus*	14	0.09	0	0
Cabbage white*	*Pieris rapae*	28	0.15	0.25	0.25
Spotted jezebel	*Delias aganippe*	13	0.07	0.25	0
Blue iris-skipper[2]	*Mesodina cyanophracta*	275	1.2	4.8	5.4
Large brown skipper[2] & Western brown skipper[2]	*Motasingha trimaculata* & *Motasingha dirphia*	27	0.12	0.75	0.13
Mallee ochre[2]	*Trapezites sciron*	14	0.09	0	0
Yellow palm-dart*[,1]	*Cephrenes trichopepla*	1	0.01	0	0
Saltbush blue[3]	*Theclinesthes serpentata*	0	0	0	0
Western xenica[2, 4]	*Geitoneura minyas*	0	0	0	0
Lesser wanderer[4]	*Danaus chrysippus*	0	0	0	0
Chequered swallowtail[4]	*Papilio demoleus*	0	0	0	0
Orange palmdart*[,4]	*Cephrenes augiades*	0	0	0	0
Western grassdart[2]	*Taractrocera payria*	0	0	0	0

Table 3. Western jewel recaptures sorted by source and location of recapture (m = male, f = female).

	Source	
Recapture location	**Colony**	**Track**
Colony	173 (80 m, 93 f)	17 (15 m, 2 f)
Track	27 (25 m, 2 f)	40 (39 m, 1 f)
Transect	6 (1 m, 5 f)	0

Twenty-seven individuals marked in the colony were subsequently recaptured on the tracks: 26 in sectors 5-9 and one in sector 12; the longest dispersal was thus about 400 m. A further six individuals marked in the colony were subsequently recaptured on transects A (1 individual), B (3), C (1) and the burnt part of transect D (1); the longest dispersal was thus 350 m.

Seventeen individuals marked on the tracks were subsequently recaptured in the colony area: thirteen from the adjacent sectors 5-9, 2 (both females) from sector 17 (approx 500m distant), but for the remaining 2 individuals the marking location could not be determined (in both cases part of the hind wing had been lost, along with the final digit of the identifying number).

Of the 39 males marked and subsequently recaptured on tracks, dispersal distances were typically short: 34 were recaptured in the same or an adjacent sector and three in the next sector but one (ie all within 100-200 m of the marking location); one moved from sector 9 to sector 36 (250 m across the unburnt area) and the last from sector 18 to sector 22 (400 m). Only one female was marked and subsequently recaptured on tracks: it had moved from sector 17 to sector 8 (500 m).

Discussion

Mark-recapture study

On three occasions, marked jewels were observed mating (Fig 5). This provides some evidence that marking did not impair the ability of individuals to undertake normal behaviour after marking. Similarly, a number of individuals were recaptured on a number of occasions, and together with the high recapture rate suggests that marking and subsequent recapture did not reduce life expectancy.

Figure 5. A marked female western jewel (number 533, left) mating with male on a flower spike of a grass tree *Xanthorrea preissii* - photo: P. Robertson.

Track surveys and transects

Comparison of the track surveys and transects indicate that track surveys provide a similar profile of butterfly taxa within the reserve. However, the track surveys had a strong bias toward male western jewels. This is likely because males use the tracks as lekking areas and females avoid males after mating.

Track surveys also revealed more taxa, but they also represented greater sampling effort and sampled a greater areal extent. A more detailed comparison of track surveys and transects will be done at a later date.

Transects through the burnt section of the reserve had substantially increased abundance of some taxa, that were attracted to the prolific flowering of *Xanthorrhoea priessii* and *Dasypogon bromeliifolius* (Fig. 6). However, some taxa were notably less abundant in the burnt area, particularly the fringed heath-blue *Neolucia agricola* and long-tailed pea-blue *Lampides boeticus* (Table 2, Figs 7, 8).

Dispersal

Dispersal distances of western jewels were all less than 500 m, consistent with the low level of dispersal recorded by Dover (in prep.) and typical dispersal distances were less than 200 m. However, there was notable dispersal by females marked in the colony into the burnt area.

Acknowledgements

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Figure 6. Large numbers of Australian painted ladies *Vanessa kershawi* feeding at a flowering spike of a grass tree *Xanthorrhoea preissii* in the burnt section of Koondoola Regional Bushalnd reserve. A yellow admiral *Vanessa itea* (middle left) and a western jewel (bottom right) are also present – photo: M. Williams

Figure 7. Fringed heath-blue *Neolucia agricola* - photo: T. Lundstrom

Figure 8. Long-tailed pea-blue *Lampides boeticus* – photo: T. Lundstrom

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