Some Effects Of Prescribed Burning On Jarrah Forest Birds

P. C. Kimber
Forests Department, Western Australia

Abstract

Two study areas were subjected to prescribed burning in late spring 1971. A temporary reduction in bird populations was found, followed two years later by an increase.

In one area the burn was moderately severe and the upper tree canopy was totally scorched over a quarter of the study area. The birds most affected were those occupying the ground vegetation, understorey and lower tree canopy, habitat levels most directly affected by fire. The species most affected were the broad-tailed and western thornbills, and the golden whistler. All three are among the commonest birds of the jarrah forest.

A third area, unburnt for 40 years was surveyed in spring 1973 and numbers of bird observations compared with one of the burnt study areas. Significantly fewer birds were found in the ground vegetation, understorey and lower tree canopy levels of the unburnt forest.

Limited observation on breeding suggested that burning in late spring had little effect on breeding success. Young were reared from four nests active at the time of fire. Breeding was completed in 70% of the observed nests before the fire.

The Jarrah Forest as a Habitat

Jarrah occurrs in almost pure tree stands over much of its range. On moist sites, and in the southern extremities of the forest, marri *Euc. calophylla* appears as a mixture forming 5% to over 50% of the canopy. The jarrah forest zone comprises 90% forest and woodland on well drained soils, and 10% swamp where tree cover is sparse or absent.

The forest proper is characterised by a medium density of trees (averaging about 150ft²/acre basal area) and a corresponding medium canopy cover. Percentage canopy cover of the ground is variable but rarely exceeds 80% and the average is 50-60%. Crowns are not dense, and this factor is exaggerated by the somewhat pendulous nature of the leaves. Hence the overall canopy is fairly thin for a forest formation, but it does vary considerably depending on the breeding status of the trees. In years of a heavy crop of capsules, little new foliage develops and the trees look moribund. Two years later they will have relatively dense green crowns.

The upper canopy, formed by mature trees, reaches from roughly 25 m to 35 m above the ground. Selection cutting in the past has created small group of regrowth; these extend the leafy canopy to within 10 m of the ground, and closer in young regeneration.

The understorey is generally sparse. *Banksia grandis* predominates with *Persoonia longifolia* and *Xylomelum occidentale* frequently represented.

The ground vegetation is also sparse, giving generally less than 50% ground cover. It is low, rarely reaching 1 m high over much of the forest. Ground cover and the height of ground vegetation increase markedly in the southern extremities.

Characteristics of jarrah forest as a habitat are thus an upper storey of medium density, a sparse understorey, and a sparse ground vegetation.

Fire History and Prescribed Burning

A brief review of fire history in the area will put fire and its effects into perspective.

Evidence exists of an association of the jarrah forest with fire for at least the past 7000 years (Churchill 1968)[1]. From the mid 1800's to the formation of the Forests Department in 1919, burning is reputed to have been frequent, intense, and ill-controlled. A period of protection from fire was then followed until the mid 1950's when prescribed burning was introduced. Present day practice is to burn on a rotation of 5-7 years.

The immediate result of prescribed burning is the removal of most of the litter, all of the ground vegetation, and scorching of the lower leaves of understorey species. 'Hot spots' sometimes occur where two fires meet earlier in the day than anticipated, and localised scorching of crowns up to 30 m or more may result. At the other end of the scale, areas of forest are missed by the fires. An average of 70% of the ignited area has been burnt in fires over the past few years. The majority of burns are conducted in late spring.

Recovery of the vegetation is rapid. Ground vegetation shoots from rootstocks and reaches its original size and conformation within 2-3 years, when the only evidence of fire is the blackened boles of the trees. Scorched crowns of overstorey and understorey trees reshoot in the first summer after the burn, and are denser (having more leaves) than normal for the following 2 years.

Studies of Fire and Bird Populations

The effect of prescribed burning on bird populations was studied in three areas of northern forest near Dwellingup during 1971 to 1973.

Method

Each study area, covering approximately 16 ha (40 acres) was traversed by permanently marked lines 100 m (5 chains) apart and 400 m (20 chains) long. Bird populations were sampled by observers walking the traverses and recording the approximate position of all the birds located by plotting them on a map of the study area (scale 1" = 20 m). Both sight and sound records were accepted, individual species were recorded, and where identification was uncertain the species was labelled unknown. Each survey of this type took in the region of 1½ hours to complete. Each area was surveyed from 3 to 9 times over a period of 4-5 weeks both before and after burning. All surveys were done in spring when the majority of birds were breeding, territorial, and consequently had a restricted range compared with other seasons.

One area, White Block, was burnt on 20 November, 1971 by a mild fire that scorched understorey leaves to 2 m high and covered approximately 80% of the area. Ignition was from the air and the entire burn covered 6500 ha (16,000 acres).

A second area, Amphion 4, was burnt on 3rd December, 1971 under conditions that gave a more than usually severe fire. Ground vegetation was entirely consumed and 25% of the area was scorched to a height of 30 m or more by early joining of the fires. Ignition was by hand and the area covered was 182 ha (450 acres).

Fire has been excluded from the third area for approximately 40 years. This forest block, Amphion 6, is 142 ha (350 acres) in extent and is held unburnt for research purposes.

All three study areas carried forest of similar structure and composition. All were cut-over 40 years ago and now comprise one third mature trees and two thirds regrowth of 20-25 m height. The total canopy cover is 60% to 70%.

Results — Short-term study

Short-term fire effects were determined from the data collected in White Block and Amphion 4 between 1971 and 1973. Only resident breeding species which occurred in reasonably large numbers have been selected for the presentation of results. They have been divided into four habitat groups, depending on the height above ground of their main activities during the survey period. This division is largely subjective and is based on observation. One common breeding species, the black capped sitella, has been excluded due to its habit of

wandering widely in small flocks in the breeding season. Although this bird is present in quite large numbers, records during the surveys were sporadic and therefore unreliable.

The overall short-term effects of fire was a slight reduction in the number of birds immediately following the fire and extending to the first spring after the fire. Total records in White Block, which was lightly burnt, fell from 33.7 observations per visit prior to the fire, to 28.9 in the month after. Amphion 4, with a relatively severe burn was surveyed over a longer period. An average of 41.3 records per survey was made prior to the fire, 39.2 in the month after, and 38.3 a year later. In the second spring after burning this figure rose to 51.4 records per visit, representing a 25% increase over the pre-fire level. A similar increase in bird populations following a very severe fire has been observed by P. Christensen in the karri forest. The greatest increase in numbers occurred in the species favouring low to mid-canopy levels (habitat group III — western warbler, brown-headed and white-naped honey eaters, and western shrike thrush), and this level of tree canopy suffered the most widespread damage in the fire. Certain species from other habitat groups also showed marked increases. Observations of the broad-tailed and western thornbills of habitat group I — ground vegetation and lower understorey, increased by 25% and observations of the golden whistler (upper understorey, lower tree canopy) by almost 50%. No significant reduction in numbers was recorded for any species.

An analysis of the immediate post fire results by habitat groups and by species shows a distinct reduction in numbers of thornbills in both White Block and Amphion 4. These are from habitat group I — ground vegetation and lower understorey, at a level where vegetation destruction was almost complete. An increase in recordings of rufous tree creepers is most likely due to young birds emerging from nesting hollows, and the decrease in western yellow robins due to their becoming particularly shy and difficult to observe once the young leave the nest.

The changes found in habitat level II (upper understorey — lower tree canopy) were not consistent in the two study areas. In the mildly burnt White Block a 50% reduction occurred in the month following the fire while there was no change in the more severely burnt Amphion 4. A possible explanation is provided by the difference in area of the two fires. The area burnt in Amphion 4 (182 ha) was small enough for birds to visit from adjacent unburnt forest, thus giving an edge effect' to the study area.

The distribution of birds before and after the fire was recorded by plotting the approximate position of each record on a map, and comparing these positions with a map of the severity of tree canopy damage. An example is given from each habitat group. At the level of ground vegetation and lower understorey the severity of burn is reflected slightly in the post-fire distribution of the broad-tailed thornbill. Its usual habitat suffered almost complete temporary destruction and it had re-established itself, in reduced numbers, at a higher level of vegetation. A similar but more marked relationship was found for the golden whistler which is an upper understorey — lower canopy occupant. At the level of habitat group III, lower to mid tree canopy, the western warbler showed the most marked disruption of distribution. It entirely shunned the heavily crowned-scorched parts of the study area. The red-tipped pardalote, habitat group IV, upper tree canopy, was unaffected in distribution and numbers.

Discussion

The reduction in numbers found in some bird species immediately following prescribed burning, and lasting for one spring after burning, can be accounted for by temporary habitat destruction. A significant increase over pre-fire numbers was found at two years after the burn in all habitat levels except for mid-upper canopy occupants. This habitat level is least affected by fire. The cause of increases below this level can be speculated on. Jarrah crowns scorched a spring burn start reshooting the following summer. By the second summer after the burn they are fully vegetated with a crown density greater than before burning and consisting of young leaves. The same dense, young foliage appears in the understorey and ground vegetation species. This factor is likely to result in increased insect populations. All the birds discussed here are primarily insectivores, hence greater food resources may account for the increase in their number.

Results — Long-term study

Data collected in Amphion 4 during spring 1973 was compared with a similar range of surveys made over the same period in Amphion 6, an area remaining unburnt for 40 years. Large differences were found in bird populations, the regularly burnt Amphion 4 yielding 55% more records than the unburnt Amphion 6.

Differences were almost entirely confined to the ground vegetation — lower understorey (habitat group I) and upper understorey — lower canopy (habitat group II). The mean records per survey in Amphion 6 for these two groups were 7.3 and 4.4 respectively, and in Amphion 4 the records were 17.4 and 11.1. Notably absent from the unburnt area was the rufous tree creeper, and the five records of western yellow robin came from 1 pair of birds resident in the study area compared with at least 5 pairs in Amphion 4. The one exception to this finding was the brown honeyeater, recorded in equal numbers in both areas.

No significant differences were found in mid canopy and mid-upper canopy species with the interesting exception of the spotted pardalote. This inhabits mainly the upper canopy levels in the forest but breeds in holes in the ground. It was recorded only 22 times in the unburnt forest compared with 44 times in the regularly burnt area.

Discussion

The study revealed an apparently enigmatic situation. The vegetation levels most affected by prescribed burning were found to be deficient in birds in the unburnt study area. Differences in populations were large and significant. No explanation is apparent and this opens a challenging field for further study.

The Effects of Burning Swamps

A brief review of swamp burning is necessary to complete the burning picture. Burning causes complete temporary habitat destruction and bird populations will undoubtedly be at very low levels immediately following the burn. Evidence of direct mortality caused by fires is occasionally found in burnt out swamps.

The ten per cent of the jarrah forest area covered by swamps is different in frequency of burning and the effects of fire. No detailed studies have been made in this habitat and the following notes are based on observation.

Swamps carry very dense vegetation and support a different range of species to the forest proper. The most frequent of these are the splendid wren and red-winged wren, the spotted scrub wren, white-breasted robin, new holland honeyeater, western silvereye and spotless crake. The broad-tailed thornbill inhabits both swamp and forest.

When fire enters a swamp it burns very intensely and habitat destruction is complete. Under the relatively mild weather conditions in the prescribed burning season fire will generally not run through a swamp until the vegetation is 7-8 years old. Hence this habitat generally at every second cycle of forest burning, that is every 10-14 years. A further factor to take into account is the uneven age of swamps due to irregular burning in the past. I have never seen a complete swamp system burnt out by one fire. Thus a refuge remains with a reservoir of birds which can repopulate burnt sections.

The initial rate of vegetation recovery is rapid, and takes place from rootstocks of the dominant species (rushes and *Agonis linearis* in western swamps, and *Melaleuca* spp. in the eastern ones). One year after a spring burn, for example, *A. linearis* exceeds 1.5 m height and is dense enough to make walking difficult. Studies of long-term recovery rates are in progress.

Effects of fire on breeding

Thirty nests were located in White Block and Amphion 4 in spring 1971, prior to burning. Fifteen of these were of the current season and only four were active at the time of burning. Breeding in the other 11 was completed before the fire.

The four active nests were broad-tailed thornbill, golden whistler and western yellow robin (2) and were situated between 2 m and 8 m above ground. Young were successfully reared from all nests.

Of the other 26, three were damaged by fire and these were all within 1 m of the ground. Vertical distribution of undamaged nests was:

1 m — 3 m:	13 nests
3 m — 6 m:	8 nests
6 m — 9 m:	2 nests
9 m:	4 nests

The following tentative conclusions were drawn:

1 Active nests are unlikely to be disturbed by fire unless they are damaged by it.
2 Only very low nests are damaged and the broad-tailed thornbill is likely to be the most affected species.
3 At the time of burning in late November breeding was completed in 70% of the observed nests. Earlier burns at a period when more nests are active may be more disruptive.

Conclusions

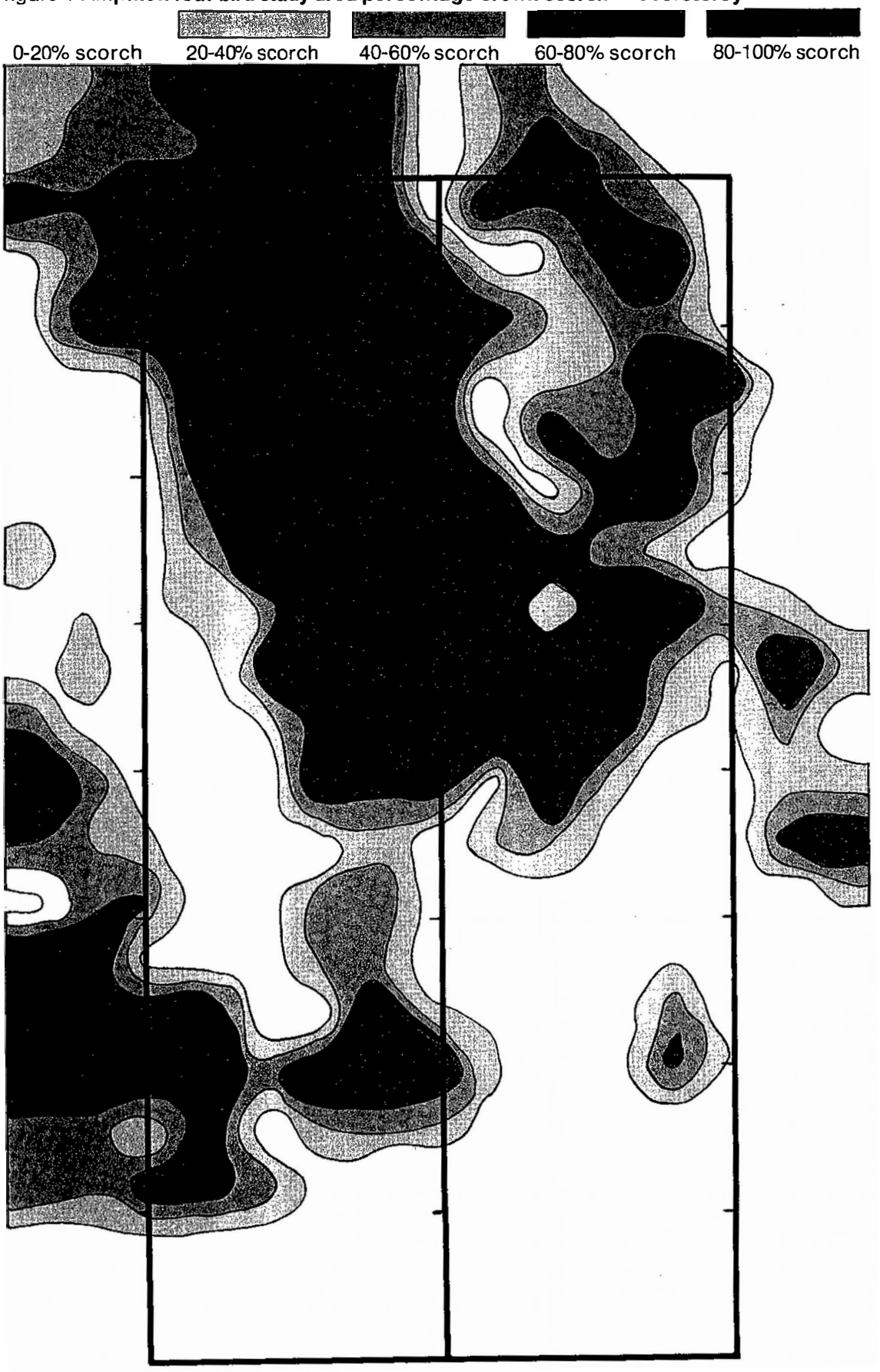
Prescribed burning causes temporary disturbance of bird populations over a 1½ year period followed by a significant increase in population the second spring after the fire. Disturbance is associated with habitat destruction and species inhabiting the lower tree canopy, understorey, and ground vegetation are most affected. These are among the commonest birds in the jarrah forest.

Populations in forest long protected from fire are significantly lower than in regularly burnt forest. This difference is confined to the ground vegetation, understorey and lower tree canopy levels. Species occupying mid and upper tree canopy are found in similar numbers in both burnt and unburnt forest.

BIRD SURVEYS IN UNBURNT AND REGULARLY BURNT FOREST
(8×15 HOUR SURVEYS IN EACH LOCALITY)
5/10/73 — 7/12/73

HABITAT	SPECIES	LOCALITY: AMPHION 6 (UNBURNT 40 YEARS) TOTAL RECORDS	AMPHION 6 (UNBURNT 40 YEARS) MEAN PER VISIT	AMPHION 4 (REGULARLY BURNT) TOTAL RECORDS	AMPHION 4 (REGULARLY BURNT) MEAN PER VISIT
GROUND VEGETATION/ LOWER UNDERSTOREY	BROAD-TAILED THORNBILL	53		82	
	WESTERN THORNBILL		7.3		17.4
	RUFOUS TREE CREEPER	0		32	
	WESTERN YELLOW ROBIN	5		25	
UPPER UNDERSTOREY/ LOWER CANOPY	SPINEBILL	5		21	
	BROWN HONEY EATER	2	4.4	2	11.1
	GOLDEN WHISTLER	28		66	
LOWER CANOPY/ MID CANOPY	WESTERN WARBLER	62		54	
	BROWN HEADED HONEY EATER	24	12.3	35	12.0
	WHITE NAPED HONEY EATER				
	WESTERN SHRIKE THRUSH	12		7	
MID CANOPY/	RED TIPPED PARDALOTE	78	8.7	84	10.5
UPPER CANOPY	SPOTTED PARDALOTE	22	2.8	44	5.5

figure 1 **Amphion four bird study area percentage crown scorch — overstorey**



PRE-AND POST-FIRE BIRD SURVEYS (AMPHION COMPARTMENT 4)

HABITAT GROUP	SPECIES	MEAN No OF RECORDS PER SURVEY			
		1971 PRE-FIRE (7 SURVEYS)	1971 POST-FIRE (7 SURVEYS)	1972 (3 SURVEYS)	1973 (8 SURVEYS)
I	BTB — WTB	8.3	6.3	9.7	10.3
	RTC	3.4	3.9	3.3	4.0
	YR	2.9	2.2	3.7	3.1
	SUB TOTAL	14.6	12.4	16.7	17.4
II	SB	3.1	2.9	2.0	2.6
	BHE	0.6	2.1	0.3	0.3
	GW	5.6	5.1	5.3	8.2
	SUB TOTAL	9.3	10.1	7.6	11.1
III	WW	4.1	3.4	4.0	6.8
	BHHE — WNHE	3.9	4.9	3.0	4.7
	WST	0.4	0.3	1.3	0.9
	SUB TOTAL	8.4	8.6	8.3	12.4
IV	RTP	9.0	8.1	5.7	10.5
	TOTALS	41.3	39.2	38.3	51.4

HABITAT GROUPS

I GROUND VEGETATION, LOWER UNDERSTOREY
II UPPER UNDERSTOREY LOWER TREE CANOPY
III LOWER TO MID-TREE CANOPY
IV UPPER TREE CANOPY

SPECIES

BTB BROAD TAILED THORNBILL
WTB WESTERN THORNBILL
RTC RUFOUS TREE CREEPER
YR WESTERN YELLOW ROBIN
SB SPINEBILL
BHE BROWN HONEYEATER
GW GOLDEN WHISTLER
WW WESTERN WARBLER
BHHE BROWN HEADED HONEYEATER
WNHE WHITE NAPED HONEYEATER
WST WESTERN SHRIKE THRUSH
RTP RED TIPPED PARDALOTE

PRE AND POST BURNING BIRD SURVEYS, WHITE BLOCK (MEAN No OF RECORDS PER SURVEY, 9×1.5 HOUR SURVEYS BEFORE AND AFTER BURNING)

HABITAT GROUP	SPECIES	SPRING 1971 (PRE FIRE)	SPRING 1971 (POST FIRE)
1	WTB & BTB	7.0	6.3
	RTC	1.0	2.7
	YR	2.8	1.3
	SUB TOTAL	10.8	10.3
II	SB	5.1	1.0
	GW	5.3	3.8
	SUB TOTAL	10.4	4.8
III	WW	2.7	2.8
	BHHE & WNHE	1.7	2.7
	WST	1.3	0
	SUB TOTAL	5.7	5.5
IV	RTP	6.8	8.3
	TOTALS	33.7	28.9

REFERENCES

1 Churchill, D. M. (1968) — The distribution and prehistory of *Eucalyptus diversicolor, E. marginata*, and *E. calophylla* in relationship to rainfall. Aust. J. Bot. 16, 1: 125-150.

figure 3 **Amphion four following burning**

○ **Broad Tailed Thornbill** ◪ **Red Tipped Pardelote** □ **Western Warbler** △ **Golden Whistler**

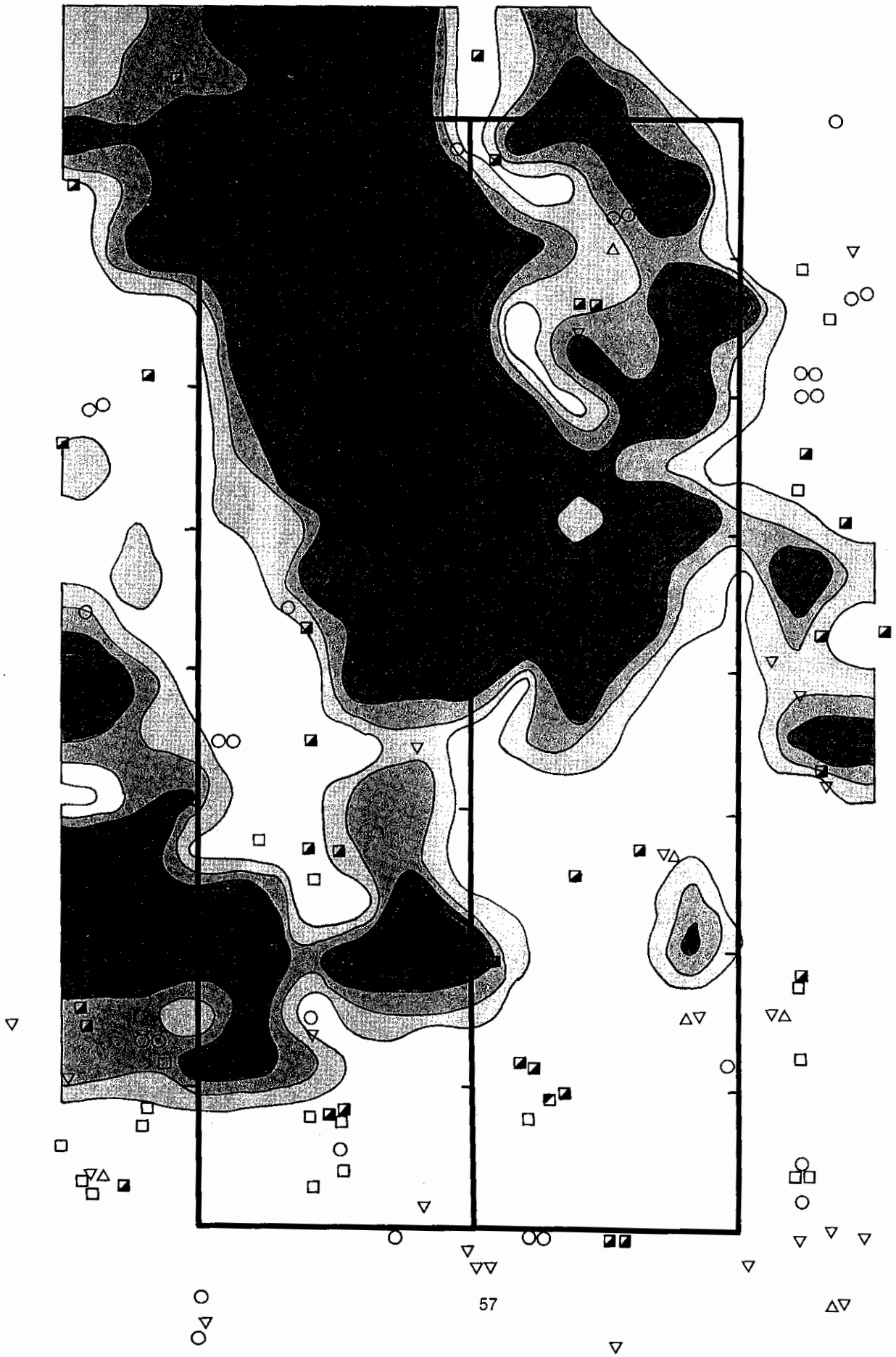
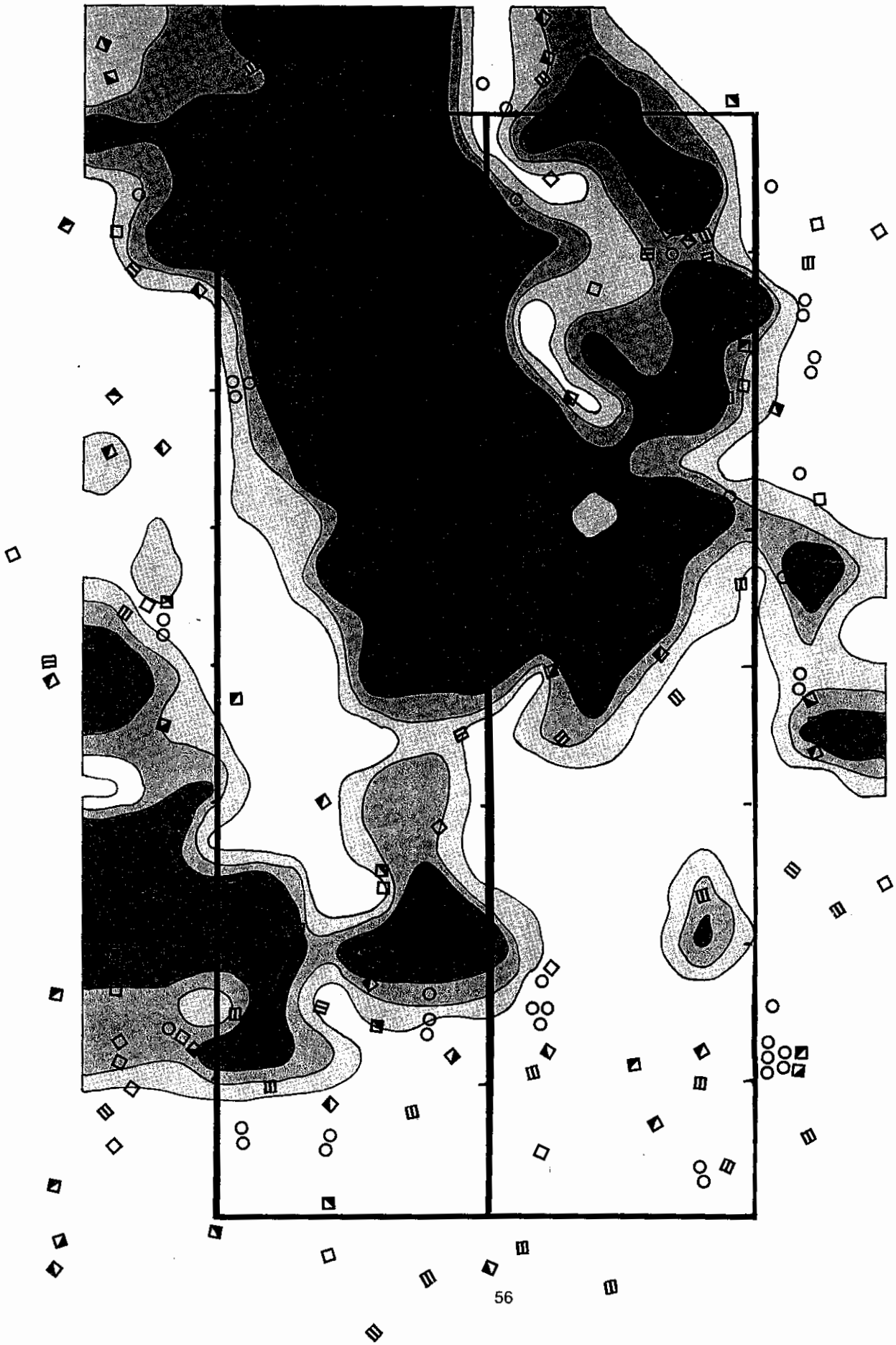


figure 2 **Amphion four before burn**

○ Broad Tailed Thornbill ◪ Red Tipped Pardelote □ Western Warbler ▥ Golden Whistler



Third

FIRE ECOLOGY SYMPOSIUM

PROCEEDINGS