HERPETOFAUNA

Vol. 16 No. 1 1984

SEASONAL AGGREGATION BEHAVIOUR IN A MIXED POPULATION OF LEGLESS LIZARDS, *DELMA AUSTRALIS* AND *D. FRASERI*

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ABSTRACT

Large numbers of *Delma australis* Kluge and *D. fraseri* Gray aggregate at a site near Esperance, Western Australia during the winter months. With the onset of spring they disperse over a much larger area, and return to the aggregation site in the following autumn. Maximum concentration/aggregation occurs in June for both species. Total dispersion occurs from December to March in *D. australis*, and November to January in *D. fraseri*. The dispersion is not random, but involves a westerly drift by most of the population to an alternative habitat which is suitable for summer occupation. It is suggested that this seasonal migration is behaviour of recent origin caused by the changes to the habitat that occurred when this area was largely cleared for agricultural use.

INTRODUCTION

Although there are many accounts of Australian snakes being found in winter aggregations, very little published material is available on this behaviour in Australian lizards. Lizards that do tend to congregate at the one site are the habitat-specific species i.e. the saxatile agamids, gekkonids and scincids. Apart from some seasonal fluctuation of population numbers in at least one habitat-specific agamid (Bradshaw, 1971), most will be found occupying the same site throughout the year. The present study is a record of aggregation in two species of lizards, and it also shows their ability to persist in or adapt to an altered environment if conditions are right.

THE STUDY AREA

Situated 65 kilometres west of Esperance in Lat. 33°44'S, Long. 121°17'E it is about 20 hectares in extent. Seventy percent of the area has been cleared for agricultural use and is undulating grassland; the remainder is coastal scrub/heath with the dominant vegetation being chittich *(Lambertia inermis)*, stunted mallee *(Eucalyptus spp.)* and munji *(Nuytsia floribunda)* interspersed with blackboy *(Xanthorrhoea preissii)* above various low scrub species. Monthly rainfall and mean temperatures are shown in Figure 3.

The aggregation site comprises a relic windrow of spongolite stones and mallee roots that passes north to south over the crest of a small hill. It is on the grassland about 100m east of the undisturbed heath and is 150m in length. The substrate here consists of shallow greyish sands (depth to 5cm) overlying brownish clay.

MATERIALS AND METHODS

The study area was visited once each calendar month over a 2 year period to record the location of each lizard found. Apart from a small sample retained for examination, all were released at the site of collection after measurements of snout-vent and total length were obtained. Collecting was done by hand, whilst a garden rake was used to locate individuals amongst leaf-litter. During the dry summer months the substrate was examined for shrinkage fissures that may have allowed the lizards access into the subsoil but none were found.

Rainfall was recorded with a conventional raingauge at a point 2km east of the study site. Mean monthly temperatures were supplied by the Dept. of Meteorology, Esperance.

Estimates of population densities used here are the result of collection data compiled for several separate 1 ha plots (3 plots visited on two occasions each in the study area, and 5 plots elsewhere). These data were collected in summer at the completion of the 2 year survey.

RESULTS AND DISCUSSION

Table 1 lists the reptile species and months these were found at or near the aggregation site. *D. australis* and *D. fraseri* were the most abundant species through the winter months followed by *Drysdalia coronata,* although the latter was much more widespread over the study area at all times. No other species displayed the observed aggregation.

The following discussion is divided into 4 sections: (1) the aggregation site, and why this occurs here; (2) stimuli; (3) the direction of dispersion; and (4) benefits of this behaviour, with notes on seasonal population densities.

In the present study the aggregation site is the only site within the study area that has all of the following characters that could be deemed to be suitable for the observed behaviour. These are high ground which would allow good drainage of seasonal rainfall; much of it has a northern aspect, therefore maximum exposure to the sun and protection from harsh south winds; and adequate cover in the form of stones and mallee roots.

The proximity of this site to the undisturbed heath appears an important factor concerning its selection. There are similar sites located further east, and a greater distance from the heath, but few pygopodids were found occupying these sites. *D. australis* and *D. fraseri* display a dislike for unvegetated areas (Bush, 1981). As a move to the aggregation site occurs in autumn when there is very little vegetation remaining on the grassland any individual attempting to reach the more easterly sites would have to spend much longer periods on open ground.

Stimuli — Two environmental factors evident are temperature and rainfall. There was an increase in population size at the aggregation site during January corresponding to a comparatively high monthly rainfall (see Fig. 3). Maximum aggregation was recorded in the coldest months (May to August). The only factor consistent with both periods is the high rainfall. I have found this to influence to some extent the degree of activity in the diurnal reptiles of this region i.e. a reduction in activity while overcast and raining, and an increase immediately it has ceased and the cloud has cleared.

The direction of dispersion (Fig. 2) — In the spring when the population disperses from the aggregation site, that site and the surrounding grassland undergoes a seasonal transformation; the annual grasses introduced as pasture have produced seeds and are dying off. The dispersal, which would reduce inter- and intra-specific competition, is also an emigration from an unsuitable summer habitat.

The heath, to the west, is the observed destination of the population and the direction of the initial dispersal is between north-west and south-west (see Fig. 2). Both these directions are downhill from the aggregation site, whereas to the west is comparatively level ground. One entirely speculative explanation is that the reduction in day-length results in a move to high ground and an increase in day-length results in a move to low ground.

Seasonal fluctuation of population density and related benefits — Included in Table 2 are estimates of population densities used to determine the theoretical distribution of the aggregating population during the summer dispersal. These densities are comparable with those recorded at other areas of undisturbed heath nearby (5 to 15km from study area) suggesting consistent distribution of the two species in local heath habitats.

The sparse distribution of these pygopodids while dispersed would limit male-female encounters. With the winter aggregation of the population, optimum conditions for males to locate females would occur during the initial stage of the dispersal. The possible relationship between aggregation behaviour and reproduction is supported by the snout-vent lengths (i.e. maturity) of the aggregated individuals (Fig. 4). Adults account for 83% in *australis* and 75% in *fraseri*.

Two questions that arise if the aggregation is reproduction linked are: (1) are both species, throughout their range, divided into breeding groups that have a 'home range' with defined boundaries? And (2) are communal egg-laying sites the result of this breeding-group situation?

CONCLUSION

The aggregation observed during the present study may or may not be typical behaviour throughout these species' range. Both are common and widespread in this region, although I have been unable to locate other comparable examples of aggregations in the undisturbed heath. Therefore, on the data available to date, it is believed to be an isolated phenomonon caused by two factors: (1) an instinctive move by individual lizards to a suitable elevated site for the duration of the wet winter months; and (2) the clearing of the natural vegetation has reduced the size of suitable elevated areas which can be used by this population, thus causing such a concentrated aggregation at this site.

The direction of general dispersal is probably a direct response to land clearing.

ACKNOWLEDGEMENTS

I am grateful for the assistance of Bob Baird and Murray Pfitzner in recording the climatic data for the duration of this study. Especial thanks go to Rick Shine, Harry Ehmann and Gerry Swan for suggestions and criticism that were invaluable in the preparation of this manuscript. Accursed with a meandering mind I also thank H.E. for keeping me on the 'straight and narrow'.

LITERATURE CITED

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SPECIES	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
Aprasia striolata									*			
Delma australis	*			*	*	*	*	*	*	*	*	
Delma fraseri	*	*	*	*	*	*	*	*	*	*		
Hemiergis peronii	*	*	*	*	*	*	*	*	*	*	*	*
Leiolopisma trilineatum	*	*		*	*	*	*	*		*	*	*
Menetia greyii	*	*	*			*	*		*	*	*	
Drysdalia coronata	*	*	*	*	*	*	*	*	*	*	*	*
Echiopsis curta						*						

Table 1. Species recorded at aggregation site.

	A	B	C
D. australis elsewhere	22	3.5/ha (N 6, 0-6) 3.2/ha (N 5, 1-5)	6.3ha
D. fraseri elsewhere	13	1.5/ha (N 6, 0-3) 1.8/ha (N 5, 0-4)	8.7ha

A — Peak population numbers at aggregation site (recorded in June).

B — Population density estimated while dispersed.

C — Possible population distribution while dispersed (A divided by B).

Table 2. Estimates of population density of the study population, including estimates from elsewhere (5-15km from study area), with theoretical dispersal area.

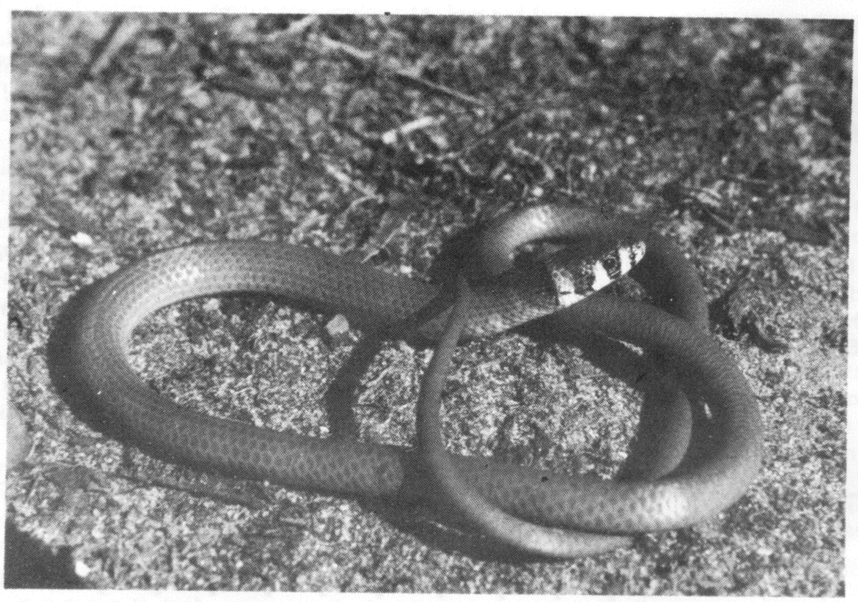

Figure 1. *Delma fraseri*. The larger of the two species of legless lizards that shared the aggregation site during the winter months.

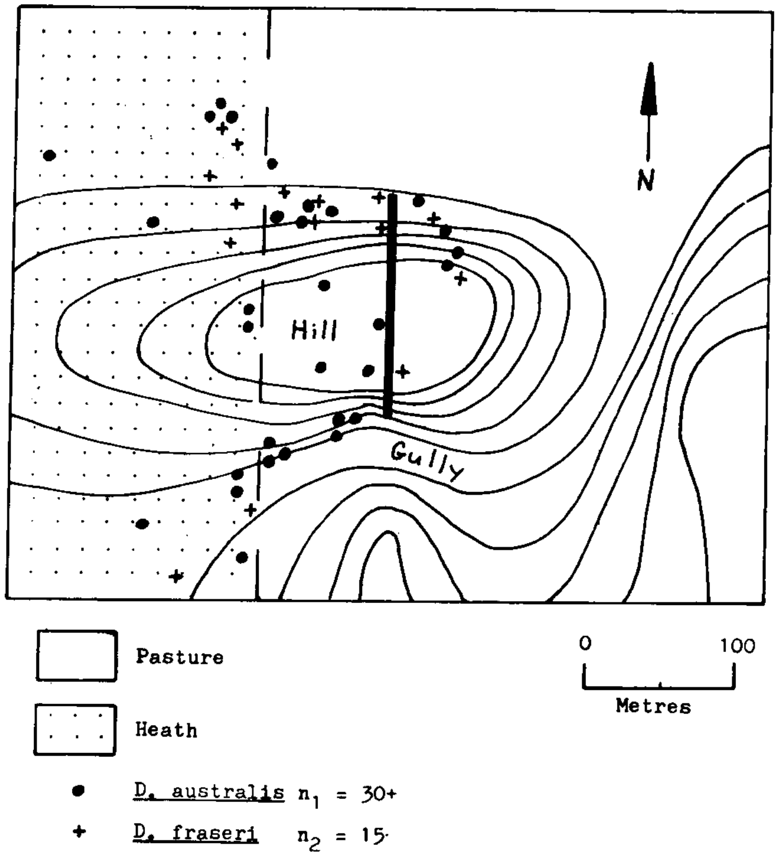

Figure 2. Map of study area showing location of legless lizards relative to aggregation site after dispersal (Oct. - Mar.). Plotted from data collected over two consecutive seasons. Note that few lizards dispersed to the east of the aggregation site.

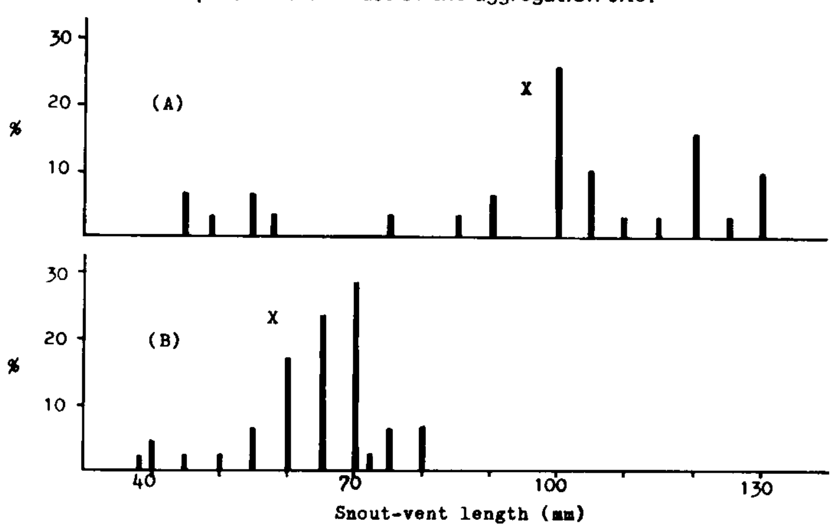

Figure 4. Histogram of S-V L ratios for aggregated population of (A) *Delma fraseri* and (B) *D. australis*. That portion to the right of X is considered sexually mature. Note that each species occupies a separate size range and that the majority of the population is to the right of X.

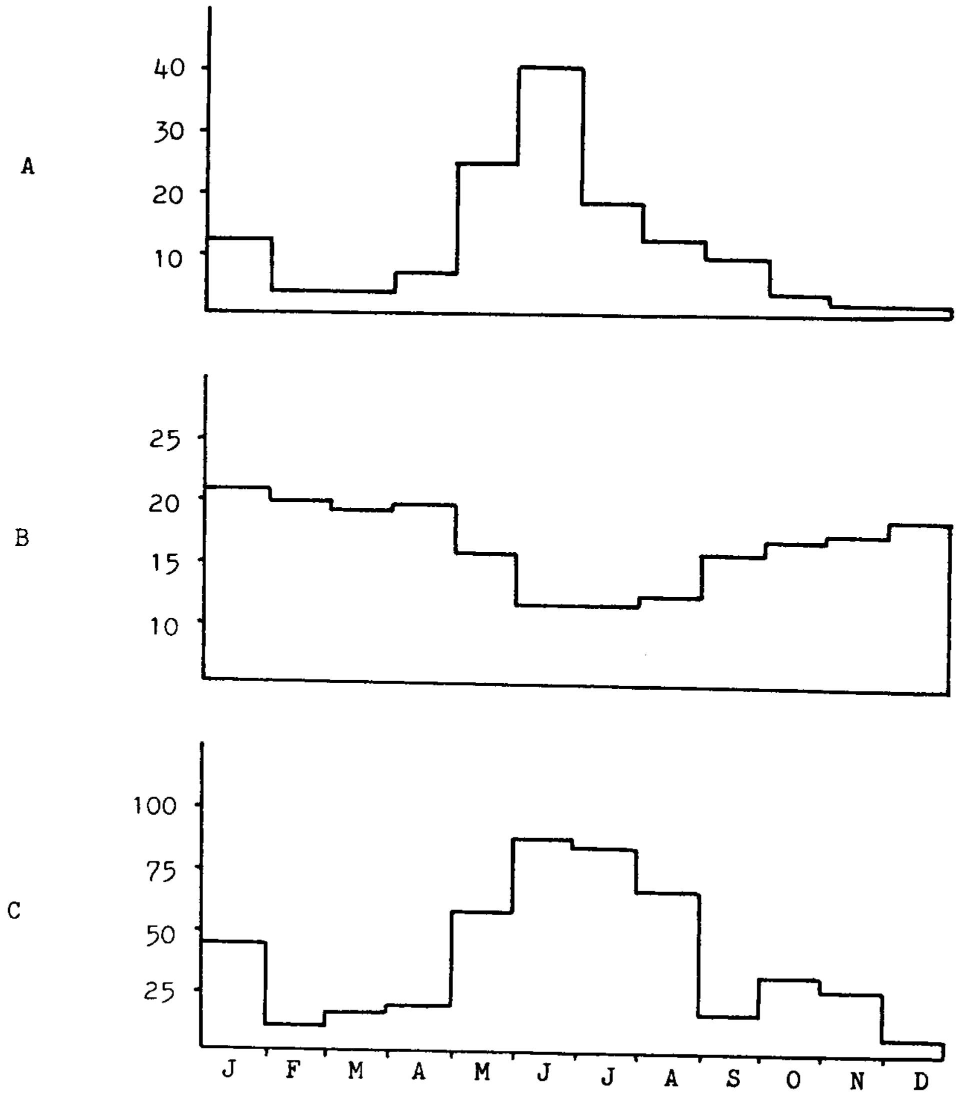

Figure 3. (A) Monthly numbers of *D. australis* and *D. fraseri* combined at aggregation site relative to (B) mean temperature in degrees centigrade and (C) rainfall in millimetres. Note the increase in legless lizard numbers in January corresponding to an unseasonally high rainfall for that month.