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An Assessment of the Hazard Posed to Northern Quolls (*Dasyurus hallucatus*) by Aerial Baiting with 1080 to Control Dingoes

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Abstract

The hazard posed to northern quolls, *Dasyurus hallucatus*, during aerial baiting programs for the control of dingoes was studied in a pastoral area of Western Australia. The incidence of mortality and the movements of the animals were studied by means of radiotelemetry. Minimum activity areas ranged from 5 to 1109 ha, and the longest movement recorded was 3·5 km over 7 days. All animals could have encountered baits. Mating occurred shortly before baits were laid. The animals subsequently lost condition and body weights were low at the time of baiting.

No quolls died in the 2 weeks following the baiting. This suggests that northern quolls and other, theoretically less susceptible, non-target species of mammals in the pastoral areas of Western Australia are not at risk from 1080 aerial baiting programs.

Introduction

Aerial baiting with the poison Compound 1080 is commonly used for the control of dingoes in the pastoral areas of Western Australia (Thomson 1986) and in other parts of Australia (McIlroy 1982). This is an efficient and cost-effective control technique for dingoes (*Canis familiaris dingo*) in Western Australia (Thomson 1986), but no information was available on the risk these programs pose to non-target species.

Native species of fauna from south-western Australia generally have a high level of tolerance to Compound 1080 (King *et al.* 1978). A recent laboratory study of the sensitivity to 1080 and daily food intake of 9 species of dasyurids and 6 of rodents from the pastoral areas of Western Australia identified the northern quoll (*Dasyurus hallucatus*) as the species apparently most at risk from accidental poisoning (Calver *et al.* 1989). On the basis of laboratory studies, McIlroy (1986) suggested that the native carnivores appear to be one of the groups most at risk from dingo-poisoning campaigns using meat baits. However, McIlroy (1982) cautions that theoretical assessments possibly overestimate the risk that carnivores face from 1080 poisoning. Sinclair and Bird (1984) suggested that mortality rates of *Sminthopsis* feeding on poisoned baits may be lower than those estimated from laboratory-derived data.

A simulated aerial baiting (baits laid by hand from the ground) in the Brindabella Ranges of the Australian Capital Territory caused a great reduction in numbers of brown antechinus (*Antechinus stuartii*) (McIlroy 1982). No field data on the risk to non-target species from poison baiting in the pastoral regions of Australia are available. Thus, a study was made to determine the hazard posed to the northern quoll during a normal dingo control program in the north-west of Australia.

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Materials and Methods

Study Area

The study was conducted near Mungowarra Pool (21°20′S.,116°15′E.) on the Fortescue River in the western Pilbara region of Western Australia during two periods, 15–29 July and 11 September to 15 October 1987. The main object of the July trip was to assess the number and condition of the quolls in the area and to obtain preliminary information on their activity areas. The study site consisted mainly of rugged ironstone hills sparsely covered with spinifex (*Triodia* spp.) and scattered trees (*Eucalyptus* and *Acacia* spp.) (Beard 1975). The area has been baited annually during dingo control programs since 1984. Research on dingo ecology and control was conducted in the area between 1975 and 1984, and baiting trials occurred in 1980 and 1984 (Thomson 1986 and unpublished data).

Annual rainfall averages approximately 300 mm and mainly occurs during summer. Daily maximum temperatures often exceed 35°C (Thomson 1986).

Trapping and Location Techniques

Quolls were captured in Elliott traps (15×16×46 mm or 9×10×33 mm) baited with peanut paste and rolled oats. Trapping was done in two hilly areas separated by a flat area approximately 2 km wide.

The quolls were fitted with 27 MHz crystal-controlled pulsed transmitters attached to brass collars and were released at the point of capture. Tracking was done during the hours of 1000 to 1600 on foot or from a 4-wheel-drive vehicle, using CB receivers and directional loop antennae. An attempt was made to locate each animal daily in its refuge site during each trip. Limited radiotracking data were obtained during July, and modifications were made to telemetry equipment and searching procedures by September. In September and October, quolls were located for varying periods before baiting and for 12 to 15 days afterwards (Table 1).

Table 1. Locations and activity areas of *Dasyurus hallucatus* as determined by the minimum convex polygon method

Animal No.	Sex	No. of radio locations	No. of days carrying radio	No. of times trapped	Total locations trapped or radio-tracked	Frequency of days when quolls trapped	Greatest distance between locations (km)	Nearest location to line of baits (m)	Activity area (ha)
2	F	11	33	8	19	0·58	0·70	300	75
5	M	5	33	5	10	0·30	3·45	150	1109
6	M	9	31	7	16	0·52	1·10	350	234
8	F	12	23	5	17	0·74	1·50	650	141
9	F	4	32	3	7	0·22	0·25	250	–
12	M	6	29	7	13	0·45	1·30	100	222
14	F	18	33	4	22	0·67	1·55	150	443
15	M	9	33	11	20	0·61	1·40	400	342
16	F	0	?	1	1	–	–	–	–
17	M	7	23	5	12	0·52	0·25	50	5
18	M	1	?	3	4	?	0·70		
19	M	4	20	3	7	0·35	1·50		
20	M	1	20	3	4	0·20	0·25		

Body weights were measured with a spring balance and the general condition and reproductive status of the quolls was noted to determine whether these factors influenced the probability of their taking baits. Individuals were earmarked to enable recognition if their collars were lost.

Locations of quolls tracked during September and October were plotted on aerial photographs to determine activity areas and proximity to baits. Retrapping began in October, 12 days after baiting, in order to capture animals that had not been radiotracked frequently and to recover transmitters.

Baiting

Meat baits were prepared in the standard fashion used by dingo control staff of the Agriculture Protection Board (APB) (Thomson 1986). They were injected with 6 mg of Compound 1080, dried in the sun, and stored at ambient temperature for 3 weeks before use. Baiting was done on 1 October by APB control staff as part of routine aerial baiting to control dingoes. Approximately 1000 baits were dropped at a variable rate (more frequently near pools of water, including Mungowarra Pool) along the dry bed of the Fortescue River and its tributaries, a flight path of approximately 54 km. The route flown by the plane near Mungowarra Pool was marked on an aerial photograph (Fig. 1).

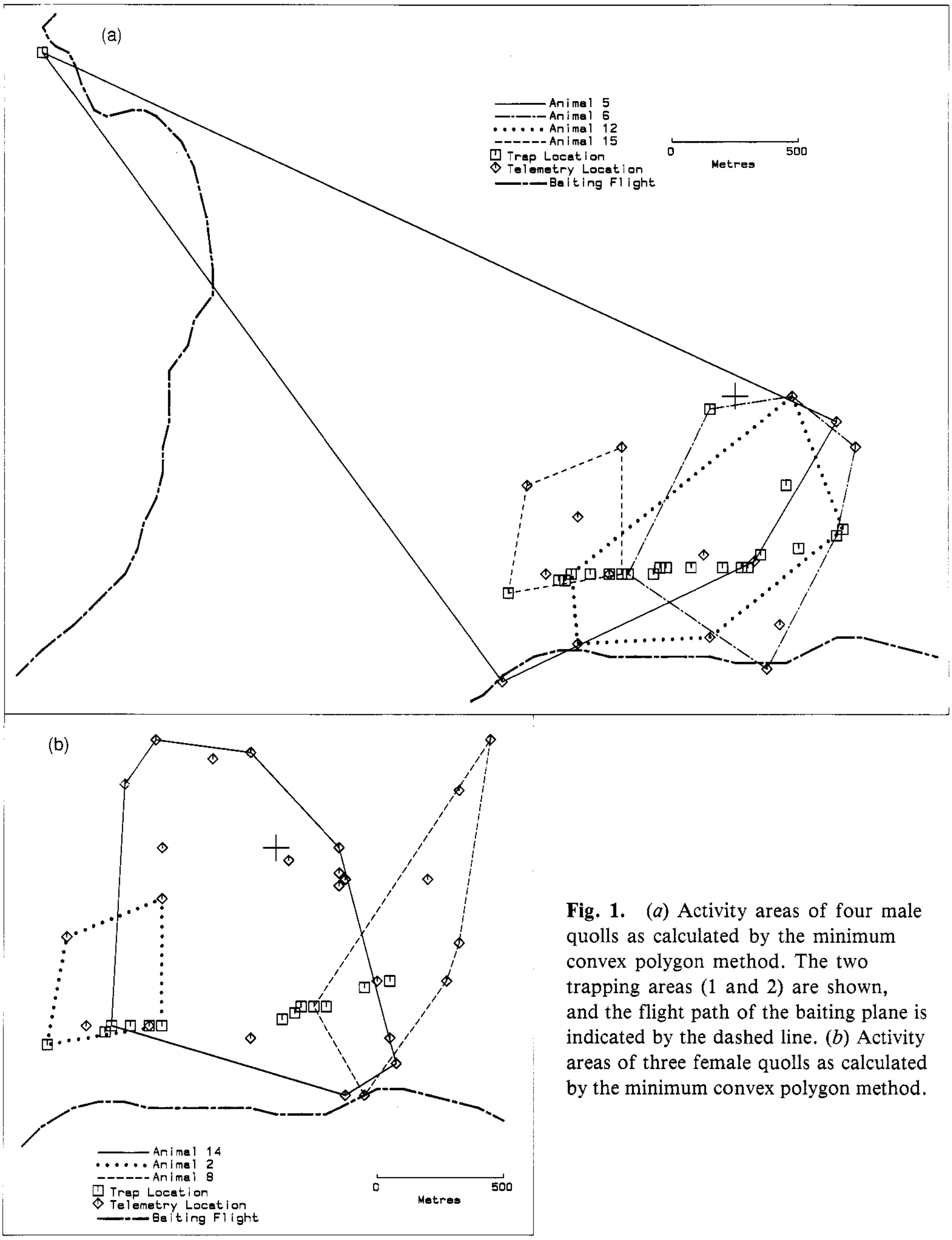

Fig. 1. (*a*) Activity areas of four male quolls as calculated by the minimum convex polygon method. The two trapping areas (1 and 2) are shown, and the flight path of the baiting plane is indicated by the dashed line. (*b*) Activity areas of three female quolls as calculated by the minimum convex polygon method.

The baits used were smaller than recommended [the average dry weight of 100 baits was 26·2 ± 9·2 g (s.d.) as opposed to a recommended minimum dry weight of 35 to 40 g], and the level of toxin in them would thus have been more concentrated than recommended.

Results

Four female and nine male quolls were captured, marked and released in July. A limited amount of radiotracking of five males and three females was done. In September, five females (three of which were caught in July) and eight males (three captured in July) were fitted with radio collars and released. Contact was lost with two females and one male before the baits were laid. All ten other quolls were retrapped 12–14 days after the baits were laid; one of these had lost its transmitter. Of the eight individuals that were located by radiotelemetry after baits had been laid, all were located within 50 to 650 m of the lines of baits at least once (Table 1).

The activity areas of those animals with more than eight locations (radiotracking and trapping) were calculated by the minimum convex polygon method (Table 1). There was considerable spatial overlapping of the activity areas for both sexes (Fig. 1).

The longest distance moved was 3·5 km by male No. 5 between 6 and 13 October.

No animal was located every day. During the period that each animal carried a transmitter in September and October, the daily frequency of trapping and radio locations ranged from 0·22 to 0·74 (Table 1). Some animals were located in the same shelter site on several days.

Table 2. Weights and tail diameters of individual quolls at first capture in July and September

Animal No.	Sex	Wt (g) July	Wt (g) Sept.	Sept. wt as % of July wt	Tail diam. (mm)	Sept. diam. as % of July diam.	Date July	Date Sept.
2	F	390			14·0		17/7	
			345	88	12·8	91		11/9
8	F	480			15·5		22/7	
			320	67	12·2	79		12/9
9	F	520			15·5		23/7	
			415	80	13·0	84		13/9
5	M	680			16·0		19/7	
			505	74	12·4	78		11/9
6	M	790			17·0		20/7	
			565	72	12·8	75		12/9
12	M	910			18·0		27/7	
			620	68	13·8	77		13/9

Table 3. Mean weights (g) and tail diameters (mm) of quolls

Ranges in parentheses

July		September	
Mean weight	Tail diameter	Mean weight	Tail diameter
Female ($n=4$)		Female ($n=5$)	
437·5±75·0 (s.d.)	14·5±1·3	370·0±46·9	12·2±0·8
(360–480)	(12·8–15·5)	(320–425)	(11·3–13·0)
Male ($n=9$)		Male ($n=8$)	
664·6±178·2	17·8±2·4	592·5±46·2	13·4±0·7
(670–910)	(14·0–21·5)	(505–660)	(12·4–14·5)

Six animals captured on the initial trip in July and recaptured in September showed a considerable weight loss between captures (Table 2). Mean weights of all males and females captured in September were also markedly lighter than those of males and females caught in July (Table 3). Quolls also showed considerable fluctuations (up to 22% within 4 days) in body weight between successive captures, particularly in September and October. Males showed a tendency to increase in weight during September and October.

The tail diameters of individuals captured on both trips (Table 2) and the mean tail diameters of all males and females captured during the two trips decreased between July and September (Table 3).

Males were generally in poor condition in September but were improving by early October. Several had lost large amounts of fur and carried high numbers of ticks and lice.

No signs of reproductive activity were observed in the four females captured in July. All five females captured in September and October were carrying pouch young or had enlarged nipples and swollen pouches.

Discussion

Of 15 species of rodents and dasyurids examined in a laboratory study (Calver *et al.*, unpublished data), *D. hallucatus* was found to be at the highest theoretical risk of accidental poisoning from aerial baiting programs. However, no quolls were known to have died following the baiting in October 1987. All animals that could be located at the time baits were laid were recaptured at least once between 12–15 October. Some animals might have died more than 2 weeks after baits were laid. Deaths of some dingoes killed by meat baits do occur after more than 2 weeks (Thomson 1986).

Perhaps because the number of animals tracked was low and the number of locations obtained was small, the estimated minimum activity areas of the quolls were highly variable (Table 1). No individual was located on every day of the study despite intensive radiotelemetric searches within their known activity areas on all days. The long distances moved by several animals in this study lends support to the idea that they were outside their recorded activity areas for some of the period of searching. The longest move recorded for an individual (3·5 km) is greater than the maximum move of 1·2 km recorded by Begg (1981) or the 2·5 km measured by Schmitt *et al.* (1989); however, both of these studies relied solely on live trapping. The home ranges of the quolls in this study were also considerably larger (Table 1) than the mean values of 2·3 ha for females and 1·8 ha for males reported by Schmitt *et al.* (1989). Radiotracking studies are likely to produce larger estimates of activity areas than grid-trapping studies of wide-ranging species since telemetric locations are not constrained by the size or layout of trapping grids. All locations in this study were of quolls in their daytime resting sites. Size of the activity areas may also vary between areas because of differences in the density of available resources.

The high mobility of these animals increases their chance of locating poisoned baits. Baits are normally dropped along river and creek beds, as occurred here. Several animals were trapped in the bed of the Fortescue River during July, and quoll No. 5 (Table 1) was known to have crossed a line of baits at least twice in October when moving between the two trapping areas. All quolls radiotracked after the baiting were located within 650 m of the bait lines at least once (Table 1); this distance was exceeded by the maximum distance moved by each of the eight quolls that were located more than eight times. The probability of them encountering baits would thus have been high. No radiotracking was done at night when the animals were active.

Quolls in this study gave birth in September. Those in more northern areas generally give birth in July or August (Nelson and Smith 1971; Begg 1981; Schmitt *et al.* 1989).

The decline in weight of quolls captured in both July and September (Table 2) indicates the extent to which they lost condition following mating. Loss of condition was also recorded by Begg (1981). The decline in body weight and tail diameter was similar to the changes in mean values of these parameters reported by Schmitt *et al.* (1989). The poor condition and low body weights of males in September and October may have made the likelihood of them eating baits at that time greater than at any other time of year.

Newsome *et al.* (1972) suggested that abundant food supplies could contribute to the failure of baiting campaigns, and unpublished data from dingo baiting trials near the Fortescue River support that suggestion (P. Thomson, personal communication).

Female quolls also lost weight (Table 2) and may thus have been particularly prone to eating baits. It is unlikely that female quolls in the Pilbara region would also have had higher food requirements because of lactation costs in September and early October. In the closely related species *Dasyurus viverrinus*, the water influx rates (and thus food intake) of free-ranging females that are not lactating and those of females in early stages of lactation do not differ significantly. Those of females in late stages of lactation were about 60% higher (Green and Eberhard 1983).

The high susceptibility of northern quolls to meat baits containing 1080 (Calver *et al.* 1989) and their relatively large size (which enables them to readily carry transmitters) made them the most suitable non-target species of mammal in the pastoral areas for such a study.

The apparent lack of real risk posed to *D. hallucatus* in this study at a time of year when their poor condition and low body weights would probably have made them most susceptible to eating baits suggests that they and other, smaller species of non-target mammals in the pastoral areas may not be at risk of accidental poisoning during aerial baiting programs using 1080 meat baits. Whether the quolls located baits and failed to eat a lethal amount of them or all animals in this study failed to locate baits is unknown. As none of the quolls died during the two weeks following baiting, there is apparently little risk to their populations from dingo baiting programs.

The simulated baiting program of McIlroy (1982) used a higher density of baits than normal; this may have accounted for his results. In this study, the 1080 content of baits and the way in which they were distributed followed normal practice and should therefore reflect more accurately the actual risk posed to non-target species of mammals. The suggestions by McIlroy (1982) and Sinclair and Bird (1984) that laboratory studies may overestimate the risk to non-target species from 1080 baiting are supported by these results.

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