FIELD OBSERVATIONS ON KANGAROO ISLAND ECHIDNAS (*TACHYGLOSSUS ACULEATUS MULTIACULEATUS*) DURING THE BREEDING SEASON

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ABSTRACT

Field studies in two different areas on Kangaroo Island confirmed that male echidnas find and follow females during the breeding season, prior to mating. Males may be attracted by a pheromone which disappears after copulation. Several days after mating, the female returns to a solitary life style while males may join 'trains' of other unmated females.

Females monitored using radio telemetry in this study laid an egg between the fifteenth and twenty-third day after male dispersal. Whereas some females continue to move about and forage while carrying the egg, others remain in a burrow for ten days during the egg incubation period.

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INTRODUCTION

Early researchers documented that the reproductive season for echidnas occurred during the winter months (Bennett 1881; Semon 1894a, b). Griffiths (1978) confirmed that echidnas throughout Australia breed mainly during July and August. Echidnas are generally solitary living animals; however there are some reports of echidnas found in groups of two or more. The first documented incidences of echidnas encountered together were those discovered 'in copulation' (Haake 1884; Broom 1895). In more recent literature, there are reports of at least six groups of two to six animals (Augee *et al.* 1975; Griffiths 1978). All sightings were made during July and August and in five cases it could be confirmed that only one of the group was a female.

Information about when these groups or 'trains' of echidnas form, how the animals find each other and how long they stay together is completely lacking. Griffiths (1978) noted that all previously discovered groups of echidnas were observed during the breeding season. He further stated that olfaction may play a role in bringing echidnas together; however there have been no data to support this theory.

Since little is known about the daily activities of echidnas in their natural habitat, this study began daily monitoring of individuals during the breeding season. The interaction of individual animals and composition of different echidna trains was observed and documented. Monitoring focused on the activities of females, but movements of some males were also recorded.

MATERIALS AND METHODS

Study site and animals

During July through September 1989, sixty-six echidnas were colour coded on the west end of Kangaroo Island. Fifty-eight of these animals were in Flinders Chase National Park. Ratio of sexes and range of body masses at time of capture are presented in Table 1. Animals whose sex could not be determined (palpation of penis) were classed as subadults.

Table 1. Sex and body mass range for echidnas from two study sites on Kangaroo Island

	FLINDERS CHASE		PELICAN LAGOON	
	Number	Wt. (gm)	Number	Wt. (gm)
Males	35	2400-4700	29	2000-3600
Females	15	3100-5100	8	2300-3500
Subadults	8	900-1400	3	1000-1500

Prior to this study thirty echidnas had been marked opportunistically in the Pelican Lagoon area, on the eastern end of Kangaroo Island, during a ten year period. The Pelican Lagoon area is a discrete geographical unit characterised by three main soil types and fourteen major vegetation associations (Trebech and Ball 1983). It is largely pristine vegetation with a low number of exotic species. From November 1990 to September 1991, forty echidnas were colour coded around the Pelican Lagoon Research Centre and Pelican Lagoon Conservation Park for the present study. Sexes and body mass ranges of individuals at the initial time of capture are also listed in Table 1.

Colour coding of all animals was achieved by slipping stretched, coloured insulation tubing over one or two spines on a designated part of the body (tail, rump, back, shoulder or head) and on the right, centre or left portion of the designated area. Animal colour codes are three or four letters describing first the colour, second the body part and third the location on the body part. Hence RTL indicates Red Tail Left and YGBR, Yellow Green Back Right. Colour codes are placed on two neighbouring spines in the event of spine shedding. From previously marked echidnas in the Pelican Lagoon area, we know that some colour codings have remained intact for up to ten years.

Radio tracking

Animals were monitored using radio telemetry. In both areas up to twelve animals at one time had tracking transmitters attached to the midline spines on their backs using a two-component epoxy.

Transmitters from Wildlife Materials, Illinois, USA, and more recently from Titley Electronics, Ballina, NSW and Biotelemetry Tracking, Adelaide, SA, were used. Tracking receivers were also from the above companies, as well as from AVM Instrument Company, California, USA. Transmitter weights ranged between 50 and 125 grams.

Observations made during 1989 at Flinders Chase National Park commenced in late June and ended in mid September. Observations in the Pelican Lagoon area commenced November 1990 with individuals being monitored daily up to and including September 1991. This study is ongoing.

Olfaction trials

In January and March 1991 (nonbreeding season) female echidnas were placed in a hessian bag for a minimum of two hours and placed in an area of known echidna activity, determined by fresh foraging signs and observed for two hours before releasing the female. The empty bag was then also observed for another two hours.

In July and August 1991 a female was removed from a train and placed in a hessian bag and placed on the ground either 50 or 100m away from where the train had been found. The same experiment was repeated with an empty bag in which a female had been placed for a minimum of two hours. The bags were observed from a distance for two hours before the female was released at the site of capture.

Echidna train survey

In 1989 and 1991 the local Kangaroo Island community was addressed through the local newspaper and 'Echidna Watch' posters hung at post offices and various national parks on the island. I requested that sightings of groups of echidnas (two or more animals) be reported, along with date, time of day and any general comments. Observations were either written and dropped in the envelopes provided with the 'Echidna Watch' posters, or phoned directly to the Pelican Lagoon Research Centre.

RESULTS

Echidna trains

Fifteen trains consisting of two to eight echidnas were personally examined during this study. The lead animal was always a female and all others were males. The female often appeared to be the largest animal of the group and in fourteen of the fifteen trains examined the female had the greatest body mass of any individual in the train. Table 2 lists the body masses of individuals found in six trains with four or more individuals.

Table 2. Body mass (gm) of female and male echidnas when first found in trains.

Train	A	B	C	D	E	F
Female	RTR 3050	YGSR 3600	RTC 3425	BTL 4450	YGSL 3600	RSC 4200
Male 1	2800	3300	3125	3900	3500	3450
2	2775	3300	2900	3350	3500	3200
3	3175	3200	2825	3300	3100	3100
4	3300	2800	-	-	-	-
5	3125	2600	-	-	-	-
6	2825	-	-	-	-	-
7	2775	-	-	-	-	-

Some males were observed with a number of females during the breeding season. Also, the number of males with any given female could vary from day to day. Males observed with female BTL on the four days after her initial capture are listed in Table 3. On the third and fourth day there were unmarked males in the train, but they were not removed for colour coding. The male ORC who spent four consecutive days (11-14/07) with the female BTL was later (21/07) found in the train of BSL. Both males ORC and YGTC were found with BSL on 25 July.

Table 3. Males found in train of female (BTL) on consecutive days from 11/7/89.

DAY			
1	2	3	4
YGTC	YGTC	ORC	ORC
ORC	ORC	Unmarked	YTC
		Unmarked	Unmarked

The male YGSR was first encountered with female WBC and two other males on 26 June 1991. Four days later he was in a train with six new unmarked males and the female RTR. On 11 July he joined two previously colour coded males and one unmarked male in the train of RTC. This animal's transmitter failed on 18 July; however he was found again on 31 August. He remained solitary after this date.

Olfaction trails and post-train observations

When females were removed from a train during the breeding season, placed in a hessian bag and moved 50 to 100m away from the train location, the males, which had usually dispersed, returned to sniff and prod at the bag after a maximum of two hours. During the same time of year, when an empty bag which had contained a female was placed in a location of known echidna activity, it also attracted at least one male within a two hour period.

When a female was contained in a bag outside of the breeding season (January and March) and placed at the same time of day in an area of high foraging activity, no other echidna was attracted to the bag during two hour observation periods either with or without the female contained inside.

Table 4 shows the dates when eight different females were first and last observed with males, the date of egg-laying calculated from the hatching date or from the day she entered an incubation burrow and the date of hatching. From observations made during this study, the duration between the dispersal of males from a train and egg-laying is fifteen to twenty-three days. The time from when a female entered and remained, or continued to return to a burrow, to the time she was found with a newly hatched young was ten days. As indicated in Table 4 most females were initially located in trains with males so that the exact duration of the train period cannot yet be determined.

Female WBC was first found in 1990 and had a young that year. In 1991 she was first observed with a male on 23 May, but was not sighted with males again until 12 June. Her 'train' subsequently lasted forty-four days, but no egg was produced.

Female LRRL was observed mating on 27 July 1989. On 30 July she was seen in the company of one male, but the next day and all subsequent days she was found alone. On 24 July 1991, the mating of female LRTC was observed. The following day she was seen with three and then one male. On 27 July and all following days she was alone. Hence, males left females three to four days after copulation. The transmitters on both of these females failed approximately two weeks after mating had occurred. Neither had entered a burrow and were not found again.

On two occasions a transmittered female was recaptured

Table 4. Dates when female echidnas were first and last observed with males and hatching.

Female	Date first sighted with male	Date last sighted with male	No. days observed with male	Date of egg-laying	Date of hatching
OTC	29/06/89	24/07	25	11/08	21/08
BTL	10/07/89	14/07	4	1/08	egg taken as sample
BSL	21/07/89	25/07	4	9/08	19/08
LBRR	24/07/89	28/07	4	12/08	22/08
RBC	29/07/89	29/07	1	21/08	egg taken as sample
WBC	12/06/91	26/07	44	no egg	-
RTR	30/06/91	5/07	6	25/07	3/08
RTC	7/07/91	25/07	18	9/08	19/08

while out foraging and found to have an egg in the pouch (BTL 7/08/89; BSL 15/08/89). Each time, the egg was located nestled in the deep pocket at the posterior end of the pouch directly above the cloaca. These females were first located in burrows on 1 and 9 August respectively, and had been pouch checked on the previous days.

Daily monitoring of pegged burrow entrances for females LBRR (12-22/08/89), RTC (9-19/08/91) and RTR (25/07-3/08/91) showed disturbances on more than one day during the period that the female was incubating the egg, indicating that she had left and returned to the same burrow. A11 of these females had young in the pouch after leaving the incubation burrow, and none returned to these burrows while carrying the young.

Female LBSR was observed foraging on 18 August 1989. A pouch check determined that there was no egg. On 19 August she was found in a burrow where she remained until the 29th. On 30 August she was active again. A pouch check revealed a young, with the egg shell still in the pouch.

DISCUSSION

Many echidna trains observed in this study were sighted walking in the "Indian file nose to tail" fashion as described by Griffiths (1978). When animals were following each other in this way it was possible to approach the rear of the train and remove animals one at a time without disrupting the follow-the-leader pattern. Some trains were discovered when the animals were at rest, usually lying in a circle or loose group. One train of five echidnas was found inside a termite mound burrow with the animals more or less piled on top of each other. The largest train of echidnas reported on Kangaroo Island between 1989 and 1991 was a group of eleven sighted together in June 1991 (D. Neighbors, pers. comm.).

During this study, fifty-three echidna trains were sighted and reported on Kangaroo Island. The earliest train sighting was mid-May 1991 on the eastern end of the island (M. McKelvey, pers. comm.) and I observed the latest train on 12 September 1989 on the west end of the island. Because data were collected over several years we cannot exclude variations in weather patterns, temperatures or food sources as a factor influencing the exact timing of train formation and breeding, or the possibility of island-wide variations in reproductive behaviour. The long time span for echidna train sightings on Kangaroo Island is, however, in agreement with the time span reported by Griffiths (1978) for the period when eggs have been found in the uteri or pouch of echidnas from different regions of Australia. More studies investigating environmental factors are needed in order to determine the timing of echidna reproduction.

Since most females were with trains when found, we do not know the exact duration that males are attracted and stay with females. However, from one observation we know that males remained with one female for forty-four days.

Griffiths (1978) described the olfactory organs of the echidna as well developed and speculated that olfaction played a role in bringing males and females together. During the breeding season, males approached and sniffed both bags which contained females, or bags in which females had been kept. This finding is a good indication that scent plays an important role in how males find females. Outside of the breeding season, males were not attracted to either an empty bag in which a female had

been or one actually containing a female. On three different occasions while lying on the ground observing a resting train of echidnas, I was able to detect a musky odour which was emitted from the female. When this happened, the males lying next to or within several meters of the female became restless. They stirred from their place of rest and several of them moved closer to the female. The role of pheromones in echidna breeding season deserves further attention.

The mated females in this study laid an egg 15 to 23 days after the males had dispersed. Since males were observed with females for three to four days after mating occurred, the apparent gestation period is between eighteen and twenty-seven days. The latter duration is in agreement with Broom's 1895 surmised gestation period of twenty-seven days, but is longer than Griffiths (1984) observations of an egg-laying some nine and 17 days respectively after a female had been separated from a male.

It has been inferred that a female enters and remains in a burrow to lay and incubate her egg. My findings show that at least some females do not remain continuously in the burrow during incubation period, but actually forage during this time. Further evidence of female activity during incubation of the egg was revealed by Griffiths (1978, pp.241 and pers. comm.). An echidna was captured while trying to escape into a mallee fowl mound. This echidna had an egg in her pouch which hatched nine days later. I have also received two other reports (1975 and 1979) of echidnas found actively foraging with an egg in the pouch (M. McKelvey, pers. comm.).

In 1967 Griffiths determined that the incubation time of an echidna egg was ten days (Griffiths 1968). He was able to more accurately define his findings after further incubations were observed (Griffiths 1978). Observations made in the current study also indicate that free-living Kangaroo Island echidnas incubate their eggs for ten days (see Table 4). When females who had been checked and found to have an empty pouch entered a burrow and remained or returned to it for a period of ten days, they were subsequently captured either out foraging with a egg in the pouch, or had a freshly hatched young in the pouch after leaving the incubation burrow permanently. None of the observed females returned to the incubation burrow after the egg had hatched.

Daily monitoring and behavioural observations have aided in determining some of the the breeding activities of the short-beaked echidna on Kangaroo Island. These data raise more questions related to olfaction, home ranges and population dynamics. There are several basic questions about the reproductive biology of the echidna which remain to be answered. It is still unknown at what age an echidna becomes sexually mature and if the maturity rate of male and female animals is the same. Bennett speculated in 1881 that an echidna may produce only one offspring every second year. This theory has yet to be proven or refuted. Long-term monitoring of known individuals in their natural habitat is providing the answers to these and other related questions.

Conclusions

The formation of trains indicates the onset of courtship for the echidna breeding season on Kangaroo Island. Females probably produce a pheromone which causes male attraction at this time of the year. With copulation the social interaction is terminated and animals return to a solitary lifestyle.

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