CHAPTER THIRTY-FIVE

Orientation and relocation in Short-beaked Echidnas *Tachyglossus aculeatus multiaculeatus*

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Learned or innate orientation ability in animals is an important factor which can influence management strategies for relocation or reintroduction of a species. Short-beaked Echidnas radio-tracked at Pelican Lagoon, Kangaroo Island demonstrate good short-distance orientation within their life ranges. Adults that were moved 500 m outside of life range boundaries returned to familiar areas within 24 h. A lactating female foraged extensively within a 42 ha area and returned via the shortest route to her nursery burrow every five days to suckle her young. Individuals also returned repeatedly, but irregularly, to shelter sites. There is also evidence indicating ability for long-distance orientation in adult Short-beaked Echidnas. A relocated lactating female with a pouch-young travelled over 5 km back to her site of origin. In contrast, subadult echidnas which were relocated 5 km from their site of origin did not show a tendency for long-distance orientation.

Key words: Echidna, Orientation, Relocation, Kangaroo Island.

INTRODUCTION

SHORT-DISTANCE orientation (orientation within an animal's familiar area, including home and life ranges) has been extensively studied in many mammal species (Schmidt-Koenig and Keeton 1978; Ellen and Thinus-Blanc 1987). Interestingly, this fundamental behaviour has never been examined in a monotreme. A number of studies, however, have reported events which indicate good ability for short-distance orientation in the Short-beaked Echidna *Tachyglossus aculeatus* (Griffiths 1968; Griffiths *et al.* 1988; Abensperg-Traun 1991; Augee *et al.* 1992). These authors document that individuals return to shelters, foraging areas or nursery sites within home ranges varying in size from 6 to 192 ha.

Field biologist, Richard Semon, reported in 1894 that echidnas must have a good "ortsinn" (sense of direction). He documented that an escaped echidna travelled 6 km back to its site of capture within 24 hours, indicating an ability for long-distance orientation. Griffiths (1968) reported that an echidna returned to its home range over a distance of more than 5 km within a week of being relocated.

Relocation of echidnas found travelling or foraging in suburban areas has become a concern for animal rescue groups, zoological gardens, sanctuaries and wildlife parks around Australia. Learned or innate abilities of orientation may play a key role in the homing of animals. We present observational and experimental data on both long- and short-distance orientation in Kangaroo Island echidnas and summarize other studies which suggest orientation abilities in echidnas.

MATERIALS AND METHODS

The study site is located on the eastern end of Kangaroo Island, South Australia along the north shore of Pelican Lagoon, a discrete geographical unit comprising a *c.* 1 000 ha peninsula. Much of the region is characterized by large expanses of nearly pristine vegetation. Four distinct habitat types are recognized: woodland, shrubland, grassland and swamp. Mallee (e.g., *Eucalyptus diversifolia*), the shrub *Acacia paradoxa* and Native Iris *Orthrosanthus multiflorus* are characteristic species within this diverse and richly vegetated area. Average yearly rainfall at Pelican Lagoon is 550 mm, most of which falls during the winter months, from June through August.

Since November 1990, 56 echidnas have been individually coloured-coded and sexed within the study site (Rismiller 1992). Mature adults are sexed by palpation and animals with juvenile spurs are considered to be subadults (Rismiller 1993). Aluminium or synthetic cases which house a radio-tracking transmitter (Biotelemetry Tracking and Titley Electronics) are fixed to the spines on the lower back of the animal using a two-component epoxy. Data from 10 echidnas (Table 1), which are part of a larger study of echidna population dynamics, are presented in this chapter.

Ability for short-distance orientation was examined in seven adults by sets of 10 relocation trials. Each animal was first radio-tracked daily for 3–6 months in order to determine its familiar range. During this time shelter sites used by individuals were tagged. In this study, "shelters" were defined as sites with a minimum depth of

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Table 1. Colour-codes, weights and details of life ranges for adult female (F) and male (M) and subadult (SA) echidnas studied on Kangaroo Island.

Animal	Sex	Wt[1] (gm)	Dates[2]	Life range (ha)	Observations[3]
RRC	F	3 000	Aug. 91–Jun. 92	48	300
RTR	F	3 050	Jun. 91–Jun. 92	54	332
WBL	F	3 475	Dec. 90–Jan. 92	42	380
YGSR	M	2 875	Jun. 91–Dec. 92	55	442
WBC	M	2 825	Jun. 91–Dec. 92	50	398
WTL	M	3 525	Jun. 91–Dec. 91	85	153
BTL	M	2 475	Jul. 92–Dec. 92	50	142
YGTL	SA	1 600	Dec. 90–Jun. 92	40	523
LBSR	SA	1 550	Oct. 92–Feb. 93	70	148
GHC	SA	1 800	Dec. 92–Feb. 93	88	109

[1]Weight at start of field study. [2]Time span over which life range was calculated. [3]Number of data points used in calculating life range.

30 cm in which the animal was not visible from the entrance. They included natural caves, fallen tree roots, self-dug burrows and wood or stone piles. These permanent shelters were distinguished from "resting sites" such as tree litter, shallow rocks ledges or fallen tree branches. In five relocation trials, each animal was moved from one area within its range to another *c.* 500 m away. In another five trials, animals were moved across their life range and *c.* 500 m outside of the life range boundaries (Fig. 1). After each relocation, the animal's movements were monitored every 2 to 4 h for 24 h or until it returned to the site of origin.

Three longer distance relocation experiments were also undertaken. In August 1991, an adult echidna was found foraging in an area *c.* 2 km (line-of-sight) west of the research centre base. It was carried in a hessian bag 5 km on foot back to base for sexing and colour-coding. The animal, a female carrying a 54 g pouch young, was tagged RRC (Red Rump Centre) and fitted with a transmitter. During the night she dug out of the holding pen. She was not recaptured, but her movements were monitored closely to test for homing tendencies.

Two other relocation experiments involved subadults which were rescued as road casualties *c.* 4.5 km (December 1990) and 5.5 km (December 1992) from the research centre. Animals were kept 21 and 10 days respectively, until lacerations and the effects of trauma had diminished. Each was colour-coded (YGTL, Yellow-Green Tail Left and GHC, Green Head Centre), fitted with a transmitter and introduced into known echidna foraging areas *c.* 500 and 800 m from the research centre base. Their daily movements were monitored and recorded. Home and life ranges for animals in this study were determined by direct plotting of multiple data points as described by Augee *et al.* (1992). All data were collected between November 1990 and February 1993.

RESULTS

Short-distance orientation

All adult echidnas demonstrated a good capacity for short-distance orientation within their life ranges, which varied in size between 42 and 85 ha (Fig. 2). Moving an animal within its familiar range did not influence daily activity patterns or affect range boundaries. Some individuals remained in the relocated area resting or foraging, while others moved back to their original site within hours. In one incident, RTR was moved 400 m within her home range and travelled 250 m to a known shelter site within 15 min of release. All animals moved 500 m outside the perimeters of their life ranges returned to familiar areas within 24 h, regardless of the translocation direction. Size or boundaries of life ranges were not influenced, nor were animals observed undertaking exploratory trips back into these areas.

As a further indication of their capability for short-distance orientation, individuals returned to and used the same shelter sites over time. There was no regular pattern in shelter site usage, although echidnas occupied shelters more often during the warmer months (November–March) than during the cooler times of year. Table 2 shows shelter usage data for adult echidnas monitored for a minimum of 10 months. The male, YGSR, had only two known shelter sites within his 55 ha life range, both of which were natural limestone caves which branched extensively underground. YGSR was located in one of these two shelters during daylight hours on 25 of 90 days between December and February. Between June and September (82 observations) he was never found in a shelter, but used shallow resting sites during the day and night. Between March and May and October and November (82 and 43 observations, respectively) he was located in a shelter six and three times.

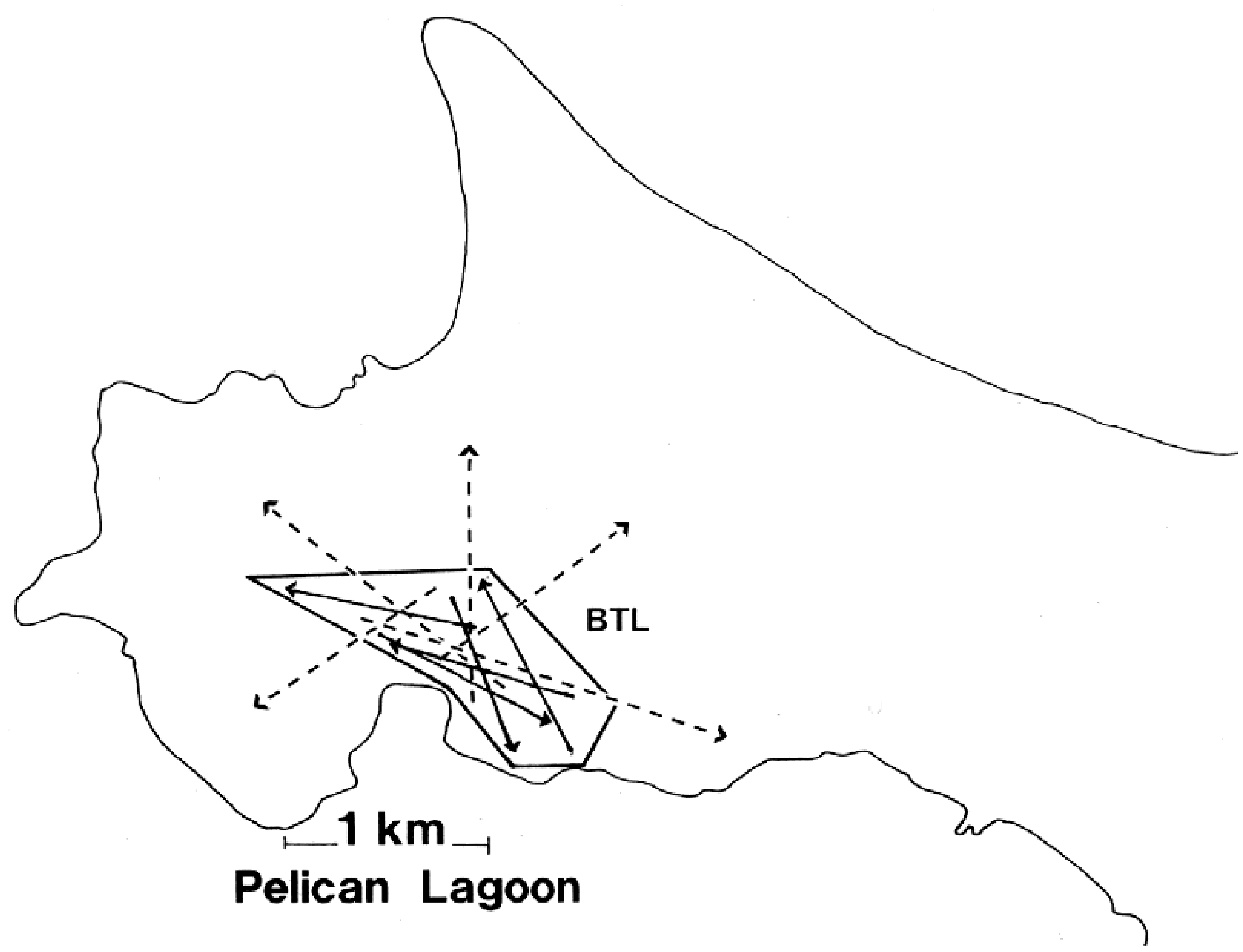

Fig. 1. Distance and direction of relocation experiments to examine short-distance orientation in an adult echidna. Five trials were within the life range (solid lines with arrows) and five were *c.* 500 m outside of the life range perimeter (broken lines with arrows).

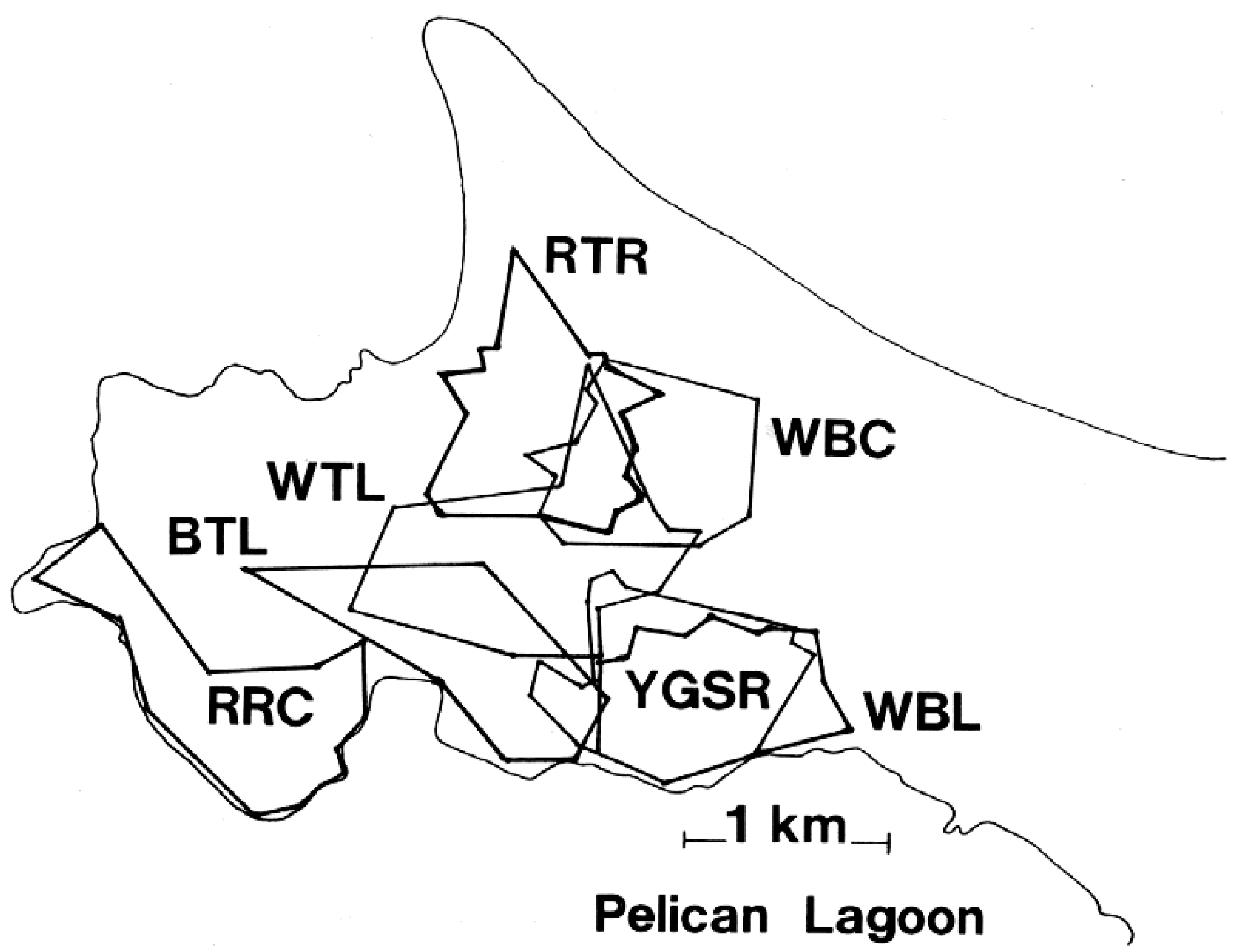

Fig. 2. Life ranges of seven adult echidnas at Pelican Lagoon, Kangaroo Island. Area sizes and number of observations shown in Table 1.

Table 2. Shelter site usage by echidnas monitored for a minimum of 10 months. Number of known shelter sites for each individual (S), number of observations (N) and percentage of observations when animal was located in a shelter (%) at different times of the year.

		Nov.–Mar.		Apr.–Oct.	
Animal	S	N	%	N	%
YGSR	2	125	33	170	3
WBC	5	130	19	162	6
RRC	5	142	22	158	9
RTR	3	150	21	182	5
WBL	1	132	10	170	3

After a lactating female, WBL, was fitted with a transmitter in November 1990, she returned to a suspected nursery burrow every 5 to 6 days during daylight hours. She dug into the burrow, remained for 1 to 2 hours and filled the entrance with dirt again before leaving the site. On December 23, the young was sighted as it was suckled at the burrow entrance. WBL's zigzag foraging movements between suckling periods covered up to 5 km and were never within 50 m of the nursery burrow. Point-to-point movements during December 1990 are shown in Figure 3. In early February 1991, a goanna (*Varanus rosenbergi*) dug into the nursery burrow and injured the young, leading to its death several days later. WBL, who is still being tracked routinely, has never returned to this burrow.

Relocation experiments

After the relocation and subsequent escape of female RRC, she travelled 400 m (line-of-sight) due south to the edge of Pelican Lagoon (Fig. 4). After 48 hours in this area, she travelled 1.5 km (line-of-sight) north-north-west and remained within a 500 m area for the ensuing 10 days. On day 13 RRC travelled south-west, moving 2 km (line-of-sight) in 36 hours and returning to within 50 m of her original capture site. Monitoring over the next 10 months confirmed this point to be well within her life range.

Two relocated subadult echidnas remained within 100 m of the release site for 10 days before beginning exploratory trips. After the first 30 days, YGTL (Fig. 5) had established a home range of 27 ha. In the following 30 days, exploratory trips by YGTL expanded his boundaries to the east and encompassed 33 ha. During the third 30-day period, the area frequented was only 22 ha. The total area explored and used over 18 months of monitoring was 40 ha.

By comparison, during the first 30 days of monitoring, subadult GHC travelled across 76 ha, crossing the peninsula before returning to its release site (Fig. 6). During the next two 30-day periods, exploratory trips by GHC overlapped only slightly outside of this area and were restricted to 30 and 36 ha, respectively. The total range used by this animal in a four month period was 88 ha. Neither of the translocated subadults showed a tendency to undertake long-distance orientation, i.e., to return to their sites of origin.

DISCUSSION

Results reported here indicate that adult echidnas with defined life ranges are capable of short- and long-distance orientation. Range boundaries are not influenced when animals are moved within their familiar area or when relocated a distance of 500 m in any direction outside of the life range boundaries. As further

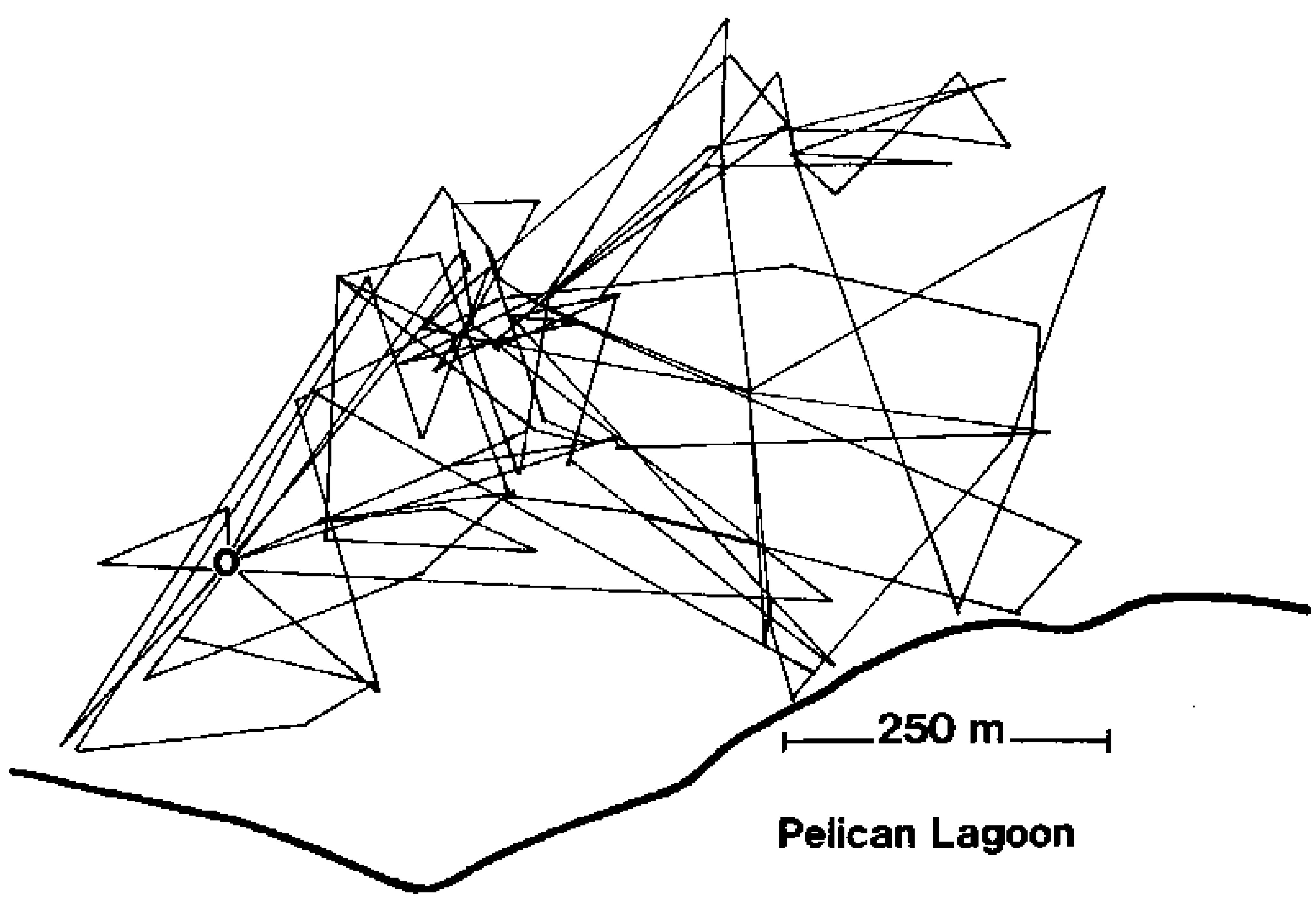

Fig. 3. Daily point-to-point movements of lactating female WBL during December 1990. Open circle (o) denotes location of nursery burrow.

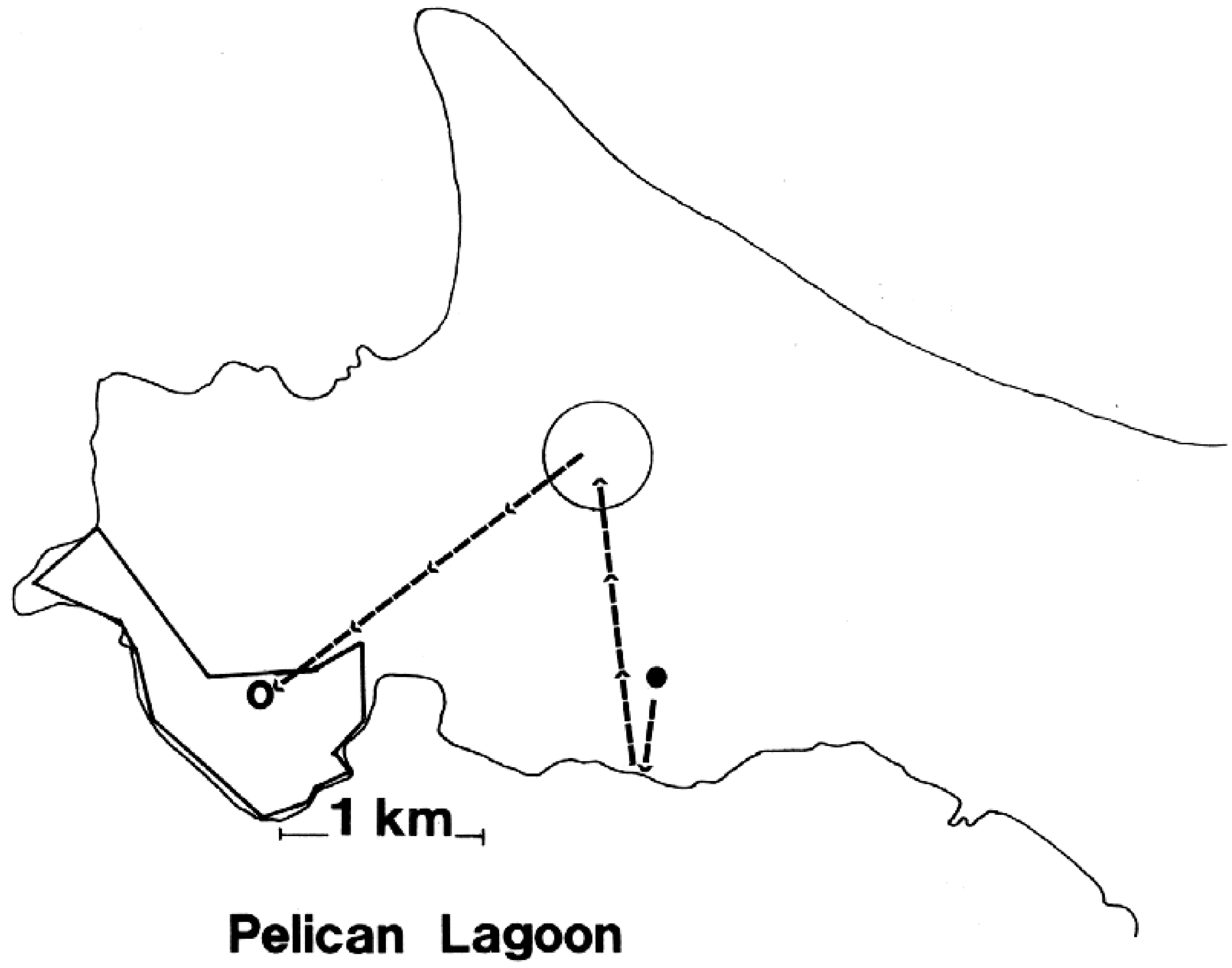

Fig. 4. Lines and arrows showing movements of adult female RRC from relocation site (●) back to site of origin (○). Large open circle shows area of movement during a 10-day period. Heavy line denotes life range.

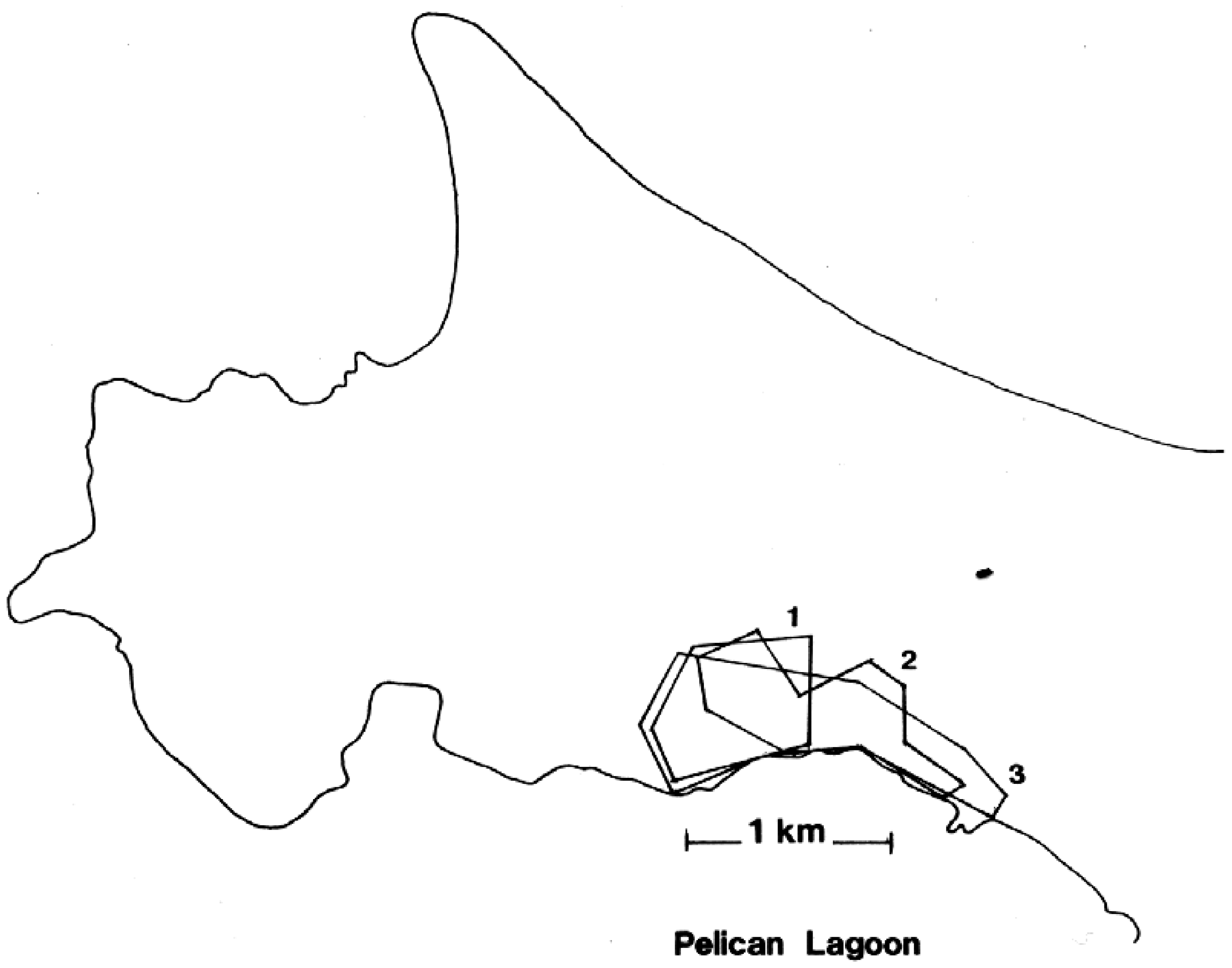

Fig. 5. Perimeters of area explored by relocated subadult YGTL during three consecutive 30-day periods. Numbers indicate the sequence. Dates and number of data points are shown in Table 1.

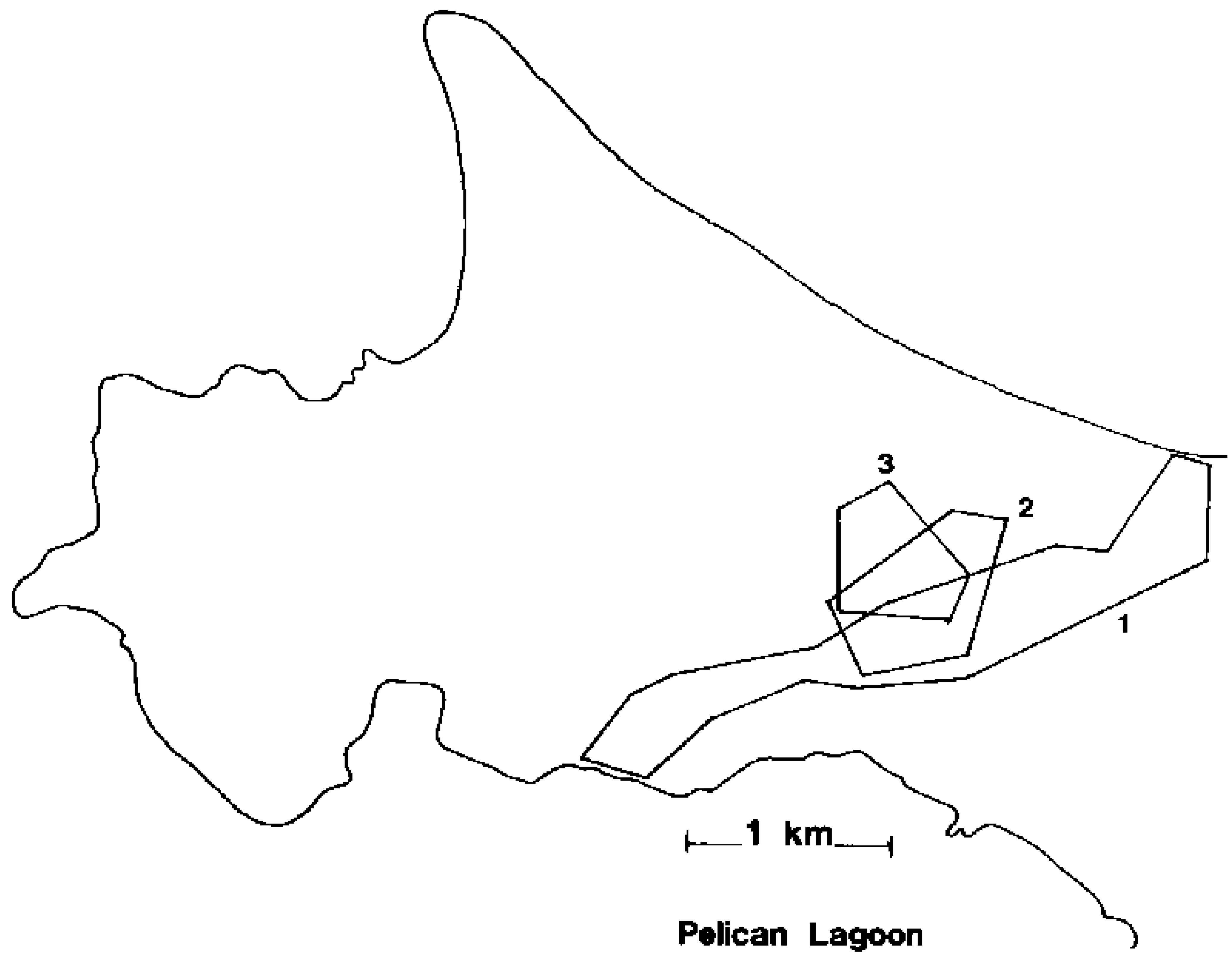

Fig. 6. Perimeters of areas explored by relocated subadult GHC during three consecutive 30-day periods. Numbers indicate the sequence. Dates and number of data points are shown in Table 1.

evidence of ability for short-distance orientation, a lactating female was observed to travel between 1 and 2 km daily, returning to her nursery burrow at intervals of 5–6 days to suckle the young. The female meandered up to 8 km while foraging between suckling periods, but returned to the nursery via a direct route. Griffiths *et al.* (1988) first observed that a lactating female returned to suckle the young at the nursery burrow at intervals of 5–10 days, and documented that she travelled minimum distances of 2 km during these periods. The female had no apparent difficulty in finding her nursery burrow as she made nine visits in 55 days. Beard *et al.* (1992) state that mothers with young return to and use the same burrow for a number of months.

Echidnas randomly use one or more shelter or resting sites within their life range. An incidental finding of this study was that echidnas more frequently used resting sites (60% of these were litter mounds at the base of a mallee) than defined shelters. Our observations are paralleled both by Abensperg-Traun's (1991) report of repeated shelter use by echidnas and findings by Augee *et al.* (1992) that echidnas reuse suitable hibernacula. Another significant indication of short-distance orientation ability is that female echidnas return to the same burrow during the 10-day period of egg incubation (Rismiller 1992).

Aside from Semon's 1894 observation, evidence for long-distance orientation in echidnas is scarce. Our findings show that the adult female RRC travelled over 5 km to return to her life range within 14 days of relocation. Similarly, Griffiths (1968) reported that an echidna transported from Gungahlin to Mt. Majura (5.6 km line-of-sight) in the Australian Capital Territory by a circuitous route was recaptured seven days later in its home territory; another echidna which was translocated was recaptured 148 days and 18.5 km away from its release site. Unfortunately, the initial capture site of the latter animal was unknown. In Western Australia, Abensperg-Traun (1991) recorded that two echidnas ranged 2.5 and 1.7 km away from their observed home ranges, but returned one and two days later, respectively. One echidna visited areas 1.8, 3.7 and 7 km away, always returning to its previous home range.

It is common for animals to make exploratory trips in order to expand their life ranges (Schmidt-Koenig and Keeton 1978; Joslin 1977; Jamon and Bernhamou 1989). Behaviour of subadults indicates that orientation ability may be a trait related to the establishment of a life range. Our observations thus far show that subadults use two different strategies in establishing life ranges, while at the same time increasing their ability for short-distance orientation. Whereas one animal extended the boundaries of its familiar area slowly over a 90-day period, another travelled extensively during the first 30 days and subsequently remained in relatively small home ranges. A subadult found within the study site demonstrated a similar pattern of movement, travelling throughout a 60 ha area

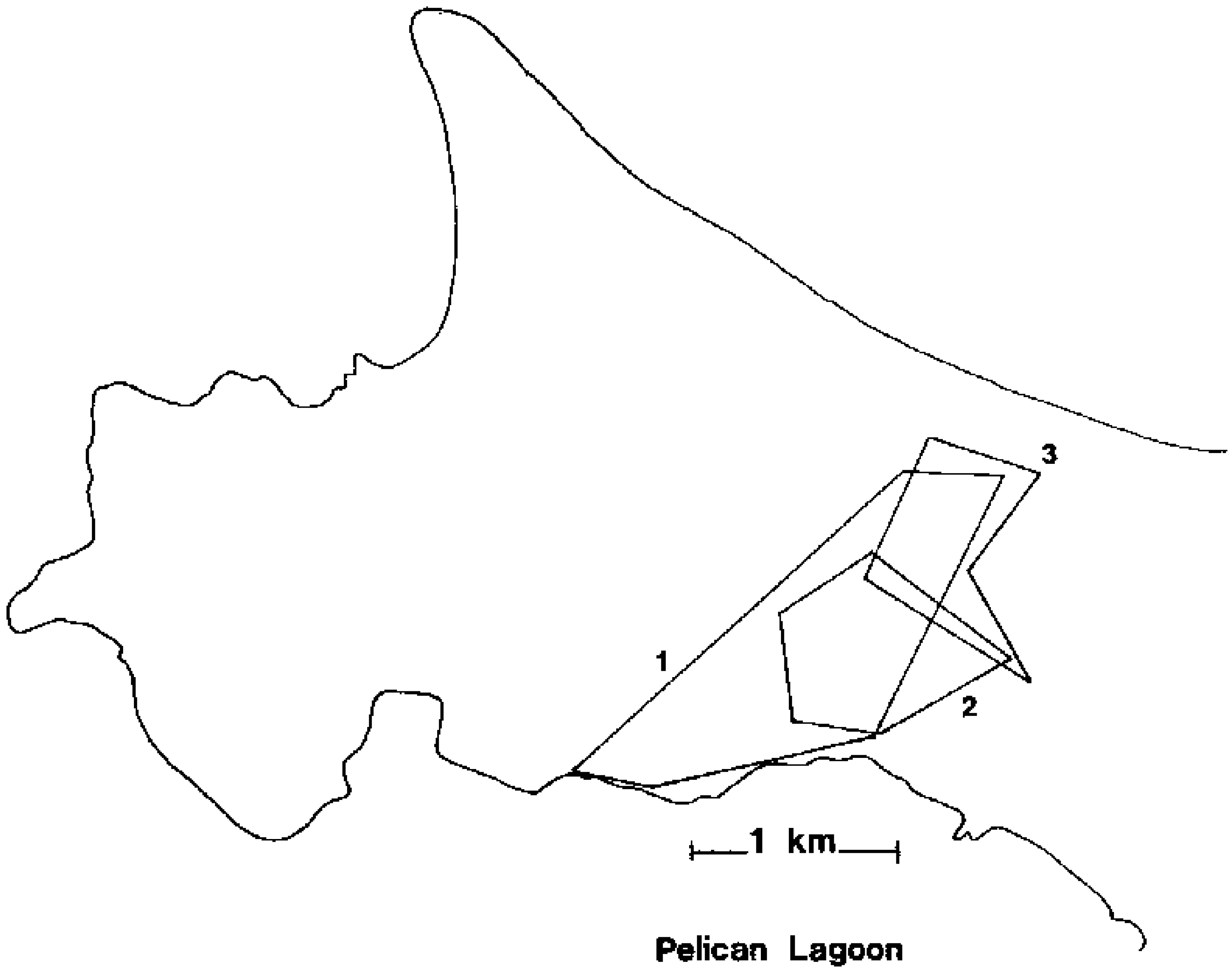

Fig. 7. Establishment of home range areas by subadult LBSR during three consecutive 30-day periods. Numbers indicate the sequence of movements. Dates and number of data points are shown in Table 1.

during the first 30 days and subsequently restricting home ranges to *ca.* 30 ha (Fig. 7). The ability to "home" over a long distance may therefore be a learned trait of experienced adult animals with well-established home ranges.

Considering echidnas may utilize up to 192 ha (Abensperg-Traun 1991) and show good orientation abilities in established life ranges, the best strategy for dealing with echidnas in urban situations may be one of nonintervention. More specifically, suggested guidelines for dealing with animals found in such areas are as follows:

(1) Remove danger of predators (domestic dogs and cats) and allow the echidna free movement out of the area.

(2) If there is danger of road hazard, animals should only be moved a short distance away into nearby woodland, shrubland or paddocks.

(3) Do not jeopardize the life of a young by long-distance relocation of an adult between September and March (Rismiller 1993).

In conclusion, we find that echidnas recognize life range boundaries and are capable of finding nursery burrows, shelters and resting sites therein, thus verifying an ability for short-distance orientation. The size of echidna life ranges varies around Australia, averaging 65 ha in Western Australia (Abensperg-Traun 1991), 42 ha in the Snowy Mountains (Augee *et al.* 1992) and 58 ha on Kangaroo Island (current study). Data thus far indicate that an adult echidna will travel in excess of 5 km to return to its site of origin. Further translocation studies monitoring the daily movements of animals are needed to clarify what distance an adult must be moved before establishment of a new life range overrides the instinct to home. We are currently examining life range establishment in young echidnas in order to help determine how and at what age orientation abilities are acquired. These data will further assist the establishment of conservation and management strategies for echidna relocations and reintroductions.

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