Monotreme Genesis: wildlife care challenges

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Abstract

Rescue, rehabilitation or hand rearing of echidnas presents special challenges to wildlife carers. The monotreme genesis resulted in a current mammalian family that is older than any other group of mammals, with species that have unique biological characteristics. Although platypus and echidnas are closest relatives, there are still vast differences in their general life histories, foraging habits, reproductive strategies and physiology. One attribute they share is low body temperature, compared to marsupials or placentals. Most native mammals that come into care have a body temperature of 36-37°C. The active body temperature of platypus and echidnas is 31-33°C. Here their similarity ends. Whereas platypus maintain their body temperature, that of an echidna can vary from 5 to 33°C.

Echidnas use torpor at any time of the day and in any season. Torpor is defined as an energy saving mechanism by which an animal lowers body temperature, heart rate, metabolism and respiration. An echidna that presents as lethargic, cool to the touch or non-responsive may be torpid due to stress, trauma or simply as part of its daily inactive period. Recognising and understanding these conditions is critical to successful rescue and rehabilitation of an injured echidna and in the hand rearing of young. Documenting behaviour of wild echidnas has provided facts for addressing the body temperature paradox and other challenges of echidna rescue, rehabilitation and hand rearing.

Materials and Methods

Research area and animals. -The primary study site is on the eastern end of Kangaroo Island, South Australia. The Pelican Lagoon peninsula (35°47'S, 137°47'E) is a discrete geographical unit comprised ca. 1,000 ha. Much of the region is characterized by large expanses of near pristine vegetation. A key to the island's intact ecosystems is the lack of rabbits (*Oryctolagus*) and foxes (*Vulpes*). There are five distinct habitat types in this study area: woodland, shrubland, grassland, fresh water, and tidal swamp.

Between 1988 and 2018, 70 adult echidnas (25 females, 45 males) have been found and microchipped in this study area. Yearly, between 10 and 20 individuals have been radio tracked, sometimes on a daily basis throughout the year. Reproductive behavior, foraging habits and home ranges have been documented. Twelve individuals had implants for recording body temperature for 12-month periods.

Over the past 30 years I have observed, recorded and lived with free ranging wild echidnas in their natural environment. I have rehabilitated numerous injured (mainly vehicle strike) echidnas, examined hundreds of dead animals, successfully hand reared and released orphaned puggles and given workshops to numerous wildlife care groups on the rescue, rehabilitation and care of short-beaked echidnas.

Results

Tens of thousands of hours spent observing and documenting life histories of echidnas in the wild has resulted in a massive data base of new information about echidna physiology, behavior and basic biology. Of particular importance to wildlife carers is how echidnas cope with stress and extreme environmental conditions. Additional major issues are understanding, acknowledging and practising as natural as possible hand rearing methods as have been documented in free ranging animals. At the core of these issues is the low operative and variable body temperature that is part of the echidna genesis.

Discussion

What makes echidna body temperature so exceptional? Short-beaked echidnas have the lowest, most variable body temperature of all mammals. The intrigue with echidna body temperature started in 1879 when Brisbane based scientist, Nicolai de Miklouho-Maclay, obtained two *Echidna hystrix* for brain study. Before euthanising the first specimen he inserted a thermometer in the cloaca and found a surprisingly low 28°C. Believing that the large opening of the cloaca had interfered with the correctness of the observation, he made an incision just large enough to insert the ball of the thermometer into the abdominal cavity. After 10 minutes it registered 30°C. Not satisfied with this observation because it was much below the known average body temperature of mammals, he repeated the observation on the other specimens and found temperatures of 26°C. (Miklouho-Maclay 1883).

These observations triggered an ongoing interest in echidna body temperature and this area remains the most studied aspect of echidna physiology. With advancements in technology, research on echidna body temperature moved out of the laboratory and into the natural environment. It is well documented and now accepted that the normal active body temperature of an echidna is 30 to 33°C. If exposed to higher temperatures over a period of time and the body temperature elevates above 34°C, an echidna can heat stress and die (Schmidt-Nielsen et al. 1966).

What is torpor?

Torpor describes a state when the body temperature, metabolism, respiration and heart rate are lowered. It is sometimes referred to as an energy saving mechanism. Echidnas regularly use torpor, but its closest relative, the platypus, does not. It is not necessarily a response to cold. On Kangaroo Island echidnas may use torpor at any time of the day and year (Rismiller 1992, 1999). Use of torpor is individualistic. Extended use of torpor is sometimes referred to as hibernation. In Tasmania, one group of echidnas studied not only showed extended periods of lowered body temperature, but body temperature indicated when a female was going to lay her egg (Nicol and Andersen 2004, 2006; Nicol et al. 2004). During hibernation echidnas have lowered body temperature to 4°C and reduced heart rate to 4 beats per minute (Augee et al 2006).

Echidnas are also known to let their body temperature lower passively during daily inactivity and have been observed basking, with their spines spread, early in the morning (personal observation).

How can an understanding of echidna behaviour and body temperature be applied to wildlife care?

1) Torpor, ie lowered body temperature, heart rate and respiration can be a natural response to trauma and stress. Ability to lower body temperature can facilitate healing.
2) Injured echidnas should not be placed on hot water bottles, heat pads or under heat lamps.

3) It is not unusual for an injured echidna to remain in a ball for several days and refuse all food or water for over a week.

Temperature, reproduction and care of the young

In general, echidnas breed during the winter/cooler months (June – August). Studies in various parts of Australia (Table 1) show the exact timing and duration of the breeding season varied slightly from region to region. At the lowest latitude (Tasmania, 42°S) echidnas mated over a period of 65 days, starting on 23 June. At the most northerly study site, south-east Queensland (28°S), mating occurred over 31 days, but did not commence until 1 August. Mating durations at the 35°S, Kangaroo Island, and 36°S, Kosciusko sites were 45 and 36 days, respectively. Breeding at these 2 locations overlapped by only one day, ending on Kangaroo Island and beginning at the Kosciusko site on 30 July.

Table 1. Field study sites in Australia where echidna matings have been verified by observation of actual mating or presence of a young.

Location	Lat/Long	Elevation	n	Source
South-east Queensland	27°28'S 153°02'E	300-600 m	7	Beard and Grigg 2000
Kangaroo Island, SA	35°47'S 137°47'E	0-60 m	17	Rismiller 1992 Rismiller and McKelvey 2000
Kosciusko, NSW	36°10'S 148°15'E	1000-1750 m	5	Beard et al. 1992
Tasmania	42°25'S 147°14'E	200-300 m	10	Nicol et al. 2004

Females lay a single egg directly into the pouch after a gestation period of 22 days (Rismiller and McKelvey 2000). It hatches after 10.5 days (Griffiths 1978). The size of the puggle at hatching is between 270 - 328 mg (Rismiller and McKelvey 2000). A way to relate to this minuscule size is to hold an Australian 5 cent coin in your hand and remember it talks 8 newly hatched echidnas to weight as much as the coin. The puggle has no teat to attach to, but clings with its well-developed front legs to the hairs on the mother's belly. The milk patches are located on either side of the pouch approximately where one would expect a teat or a nipple to be. The young suckle at the milk patches, it does not lick. Echidna milk is rich in fat and protein and the young grow rapidly (Rismiller and McKelvey 2003). Temperature in the female's pouch while carrying the egg and/or puggle is 2 - 5°C lower than her body temperature.

Depending on the body mass/size of the female the puggle will be carried for between 45 and 55 days before being placed in a specially dug nursery burrow. A nursery burrow can be dug just about anywhere (Rismiller and McKelvey 2009). Once inside the nursery, the life of the young changes dramatically. It goes from clinging to the warm belly of its mother and having access to the milk patch at all times to being left alone in a cool (15 - 18°C) chamber (Rismiller 2008).

After discovering active nursery burrows it took additional hundreds of hours to conclusively determine that females return to suckle their young for only 2 hours once every 5 days (Rismiller 1999; Rismiller and McKelvey 2009). On a number of occasions over the past 30 years we had the opportunity to access the nursery chamber, check the temperature and weigh the young before and after the mother had visited. We discovered that 1) young were cool to the touch and sluggish prior to feeding, 2) young ingested between 10 to 40% of their own body mass in any one feeding session 3) young were often torpid between feeding sessions and 4) once in the burrow, young grew at different rates depending on the body mass of the mother (Rismiller and McKelvey 2003; Rismiller 2008). Regardless of body mass, young are weaned at about 7 months of age with small mothers weaning small young and larger mothers weaning larger young. At weaning the female opens the burrow, suckles the young and rarely returns. There is no mother/offspring relationship or teaching the young what to eat and where to go.

How can understanding temperature assist with rescue and hand rearing of young?

1) When hand rearing pouch young, temperature for housing should range between 20-29°C, if possible imitating the natural fluctuation in the mother's pouch.
2) Housing for burrow young should be maintained at 15 – (max) 20°C to allow the young to lower its body temperature and sleep (go torpid) between its 5 day feeding period.

Why care about temperature and feeding frequencies when hand rearing?

1) Hand rearing experiences shared by other wildlife carers show that deviations from as natural as possible temperature and feeding patterns have resulted in death of the young.
2) Temperature and feeding intervals affect the development of young, including internal organs and immune system. Both are essential for functional physiology and natural longevity.

Conclusions

Because echidnas are one of the earliest and longest surviving mammals, they are different in many ways. Their body temperature and use of variable body temperature means their physiology is different from any other native Australian mammal. Acknowledging and understanding this one difference is vital for the well-being and welfare of an echidna during rescue, care and hand rearing. Field studies on free ranging echidna populations provide useful guidelines for wildlife carers.

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