Platypus Burrow Temperatures at a Subalpine Tasmanian Lake

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Bethge, P., Munks, S., Otley, H. and Nicol, S. (2004). Platypus burrow temperatures at a subalpine Tasmanian lake. *Proceedings of the Linnean Society of New South Wales* **125**, 273-276.

When platypuses are in their burrows, microhabitat is of great importance for energy conservation, especially where air temperatures frequently fall below freezing in winter. In this study, we investigated burrow temperatures of platypuses (*Ornithorhynchus anatinus*) living at a sub-alpine Tasmanian lake. Nine individual platypuses were equipped with time-depth recorders with integrated temperature sensors measuring ambient temperature. Burrow temperatures were recorded in two minute intervals for a total of 61 resting periods (duration: 5.45 to 27.20 hours) and were averaged over the period of resting. Mean burrow temperatures were 17.5 and 14.2°C (SD=2.76 and 0.89, respectively, n=9) in summer and winter, respectively, and ranged between 12.2 and 22.8°C for individual resting periods. In winter, burrow temperatures were held fairly constant over the resting period while in summer larger variations were observed. Burrow temperature in winter was found to be up to 18°C higher than outside air temperature.

Manuscript received 26 November 2003, accepted for publication 8 January 2004.

Key words: Burrow temperature, Energetics, *Ornithorhynchus anatinus*, Platypus, Tasmania

INTRODUCTION

The platypus, *Ornithorhynchus anatinus*, inhabits the lakes, rivers and streams of eastern Australia from the Cooktown area in the north to Tasmania in the south. Over much of its range, the animal is found in alpine and tableland areas where, especially in winter, air temperatues fall well below freezing and water temperatures approach 0°C (Grant 1995). Grant (1983a) suggested that under such conditions, the microhabitat of platypus burrows is of great importance for energy conservation. Even in an unoccupied artificial burrow the insulation of layers of earth was found to provide significant buffering effect against outside ambient temperature changes both in winter and in summer (Grant 1976). (Grant 1983b) suggested a further modifying effect of the animal's presence on the microhabitat temperature, elevating it several degrees above that of an unoccupied burrow.

In this study ambient temperatures in occupied platypus burrows at a sub-alpine Tasmanian lake were investigated. The use of time-depth recorders with integrated temperature sensors made it possible to determine burrow temperatures during naturally occuring resting periods of the equipped animals.

MATERIALS AND METHODS

Field experiments were carried out at Lake Lea (41°30′ S, 146°50′ E), a sub-alpine lake in northwestern Tasmania. Information on burrow temperatures was obtained from nine individual platypuses (4 adult males, mass: 2.27 kg ± 0.26 (SD), 5 adult females, mass 1.48 kg ± 0.07 (SD)) between November 1998 and January 2000. Platypuses were captured and processed following the methods outlined in Otley et al. (2000) and Bethge et al. (2003). Individuals were equipped with combined data logger-transmitter packages (max 62 mm x 28 mm x 18 mm, weight 50 g, Fig. 1) consisting of a specially designed standard transmitter (Faunatech, Eltham, Victoria) and a time-depth recorder (LTD 10, Lotek Inc., Canada). The packages were attached with glue (5 min-Araldite, Selleys Inc., Australia) to the guard fur of the lower back of the animals, just above the tail, following the method outlined in Serena (1994). Animals were released at the site of capture. After approximately two weeks the animals were relocated by radiotracking and recaptured on emergence and the devices were removed.

The data loggers allowed measurement of ambient temperature in the range from 2 to 25°C with

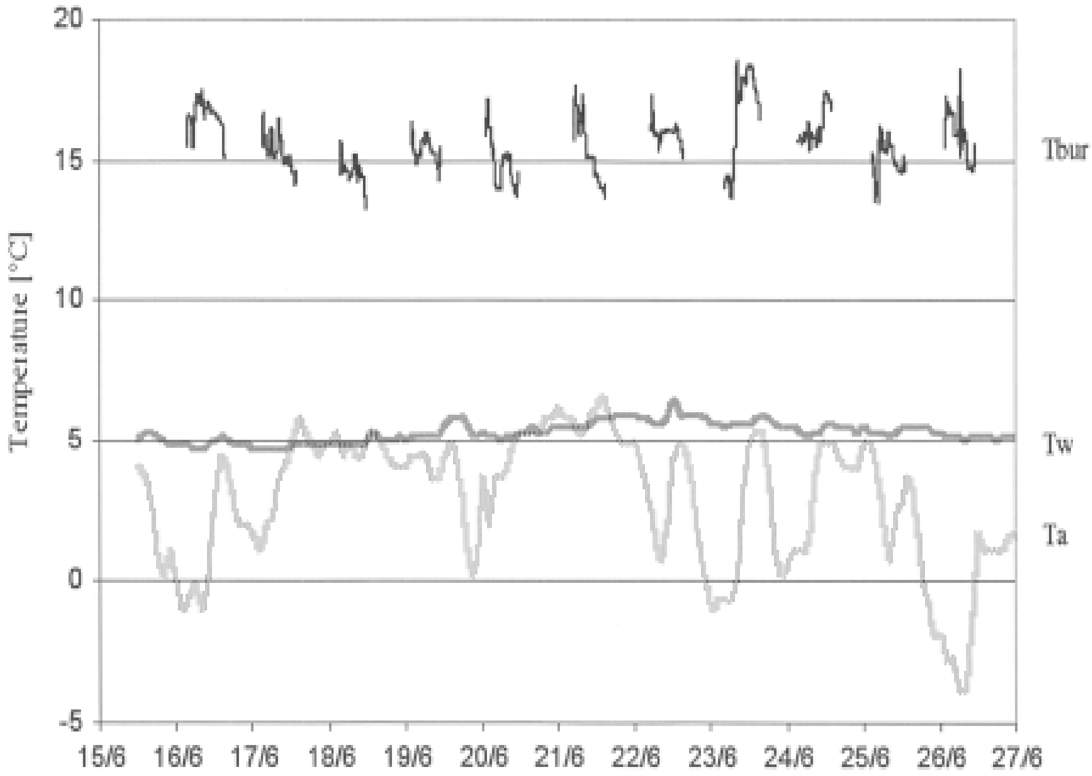

Figure 1: Winter sample data of water (Tw), air (Ta) and burrow temperatures (Tbur, derived from a time-depth recorder with integrated temperature sensor fitted to the back of a platypus; the temperature is only shown at times when the animal was in the burrow).

an accuracy of 0.06°C. The devices were calibrated by the manufacturer (Equipment for temperature-calibration: Neslab RTE-2000 Bath/Circulator and Omega HH40 Thermistor/Thermometer). Temperature sensors were located at the back end of the devices and were facing backwards when the devices were fixed on the platypus's lower backs. Ambient temperature was measured in two-minute intervals for 11 days each. While foraging, the sensors measured water temperatures. In resting platypuses, ambient temperatures close to the animals' bodies (approx. 5 mm from above the fur) were recorded. The resting period was defined as the time span between the end of the last dive of a foraging trip (detected by the depth sensor of the time-depth recorders) and the beginning of the first dive of the following foraging trip. Burrow temperatures, i.e. ambient temperatures during resting periods, were recorded in two minute intervals for a total of 61 resting periods and were averaged over the period of resting. Resting periods ranged from 5.45 to 27.20 hours.

All investigated platypuses occupied burrows in consolidated steep or gently sloping earth banks of the lake or along associated creeks. Water and air temperatures at Lake Lea were recorded in two-hour intervals using archival tags (HOBO Thermocouple logger and Stowaway Temperature Logger, Onset Computer Corp., USA). Water temperature was measured in the lake while air temperature was taken in a wind shaded forest patch nearby.

RESULTS

Mean burrow temperatures were 17.5 and 14.2°C (SD=2.76 and 0.89, respectively, n=9) in summer and winter, respectively, and ranged between 12.2 and 22.8°C for individual resting periods. In winter, burrow temperature was held fairly constant over the resting period while in summer larger variations were observed. A low but significant correlation between air temperature and burrow temperature was found with higher air temperatures resulting in higher burrow temperatures ($p=0.003$, $n=61$). Ambient air temperatures ranged between -4°C and 31°C and water temperatures between 0°C and 29°C depending on season. Samples of measured burrow temperatures and corresponding air and water temperatures are shown in Fig. 1 and Fig. 2 for winter and summer, respectively.

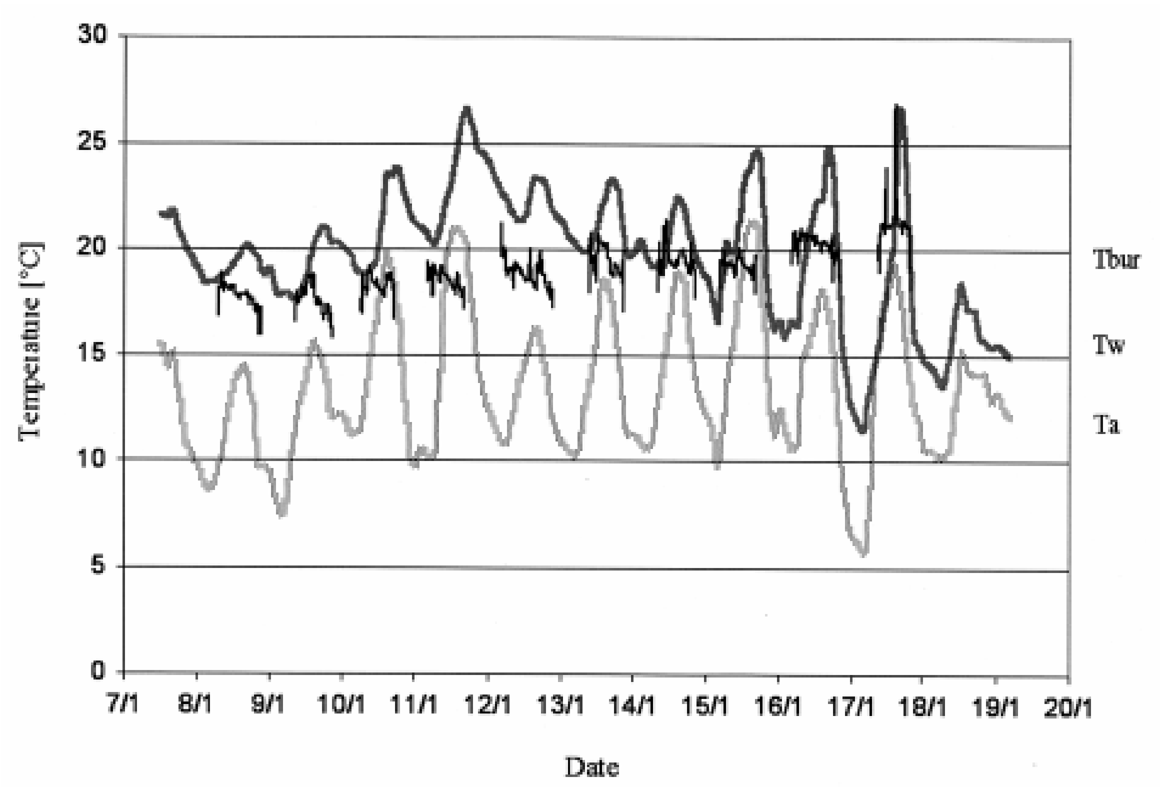

Figure 2: Summer sample data of water (Tw), air (Ta) and burrow temperatures (Tbur, derived from a time-depth recorder with integrated temperature sensor fitted to the back of a platypus; the temperature is only shown at times when the animal was in the burrow).

DISCUSSION

Grant (1983b) suggested that platypus burrows act as microenvironments, buffering the animals against the rigours of below-freezing air temperatures in winter, and modifying the effects of high summer temperatures. Accordingly, we found that in winter, burrow temperatures at Lake Lea were up to 18°C higher than outside air temperatures (Fig. 1). In summer, the burrows at Lake Lea clearly buffered high midday temperatures of over 25°C (Fig. 2). These findings are in line with results by Grant (1976) and Munks (personal communication). In winter, unoccupied artificial burrow temperatures in the upper Shoalhaven River, NSW, averaged around 14°C (this study: 14.2°C) despite the fact that ambient air temperatures dropped as low as -5°C. During summer the temperature of an unoccupied artificial burrow averaged around 18°C (this study: 17.5°C) with air and water temperatures being several degrees higher (Grant 1976, Grant 1995). Munks (personal communication), while monitoring the burrow of a breeding platypus in lowland Tasmania, recorded a mean burrow temperature of 16.5°C (range 12.5 to 20°C) during late summer/early autumn.

The consistency of these data from different sites suggests that platypus burrow temperatures are fairly constant regardless of habitat. Whether this is a consequence of the metabolic heat produced by the animals or mainly of physical characteristics of their burrows, remains unclear. Results of Grant (1976) from unoccupied burrows are in line with findings presented here from occupied burrows. This suggests that - at least in burrows located in consolidated earth banks - physical characteristics of the burrow are more important for burrow temperature than the absence or presence of the animal. This view is supported by the significant correlation between air temperature and burrow temperature found in this study.

However, Munks (personal communication) reported peak burrow temperatures when the mother returned to the nest to suckle her young. Also, Grant (1983b) suggested that the animal's presence further elevates the microhabitat temperature of the burrow. In captivity, Grant (1976) observed, that the temperature in an uninsulated plywood nest box rose around 1 to 2°C above ambient temperature when an animal was inside.

We suggest that these different observation are a consequence of different burrow characteristics. In this study, all investigated platypuses occupied burrows in consolidated earth banks. Under such conditions, the insulation properties of the surrounding earth and of the nesting material inside the burrow are most likely the main factors determining burrow temperature. A fairly constant burrow temperature may of course be more critical during the breeding period (Grant, personal communication), which makes deep earth burrows ideal for nesting.

A different situation, however, might occur in burrows, which are closer to the surface or above ground. Otley et al. (2000) reported that 25 % of burrows at Lake Lea were located within dense vegetation, such as sphagnum and button grass. The insulation properties of such burrows would be expected to be poor compared to underground earth burrows. How animals cope with high thermal stress in vegetation burrows and if they use this sort of burrow site regardless of season or even during nesting requires further investigation.

ACKNOWLEDGMENTS

This work was supported by the Australian Research Council, an Overseas Postgraduate Research scholarship by the University of Tasmania and a doctoral scholarship by the DAAD (Deutscher Akademischer Austauschdienst, Germany ‚Hochschulsonderprogramm III von Bund und Ländern‘). The field work was carried out under permit from the Department of Parks, Wildlife and Heritage, Tasmania, the Inland Fisheries Commission, Tasmania and the University of Tasmania Ethics Committee. Thanks to all those who assisted with the field work and to Mr H.Burrows for access to private land.

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