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**Energetics and foraging  
behaviour of the Platypus  
*Ornithorhynchus anatinus***

by  
Philip Bethge (Dipl.-Biol.)

Submitted in fulfilment of the  
requirements for the Degree of  
Doctor of Philosophy

University of Tasmania, April 2002

***Declaration of originality***

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*For Tom, Louise, Karl, Albert, Eric,  
Fritz, Gerda, Hilde,  
Isolde, Julia, Konrad, Lydia*

**Abstract**

In this work, behavioural field studies and metabolic studies in the laboratory were conducted to elucidate the extent of adaptation of the platypus *Ornithorhynchus anatinus* to its highly specialised semiaquatic lifestyle. Energy requirements of platypuses foraging, resting and walking were measured in a swim tank and on a conventional treadmill using flow-through respirometry. Foraging behaviour and activity pattern of platypuses in the wild were investigated at a sub-alpine Tasmanian lake where individuals were equipped with combined data-logger-transmitter packages measuring foraging activity or dive depth and ambient temperature.

Energy requirements while foraging in the laboratory were found to depend on water temperature, body mass and dive duration and averaged  $8.48 \text{ W kg}^{-1}$ . Mean rate for subsurface swimming was  $6.71 \text{ W kg}^{-1}$ . Minimum cost of transport for subsurface swimming platypuses was  $1.85 \text{ J N}^{-1}\text{m}^{-1}$  at a speed of  $0.4 \text{ m s}^{-1}$ . The metabolic rate of platypuses resting on the water surface was  $3.91 \text{ W kg}^{-1}$  while minimal RMR on land was  $2.08 \text{ W kg}^{-1}$ . The metabolic rate for walking was  $8.80$  and  $10.56 \text{ W kg}^{-1}$  at speeds of  $0.2$  and  $0.3 \text{ m s}^{-1}$ , respectively. Minimal cost of transport for walking was predicted to be  $2.13 \text{ J N}^{-1}\text{m}^{-1}$  at a speed of  $1.7 \text{ m s}^{-1}$ . A formula was derived, which allows prediction of power requirements of platypuses in the wild from measurements of body mass, dive duration and water temperature.

Activity patterns of platypuses in the wild were highly variable. Forty percent of the platypuses studied showed patterns, which deviated considerably from the nocturnal pattern generally reported for the species. Some animals showed diurnal rhythms while others temporarily followed the lunar cycle. Foraging trips lasted for an average of  $12.4 \text{ h}$  of continuous foraging activity per day (maximum:  $29.8$  hours). There were significant differences in diving behaviour between sexes and seasons. Activity levels were highest between August and November and lowest in January.

While foraging, platypuses followed a model of optimised recovery time, the optimal breathing theory. Mean dive duration was  $31.3$  seconds with  $72 \%$

of all dives lasting between 18 and 40 seconds. Mean surface duration was 10.1 seconds. Mean dive depth was 1.28 m with a maximum of 8.77 m. Up to 1600 dives per foraging trip with a mean of 75 dives per hour were performed. Only 15 % of all dives were found to exceed the estimated aerobic dive limit of 40 seconds indicating mainly aerobic diving in the species. Total bottom duration per day was proposed as a useful indicator of foraging efficiency and hence habitat quality in the species.

In contrast to observations made earlier in rivers, temporal separation was found to play a vital role for social organisation of platypuses in the lake system that was investigated. It is suggested that high intra-specific competition as well as limited burrow sites and a limited number of at the same time highly productive foraging locations were responsible for this observation. Mean burrow temperature in the wild was 17.5 and 14.2°C in summer and winter, respectively, and was fairly constant over the platypus's resting period. In the cooler months, burrow temperature was up to 18°C higher than ambient air temperature.

By combining both field and laboratory data, a time-energy budget for the platypus was created. Mean field metabolic rate was 684 kJ kg<sup>-1</sup> day<sup>-1</sup> and was significantly higher in the winter months. Mean food requirement was 132 g fresh matter kg<sup>-1</sup> day<sup>-1</sup>. Feeding rates were 68 % higher in winter than in summer.

While platypuses in the swim tank were found to expend energy at only half the rate of semiaquatic eutherians of comparable body size, cost of transport at optimal speed as well as field metabolic rates were in line with findings for eutherians. These patterns suggest that locomotor efficiency of semiaquatic mammals might have reached a limit for energetic optimisation. The semiaquatic lifestyle seems to pose comparable energetic hurdles for mammals regardless of their phylogenetic origin.

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## **Table of contents**

<i>Abstract</i> .....	5
<i>Acknowledgments</i> .....	7
<i>Table of contents</i> .....	9
<b>1 General introduction and aims</b> .....	<b>13</b>
<b>2 Study areas, animal details and general field methods</b> .....	<b>19</b>
2.1 Study Areas.....	19
2.1.1 Salmon Ponds / Plenty River, southeast Tasmania.....	19
2.1.2 Lake Lea, northwest Tasmania .....	21
2.2 Field methods and animals .....	26
2.2.1 General capture and handling methods.....	26
2.2.2 Salmon Ponds animal details .....	28
2.2.3 Lake Lea animal details .....	30
2.2.4 Comparison between habitats .....	35
<b>3 Maintenance of platypuses in captivity</b> .....	<b>37</b>
3.1 Introduction.....	37
3.2 Captive methods .....	38
3.2.1 Animal details, maintenance and food.....	38
3.2.2 Swim tank details.....	38
3.3 Results.....	40
3.4 Discussion .....	43

<b>4</b>	<b><i>Energetics of foraging and resting in the platypus</i></b>	<b>46</b>
4.1	Introduction	46
4.2	Materials and methods	47
4.2.1	Experimental setup	47
4.2.2	Data Analysis	48
4.3	Results	50
4.3.1	Resting metabolic rate in water and on land	50
4.3.2	Metabolic rate for foraging and subsurface swimming	51
4.4	Discussion	55
4.4.1	Instrument and experimental effects	55
4.4.2	Resting metabolic rates	56
4.4.3	Metabolic rates for diving and foraging	58
4.4.4	Cost of transport for under water swimming	59
4.4.5	Comparison with other mammalian swimmers	62
<b>5</b>	<b><i>Energetics of walking in the platypus</i></b>	<b>67</b>
5.1	Introduction	67
5.2	Materials and methods	68
5.3	Results	68
5.4	Discussion	69
5.4.1	Metabolic rate and cost of transport for walking	69
5.4.2	Comparison with other mammalian walkers	71

<b>6</b>	<b><i>Foraging behaviour and activity pattern of platypuses in a sub -alpine lake.....</i></b>	<b>73</b>
6.1	Introduction.....	73
6.2	Materials and methods .....	75
6.2.1	Experimental setup .....	75
6.2.2	Data-logger details and data analysis .....	80
6.3	Results.....	83
6.3.1	Diving pattern .....	83
6.3.2	Activity pattern .....	91
	Foraging duration .....	91
	Foraging pattern .....	92
	Temporal activity pattern .....	95
6.3.3	Behavioural observations and population dynamics .....	102
6.4	Discussion .....	107
6.4.1	Instrumental and experimental effect .....	107
6.4.2	Dive and surface durations .....	108
6.4.3	The organisation of the dive cycle and dive depth .....	109
6.4.4	Seasonal differences in diving behaviour .....	113
6.4.5	Foraging efficiency and dive/surface duration ratios .....	114
6.4.6	Gender differences in diving behaviour .....	116
6.4.7	Maximum dive times .....	117
6.4.8	Aerobic dive limit .....	119
6.4.9	Active period and foraging duration.....	123
6.4.10	Inactivity .....	126
6.4.11	Rhythm and activity pattern.....	127
6.4.12	Social interaction between individuals and spatial separation .....	131
6.4.13	Temporal separation .....	135
6.4.14	Seasonal differences in activity pattern .....	139

<b>7</b>	<b><i>Platypus burrow temperatures.....</i></b>	<b>142</b>
7.1	Introduction and Methods.....	142
7.2	Results.....	143
7.3	Discussion.....	143
<b>8</b>	<b><i>Metabolic rates of free-living platypuses.....</i></b>	<b>146</b>
8.1	Introduction and methods .....	146
8.2	Results.....	149
8.3	Discussion .....	150
8.3.1	Field metabolic rates.....	150
8.3.2	Platypus food requirements and catch per dive .....	153
8.3.3	Comparison with other semiaquatic mammals .....	154
<b>9</b>	<b><i>Conclusions .....</i></b>	<b>157</b>
9.1	Time-energy budget and comparison of methodologies.....	157
9.2	Activity pattern of free-living platypuses .....	158
9.3	Energetics of the platypus.....	160
	<b><i>Tables, Figures and Photos .....</i></b>	<b>163</b>
	<b><i>Appendix A: Field data, Actograms .....</i></b>	<b>167</b>
	<b><i>Appendix B-1: Platypus Energetics: Statistics.....</i></b>	<b>204</b>
	<b><i>Appendix B-2: Behavioural activity of the Platypus: Statistics.....</i></b>	<b>207</b>
	<b><i>Appendix C: Technical supplier contact details .....</i></b>	<b>213</b>
	<b><i>Bibliography .....</i></b>	<b>214</b>