Bio-logging 4 Workshop

Multivariate biologging: ensuring accuracy in describing animal energy budgets

Organisers:
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Proposed Dates:
Saturday 12 March 2011 from 09:00 to 16:00

Venue
University Club, University of Tasmania, Churchill Avenue

Cost
$30 per head, includes morning and afternoon refreshments and lunch

Workshop aim and objectives:
Energy is a primary requirement for an animal to function and its use within an animal is important in understanding certain aspects of animal behaviour, range limitation, and physiological adaptation to (changing) environments.

In the laboratory, energy is easily measured via direct or indirect calorimetry. Indirect calorimetry in the form of rate of oxygen consumption is often used to measure metabolic rate of an animal that is inside a chamber or fitted with a mask over its mouth and nostrils. Clearly, such an approach is not feasible or practical in a free ranging animal.

Heart rate (HR), is reasonably easy to record, and is related to the rate of oxygen consumption ($\dot{M}O_2$) by the Fick principle for convection for the cardiovascular system. Data storage devices have been developed and used that can store HR for up to a year, but it is important to demonstrate that the value of HR obtained from the device is accurate. Recent evidence has demonstrated that it is essential that the HR-$\dot{M}O_2$ relationship is calibrated using wild or recently-caught wild animals, that it is calibrated at different times of the year, for the activities of interest and, especially for ectotherms, under different conditions of environmental temperature and nutritional state.

Heart rate by itself cannot be used as a surrogate for $\dot{M}O_2$. If HR increases, then chances are that $\dot{M}O_2$ has also increased, but if HR has increased by 50%, this does not mean that $\dot{M}O_2$ has also increased by 50%, as the relationship has never been found to go through zero. Thus, the only way to obtain absolute estimates of $\dot{M}O_2$ from HR, is to have an appropriate calibration, or calibrations. It is also advisable to determine the accuracy of $\dot{M}O_2$ estimated by the HR method by performing validation experiments. In sum, the HR method alone provides an average estimate of daily field metabolic rate (FMR) and at

best some indication as to diel cycles and/or periods of elevated $\dot{V}_{O_2}$. The only other established approach for determining FMR is the doubly labelled water method, though this yields little more than an average value for FMR.

Although obtaining estimates of FMR tells us much about how an animal survives in its natural environment, it is more informative to be able to estimate details of an animal's energy budget (i.e. the cost of a specific activity/s - sleeping, digestion, locomotion and thermoregulation) and this requires measurement of other physiological and abiotic variables. Such variables might include temperature, pressure, light and/or accelerometry. Again, it is essential that the variables are properly characterised for the various activities they intend to measure. The multivariate HR method can provide accurate estimates of the overall and detailed energy budget of an animal.

Finally, attaching or implanting devices to animals is potentially fraught with problems that range from altering behaviour/s, increasing the payload, affecting buoyancy and in terms of retrieving the data. Behaviour, payload and buoyancy can be overcome through miniaturisation of devices. Data retrieval over a short range may be by telemetry (VHS, acoustic), but many animals travel distances, live in environments or adopt lifestyles where this is not practical. Other options involve recapturing the animal with the device, having some release mechanism which enables the device to be retrieved without the necessity of recapturing the animal and remote downloading of the data. For some species that are not easy to relocate and do not lend themselves to making use of a release mechanism for the device, remote downloading may be the only solution, but so far this technology is in its infancy.

Relevance of workshop:
This workshop will examine the multitude of issues that surround the use of the multivariate HR method and critique its validity, accuracy or usefulness in predicting animal energetics in the field and whether 'standards' be established for researchers utilizing this approach.

The workshop will be of interest to physiologists, behavioural ecologists, engineers, modellers and any-one else interested in measuring animal energetics.

Communication of outputs:
It is anticipated that workshop proceedings will be formalised in a document and distributed as requested to Bio-logging 4 delegates. Additionally, the workshop organisers aim to publish a review of the workshop in the peer-reviewed literature.

Participation
If you would like to attend this workshop please email Peter Frappell (peter.frappell@utas.edu.au). If you would like to give a presentation at this workshop include in your email a title and short abstract (limit 250 words) that outlines the work you wish to present.