QCL WATER SCIENCE

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

PyroScience FireSting

Thermal Sensitivity of Temperature on the Metabolic Rate of Ecotherms

Introduction

The purpose of this 3rd level Undergraduate Zoology course is to examine modern approaches in animal ecophysiology, detailing examples from both the laboratory and field, and highlighting the integration of molecular, physiological and ecological techniques. In particular, it focuses on how animals have evolved strategies to overcome the physiological challenges associated with changing and/or extreme environmental conditions. Students will be introduced to the emerging and exciting field of "Conservation Physiology" that attempts to demonstrate cause and effect of human-induced environmental disturbance on organisms. This particular class examined the thermal sensitivity of an Australian freshwater crayfish.

Methods

Students are provided with several small redclaw crayfish (Cherax quadricarinatus) that have been acclimated to one of 6 water baths at their respective test temperatures (10, 15, 20, 25, 30 or 35˚C). The crayfish will have been held at room temperature in the lead up to the class, so their introduction these temperature treatments reflects a relatively acute thermal challenge and will help students understand the thermal sensitivity of metabolic rate in this species. A 60ml syringe with a 3-way tap is used as a respirometer. Individual crayfish are placed in the respirometers filled with air-saturated water and samples of the water are measured over time using a PyroScience FireSting-O2 by injecting small amounts through a flow-through cell with integrated optical temperature and oxygen sensor. By measuring the concentration of oxygen in the water at regular intervals and determining the relationship

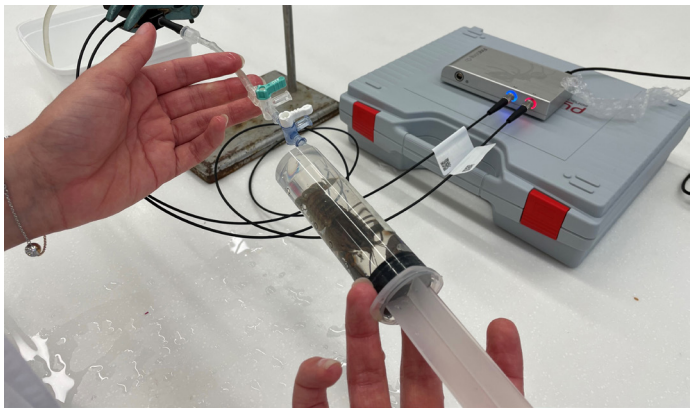

Fig. 1 Redclaw Crayfish inside syringe respirometer. A water sample is being injected through the flow-through cell

between oxygen concentration (% air saturation) and time (h), it is possible to determine the rate at which the animal is changing the amount of oxygen in the water, which can be used to calculate its rate of oxygen consumption which the students can use as a proxy for metabolic rate.

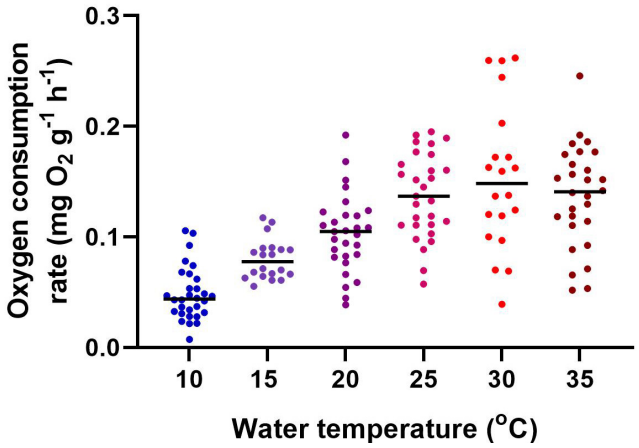

Fig. 2 The thermal sensitivity of crayfish oxygen consumption rate

Conclusion and Application

Metabolic rate is highly sensitive to environmental temperature in ectotherms and this laboratory exercise clearly demonstrates this phenomenon to students. They can also see that metabolic rate increases with increasing temperature up to a maximum point after which metabolism begins to decline as animals approach their thermal tolerance limits. This approach allows us to measure reasonably large numbers of individuals in several temperature treatments within the 3h allotted class time.

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