*Evolutionary Ecology Research*, 2007, **9**: 123–143

# Estimating the energetic cost of abiotic conditions using foraging behaviour

Sandra J. Webster and Lawrence M. Dill

*Behavioural Ecology Research Group, Department of Biological Sciences, Simon Fraser University, 8888 University Drive, Burnaby, British Columbia V5A 1S6, Canada*

## ABSTRACT

**Questions:** What are the energetic costs associated with different temperatures and salinities? How do these costs change as a result of physiological development and how do they affect habitat choice?

**Organism:** Juvenile chinook salmon, *Oncorhynchus tshawytscha*.

**Methods:** We quantified energetic costs by estimating the quitting harvest rate of juvenile salmon expressing different amounts of osmoregulatory enzyme activity (i.e. different stages of smolting) in habitats that differed in either temperature or salinity.

**Results:** The cost for saltwater-preferring fish to forage in freshwater was 1.65 times greater than the cost for freshwater-preferring fish to forage in saltwater. The cost of foraging in freshwater was positively correlated with osmoregulatory enzyme activity among saltwater-preferring fish but, surprisingly, the cost of foraging in saltwater was not correlated with enzyme activity among freshwater-preferring fish. Salmon had no preference for water of 8.6°C over that of 12.6°C, but did prefer water of 8.9°C over that of 15.7°C. The costs associated with foraging in cooler or warmer water were equal when habitats differed by only 4°C, but when habitats differed by 7°C the cost of foraging in warmer water was 1.72 times greater than the cost of foraging in cooler water. For the range of conditions considered here, the cost of foraging in different salinities versus different temperatures is very similar.

**Conclusion:** Foraging behaviour can be used to estimate the energetic costs paid by animals exposed to different abiotic conditions and how these costs are influenced by changes in their physiological state.

*Keywords*: giving-up density, habitat choice, $Na^+/K^+$-ATPase, salinity, temperature.

## INTRODUCTION

To predict habitat choice, it is necessary to determine which habitat provides the maximal difference between energetic gains and costs (Stephens and Krebs, 1986). Metabolic costs are relatively straightforward to measure and may vary depending on the state of the animal, such as its body size (Elliott, 1976) or developmental stage (Rowe and Ludwig, 1991; Morgan and

* Author to whom all correspondence should be addressed. e-mail: sandrajwebster@hotmail.com