Vigilance, patch use and habitat selection: Foraging under predation risk

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ABSTRACT

To balance conflicting demands for food and safety from predation, feeding animals have two useful tools. First, they can vary the amount of time they devote to harvesting patches that vary in predation risk and feeding rates. Second, they can use vigilance to trade-off food and safety while feeding from a food patch. I present a model for predicting how an optimal forager should jointly use these two tools. Factors influencing the use of these tools include encounter rate with predators, predator lethality in the absence of vigilance, effectiveness of vigilance in reducing predator lethality, the marginal value of energy to the forager and the forager’s survivor’s fitness. Patch-use behaviours influenced by these factors include vigilance level, quitting harvest rate and giving-up density (GUD). All three of these patch-use behaviours should increase in response to an increase in encounter rate with predators, predator lethality and the forager’s survivor’s fitness, and decrease with an increase in the marginal value of energy. In response to increasing the effectiveness of vigilance, vigilance should increase and the GUD and quitting harvest rate should decline. The amount of food left by a forager in a depletable food patch, the GUD, provides an empirical link for testing the model’s predictions. Giving-up densities should increase with increasing predation risk, and GUDs should increase with declining food-density-specific harvest rates. Differences in GUDs among food patches attributable to differences in quitting harvest rates measure the contribution of time allocation to managing differences in predation risk. Differences in GUDs attributable to differences in food-density-specific harvest rates measure the contribution of vigilance to managing predation risk.

Keywords: ecology of fear, foraging theory, giving-up density, habitat selection, patch use, predation risk, quitting harvest rate, time allocation, vigilance.

INTRODUCTION

Two approaches have been taken to understanding foraging under predation risk. The first considers how a forager should allocate its time among activities that vary in feeding opportunities and predation risk. The second considers how a forager should use vigilance to trade-off feeding rates and predation risk while engaged in a particular activity. Lima and Dill (1990) characterize the safety of a feeding activity as the probability of surviving predation. This probability has two components. The first represents the rate of encounters

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