HOST DENSITY SIGNAL IN RELATION TO AGGREGATION IN THE PARASITOID VENTURIA CANESCENS

by

JUAN C. CORLEY*

(School of Biological Sciences, University College of North Wales, Bangor, Gwynedd, U.K.)

ABSTRACT

The aggregation of predators in response to prey that is heterogeneously distributed is a central issue of population dynamics. Although it is generally agreed that ultimately the aggregative response is a consequence of individual decision making, most models traditionally assume a simplified scenario for the predators foraging behaviour.

Recent work has drawn attention to the importance of more detailed knowledge on the foraging behaviour leading to aggregation at the population level. A theoretical model concluded that a condition necessary for stability is that parasitoids respond to the absolute differences between patches, irrespective of the systems richness.

In this work I have studied the aggregative behaviour of the parasitic wasp Venturia canescens Gravenhorst (Hymenoptera: Ichneumonidae) to a patchy distribution of its host, Plodia interpunctella Hubner (Lepidoptera: Pyralidae) in order to test the prediction that a parasitoid’s foraging pattern is more affected by absolute than by relative patch values. In a 3-patch-experimental arena (the system) I manipulated the density and distribution of hosts within each patch and recorded parasitoid patch residence time and parasitisation rates. The results confirm that this parasitoid is sensitive to system host abundance and that its host density signal (sensu Murdoch & Stewart Oaten, 1989) is closer to the relative than to the absolute patch value.

KEY WORDS: host distribution, Plodia interpunctella, patch residence time, parasitoid behaviour.

INTRODUCTION

In patchy environments, heterogeneous mortality among patches caused by the aggregation of predators can be a strong stabilising process in many theoretical discrete generation parasitoid-host population models (e.g., Hassell & May, 1973; 1974; Hassell, 1978; Chesson & Murdoch, 1986; Pacala et al., 1990; Godfray and Pacala, 1992). However, the behaviour leading to aggregation, for most of the models,
responds to simple and straightforward rules (REAL, 1992). Thus, aggregation, defined as a concentration of parasitoids on certain host patches (GODFRAY & PACALA, 1992) is usually taken to be a fixed function of host density and distribution, i.e., parasitoids distribute themselves among patches only once during their lifetime (GODFRAY, 1994; ROHANI et al., 1994). Such assumptions of limited mobility between patches are central to the stability effect of aggregation (MURDOCH & STEWART OATEN, 1989; ROHANI et al., 1994). But, in natural environments, host abundance and distribution may vary within generation time for example as a consequence of parasitoid exploitation (GODFRAY & PACALA, 1994) and the behavioural rules leading to aggregation by parasitoids may differ under different host densities and distributions.

In some recent work, MURDOCH & STEWART OATEN (1989) have shown that for continuous time models aggregation may not normally be stabilising or may even be destabilising. In their models stability hinges on how parasitoids respond to a constantly varying patterns of host distribution as a function of host density (i.e., on how parasitoids redistribute themselves). Despite some criticism stemming from the biological assumptions of these models (see GODFRAY & PACALA, 1992), Murdoch and Stewart Oaten’s paper emphasises, among other things, the need for more precise knowledge on the nature of the behavioural cues through which parasitoid aggregation relates to host abundance and distribution (MURDOCH et al., 1992; GODFRAY & PACALA, 1992).

For their models, MURDOCH & STEWART OATEN (1989) coined the term host density signal \( s(h) \) to represent the host distribution and density variable on which parasitoids’ decisions leading to aggregation are based. At its simplest, they took \( s(h) \) to range between two extreme conditions: parasitoid aggregation to any one patch is determined by the absolute value that patch has \( s(h) = 0 \), or parasitoid response is instead a consequence of some comparison of the patch to the average for the system \( s(h) = 1 \). According to their results, the chances for stability are increased if parasitoids respond to the absolute differences between host patches irrespective of the systems average (MURDOCH & STEWART OATEN, 1989).

In this paper I tested the prediction that a parasitoid actually responds to absolute rather than relative patch value. To do so I studied the aggregative response of the parasitoid V. canescens (Hymenoptera, Ichneumonidae) across a range of different host rich patches under controlled laboratory conditions.