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BEHAVIOURAL ASPECTS OF THE FUNCTIONAL RESPONSES OF A PARASITE (PSEUDEUCOILA BOCHEI WELD) TO ITS HOST (DROSOPHILA MELANOGASTER)

by

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SUMMARY

1. The functional response of the parasite *Pseudeucoila bochei* to different densities of its host (*Drosophila melanogaster* larvae) was studied in three series of experiments.

In the first series, the host-medium sites (yeast spots) were equal in size, but the number (and hence the density) of hosts varied between 0 and 128. The parasitization period was limited to one hour. In the second series, the spots and densities were the same as in the first, but differed in the time the parasite was permitted to search. She was allowed to search the medium until she left, at which time the experiment was terminated. In the third series, the size of the yeast spot and the number of larvae in the spot differed, so that the density per spot remained constant.

2. All females found the host medium, but the smaller the yeast spot, the longer the interval between the introduction and the time before the spot was discovered. This time was not influenced by the number of host larvae present (Fig. 2). Apparently the wasps first located the host habitat, independently of the presence of hosts.

3. Females that failed to find a host during their first visit to a yeast spot spent a more or less fixed time searching before they left. This "giving-up" time (ca. 73 seconds at 2 cm diam) depended on the size of the yeast spot. If a host was found during this initial search, then the parasite increased the time she searched for a second host by an average of 623 seconds before leaving the spot. This behaviour is clearly adaptive when the hosts are clustered.

4. Because parasites in series 1 were permitted to return to the yeast after one or more unsuccessful visits (searching time limited to one hour), the number of visits to the host medium was initially high at the low host densities but decreased with increasing density. The hosts were more easily found at higher host densities so fewer unsuccessful visits occurred. If her first visit to the spot was unsuccessful, subsequent unsuccessful ones appeared to be of shorter duration, indicating that the wasps might recognize sites already searched.

5. Because the parasites were permitted to return to the yeast in series 1, the wasps laid more eggs in this series than in series 2, because the frequent visits to the yeast at low densities increase the likelihood of finding hosts. In series 3 once a parasite found the host medium, she discovered a host more easily than in series 2 because the hosts were at a constant high density in series 3: only the size of the yeast spot varied.

6. The wasp's perseverance was high: she continued to search for unparasitized hosts even although she had already parasitized about 85% of them. Thus, she continued to search in a situation in which she frequently encountered parasitized ones.

7. The percentage parasitization in series 1 was already rather high at the lowest densities. This was caused by the repeated visits to the host medium by the parasites

within the allotted time of one hour. Since the design of series 1 is traditionally the one employed to study functional response in a parasite or predator, it results in a distorted picture of what would probably occur in nature: the wasps would almost certainly leave a site and search elsewhere, if initially unsuccessful, instead of returning several times to a site already searched. This explains why a functional response of type 2 was usually found for invertebrates in experiments. The increasing percentage parasitization at lower densities of series 2 probably reflects the natural situation better: it is a type 3 response (Fig. 7).

8. The parasites did not search entirely at random on a host-medium site. Thus, searching efficiency was higher, which of course increased the parasite's reproductive power. In ecological theory and particularly as it is formulated in mathematical models, random search is usually assumed, although factors such as interference among the parasites, reaction to host aggregations, switching to other hosts, etc. are taken into account. Non-random search will strongly affect the results from modelling.

INTRODUCTION

The quantitative effect of the reactions of predators and parasites on different densities of their prey or hosts still remains a topic of great interest among ecologists, because these reactions are of importance in bringing down the numbers of prey or hosts, or even in regulating their numbers. Therefore these reactions play an important role in some population dynamical theories and in biological control of pests.

Usually, two different types of response are distinguished: the functional response, in which the individual predator (or parasite) attacks more prey when prey (or host) density increases, and the numerical response, in which, as a result of an increase in prey (or host) density, the number of predators (or parasites) increases (SOLOMON, 1949). Obviously, some predators and parasites may show both a functional and a numerical response in a given environment.

This paper deals with the functional response only. HOLLING (1959) has distinguished three different types, depending on the nature of the relation between the density of prey (hosts) and the number of prey

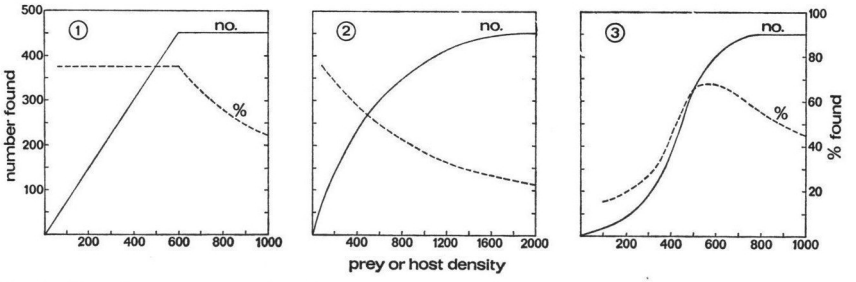

Fig. 1. The three types of functional responses of predators (or parasites) to changes in prey (or host) density (see text).