HOST QUALITY EFFECTS ON SEX RATIO
OF THE PARASITIC WASP ANISOPTEROMALUS CALANDRAE
(CHALCIDOIDEA, PTEROMALIDAE)

by

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SUMMARY

The pteromalid wasp Anisopteromalus calandrae (Howard) is a parasite of larval instars of several species of beetles. In our experiments we used larvae of the granary weevil (Sitophilus granarius L.) as hosts. Host size may differ considerably, older larvae being much larger than younger ones. Fitness of the wasps' offspring depends on host size but differences between small and large sons are probably less than between small and large daughters.

A number of experiments were carried out to investigate the effect of host quality on sex ratio. Evidence was found for the hypothesis that in Anisopteromalus offspring sex-ratio depends on clutch size. On large hosts (better quality) the proportion of sons is small, on young hosts (lower quality) the proportion of sons is high but these differences are due to large numbers of female-eggs being deposited on old hosts, and far fewer on young hosts, per laying period of 24 hrs. On both categories the number of sons produced per laying period is about similar.

In the course of time (i.e. with decreasing life expectancy) the initial difference between treatments disappears almost completely (i.e. more and more, sub-optimal, daughters are produced on young hosts). Evidence for a memory factor was obtained with experiments in which we offered different host sizes, either successively or simultaneously.

A simple model is proposed to describe the succession of sex-ratio decisions made under different conditions of host quality. Results are compared with those obtained earlier with Lariophagus, another pteromalid parasite of granary weevils, which is supposed to change sex ratio independent of clutch size.

INTRODUCTION

One of the implications of haplodiploid sex determination of the Hymenoptera is that an ovipositing female may control the sex ratio of her offspring; for example, as a function of environmental factors. In parasitic wasps the decision to fertilize or not fertilize an egg (i.e. the choice between a daughter and a son) could be made on the basis of stimuli related to host quality. Size of a host is of particular relevance in this respect, because it determines the eventual body-size reached by a son or daughter as an adult, which, in turn, relates to reproductive prospects. Prospects of large and small daughters differ much
more than those of large and small sons (van den Assem, 1979). Therefore, a female wasp which discriminates between hosts of different size, and acts accordingly—daughters on large, sons on small—, scores much better than one which oviposits indiscriminately (Charnov, 1979). Assessment of a host’s size is a prerequisite for such a discrimination. Ample data are available to show that females of several species collect such information, and act up to it (Claußen, 1939; Klomp & Teerink, 1962; van den Assem, 1971; Sandlan, 1979; Charnov et al., 1981).

Wasps parasitizing on host populations with a variable size composition could end up with very different offspring sex-ratios. Under such circumstances natural selection will work in the direction of an equilibrium sex-ratio: those females which conform to certain allocation rules with respect to offspring sex-ratio will maximize the probability of being represented in future wasp generations (Charnov, 1979). If daughters are indeed better off by being large than sons (i.e. differences in fitness returns from large and small daughters greater than from large and small sons), selection will favour those individuals which deposit male-eggs on smaller, and female-eggs on larger hosts. Charnov’s “size advantage hypothesis” applies to a vast array of organisms (Charnov, 1982); experimental support of the hypothesis was first provided with parasitic wasps (Charnov et al., 1981).

Anisopteromalus calandrae (Howard), Chalcidoidea, Pteromalidae, is a solitary ectoparasite of larval instars of several species of beetles which infest stored grains and beans; as such it may have some economic importance (Williams & Floyd, 1971). Its life-history has many points in common with that of Lariophagus distinguendus, another pteromalid, on which was reported earlier (van den Assem, 1971). Anisopteromalus males are, on average, smaller than females, just as in Lariophagus. This is due, at least partially, to the fact that male-eggs are more often laid on small hosts than female-eggs. Apparently, Anisopteromalus is able to discriminate between hosts of different size and make decisions on the sex of the offspring to be laid on them. We do not know, however, how this is achieved. For measuring a host the wasp’s ovipositor is most probably used in the process, although this has not been established irrevocably. In Lariophagus, females are known to react to host-size differences of .2 mm; perhaps they can do even better (Charnov et al., 1981). It is not well conceivable how they could achieve this precision without measuring the host itself or its tunnel, using sense organs located on the tip of the ovipositor.

We expect similar procedures in Anisopteromalus. Direct observations are consistent with what one should expect of “measuring procedures”: females insert their ovipositor into a tunnel for longer