

FAT AND EGGS: AN ALTERNATIVE METHOD TO MEASURE THE TRADE-OFF BETWEEN SURVIVAL AND REPRODUCTION IN INSECT PARASITIDS

by

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ABSTRACT

The cost of reproduction, a trade-off between reproduction and survival, is important in life history study. In parasitoids this trade-off is studied by measuring number of offspring and longevity. Measuring longevity, however, is a time consuming method and probably does not reflect a realistic value for survival in the field. I present an alternative method, which uses fat content as a measure for survival. Using the insect parasitoid *Asobara tabida* (Nees) (Hymenoptera), I show in two ways that fat content is strongly correlated to longevity. Firstly, strains with a higher fat content have a greater longevity. Secondly, fat reserves decrease linearly with age.

The trade-off between reproduction and survival can be studied using this method. There is a negative correlation between the number of eggs in the ovarioles and the fat content of *A. tabida* females. This indicates that there is a cost of reproduction in *A. tabida*. The most important advantage of this method is that measuring fat content is a quick method. This method may also be applied to other insect species.

KEY WORDS: fat reserves, fecundity, longevity, *Asobara tabida*, cost of reproduction.

INTRODUCTION

One of the major principles in life history theory is the existence of trade-offs (STEARNS, 1989; ROFF, 1992). Physiological, genetic or biomechanical constraints prevent an individual from maximizing all traits. If an individual can only increase one trait at the cost of another trait it is called a trade-off. Natural selection will favor that combination of traits which is best adapted and thus maximizes fitness. One of the trade-offs most often investigated is the cost of reproduction (WILLIAMS, 1966; REZNICK, 1985). Resources allocated to reproduction can not be used for survival. Females investing more in reproduction and laying many eggs therefore will have less energy for survival and thus a shorter lifespan. This trade-off has been shown to exist in many species, although not in all cases (REZNICK, 1985).

In parasitoids there are various ways to measure the life history parameters involved in this trade-off. Reproduction can be measured by counting the number of offspring of an individual. Another way to determine allocation to reproduction is to count the number of eggs in the ovarioles. Allocation to survival can be measured by keeping the parasitoids in glass vials and counting the number of days the parasitoid lives, with or without food. Measuring longevity, however, can be very time consuming. Published parasitoid longevities range from 2 to 20 days without food and from 5 to more than 80 days with access to food (CORRIGAN, 1990; HARDY, 1992; VISSER, 1994). Moreover, there is no reason to assume that longevities measured in the laboratory reflect realistic values for longevities in the field. Survival comprises not only longevity but also other energy demanding activities like, *e.g.*, flying. The longevity measured in the laboratory therefore overestimates survival in the field. So despite of the common use of this method, other ways of measuring allocation to survival may be more convenient.

It is a general principle in animals that stored fat can be used as energy to live. In insects the fat body is a storage organ for lipid, glycogen and protein (BEHAN & HAGEDORN, 1978; HAUNERLAND & SHIRK, 1995). Therefore an increase in allocation to survival might mean greater fat reserves. In several insect species there is a positive correlation between longevity and fat reserves (DAVID *et al.*, 1975; DIXON, 1975; DIXON *et al.*, 1993). In *Drosophila melanogaster* selection for a greater starvation resistance (longevity without food) leads to an increase in fat reserves (SERVICE, 1987; ZWAAN *et al.*, 1991). Therefore, it might be possible to use fat content as an indication for the amount of resources allocated to survival in parasitoids.

In this paper I present an alternative method to measure allocation to survival in parasitoids. The usefulness of this method is demonstrated by studying the trade-off between reproduction and survival in the parasitoid *Asobara tabida*. I will compare this alternative method with the conventional method and discuss their relevance for life history studies.

MATERIALS AND METHODS

Parasitoids and host

Asobara tabida is a solitary endoparasitoid of larvae of *Drosophila subobscura* and *D. melanogaster* that live in fermenting fruits and sapfluxes. *A. tabida* has a holarctic distribution and occurs all over Europe. The *A. tabida* females used in this experiment were from two Dutch strains (HVel and Sin) and one Greek strain (Kos). All parasitoids were reared on the same *D. subobscura* strain. Females of each strain were allowed to oviposit for 24 hours in second instar larvae in an active bakers' yeast suspension. The parasitised larvae were reared at 20°C, L:D 16:8.