TRAITS COMMON TO PREDATORS AND PARASITOIDS

Notes

I. Behavior in Host/Prey Selection

A. A natural enemy in nature limits its attack to a fraction of the suitable prey / hosts species that may be available to it.

B. Behavior, like morphological characteristics, is specific and adaptive, but the adaptive action is based on a foundation of specificity.

C. Several distinct and consecutive processes of host selection occur and through their operation the host list of a parasite or predator becomes restricted to fewer host species than are potentially available to it in nature (Fig. 5.1).

D. Salt classified these processes into 3 broad categories which follow in proper sequence:

1. Ecological selection
2. Psychological selection
3. Physiological selection

E. These were later reclassified into:

1. Host habitat finding (initially ecological selection)
2. Host finding (initially ecological selection)
3. Host acceptance
4. Host suitability

F. S. Bradleigh Vinson (1975) added host regulation as a fifth step.

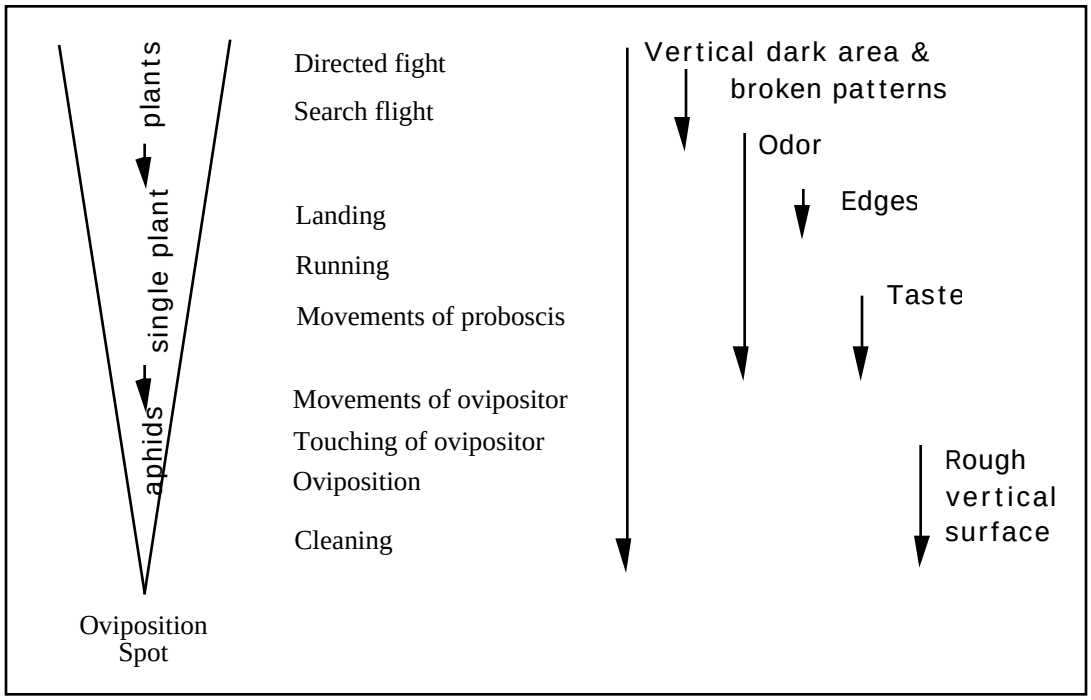


Fig. 5.1. Sequence of behavioral responses to environmental stimuli which guides female *Syrphus corollae* to an aphid habitat and that stimulates oviposition within an aphid colony. Figure from Hagen *et al.* (1976).

Notes

II. Host Habitat Finding

A. Parasites and predators initially and fundamentally seek a certain environment, and they do this irrespective of the presence of hosts.
B. Particular plant species may exert a strong attraction even though suitable hosts are not present on it. Conversely, the parasite / predator may ignore suitable hosts / prey growing on plants to which it is not attracted.

III. Host Finding

A. Once the parasite / predator is in the habitat of the host / prey, it still must be able to locate a host individual.
B. The most commonly reported senses used in detecting the host are tactile and olfactory (for parasitoids).
C. It has been proposed that a parasite / predator tends to search in the parts of its environment most likely to contain its host and that this is caused by a combination of preadaptation in habits and a specific attraction exerted by the portion of the environment concerned.
D. Some natural enemies display a distinct behavioral change when hosts are found in a location. This change is from a random search "mode" to a search mode of tight circles within the area of interest.

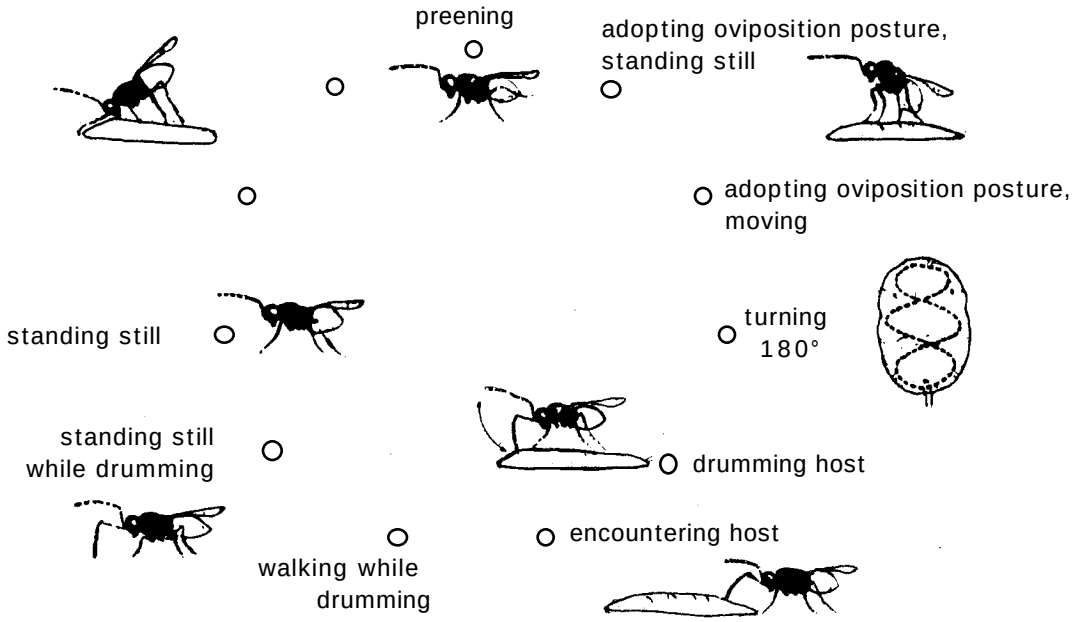
IV. Host Acceptance

A. Even though a parasite / predator actually finds or contacts a suitable host / prey, it still may not attack if the proper stimuli are lacking.
B. This step is truly host selection and is clearly a matter of innate behavior of a parasitic / predacious species.
C. van Lenteren (The Netherlands) has done some excellent work with regards to this area using the parasitoid *Encarsia formosa* and the greenhouse whitefly.
D. Hosts may be rejected because they are:

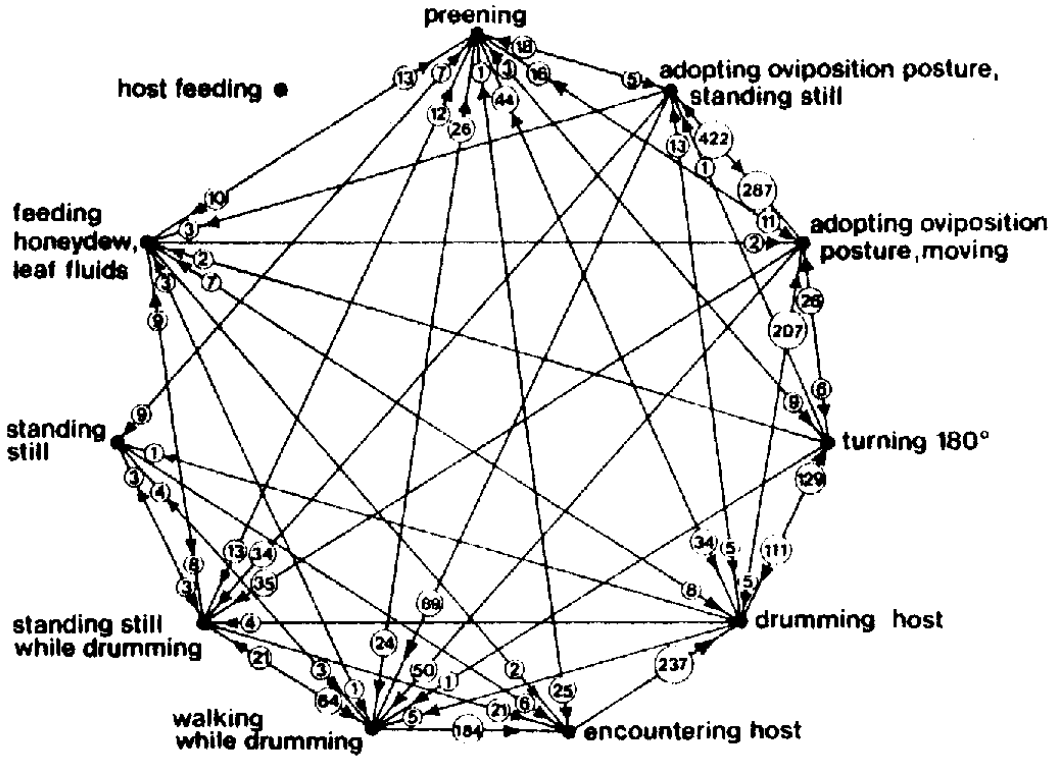
1. Too young or old; 2. Wrong size
3. Diseased; 4. Unhealthy
5. Already parasitized (by the same or another species)
6. Have been used for host feeding
7. Do not exhibit the correct reactions when investigated by the parasitoid

V. Host Suitability

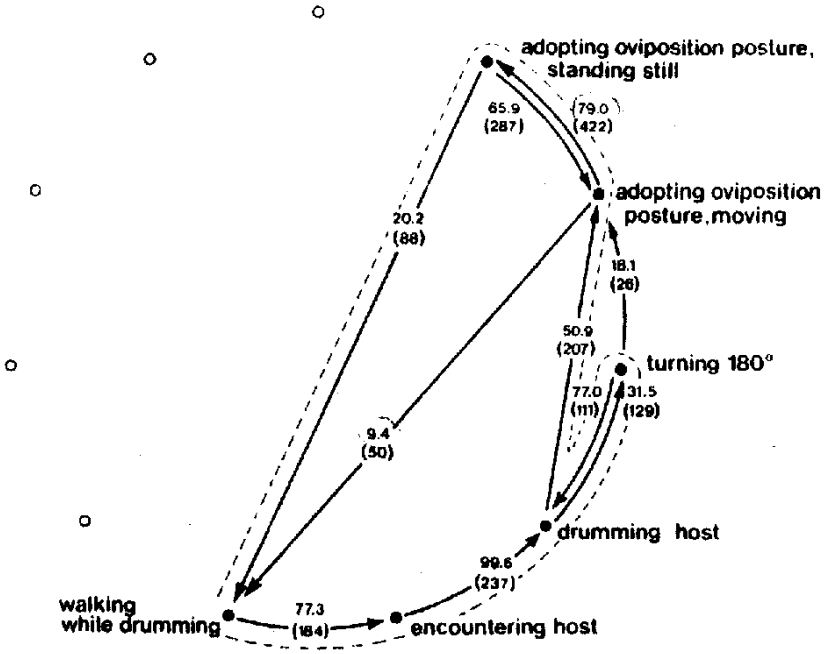
A. Even though a parasite / predator has found the potential host / prey in its habitat and selected it for attack, the host/parasite or prey/predator relationship may still not suceed if the potential host individual is immune or otherwise unsuitable.
B. Oviposition by a parasite is not necessarily an index to host suitability and the attractiveness of the host is often independent of its suitability for parasitic development.
C. Studies have suggested that hosts may evolve some type resistance to parasites. The larch sawfly was heavily parasitized by *Mesoleius tenthredinis* in Canada. After some years the efficiency greatly decreased in Manitoba and Saskatchewan. Studies showed that the hosts were inhibiting the parasite's embryonic development.



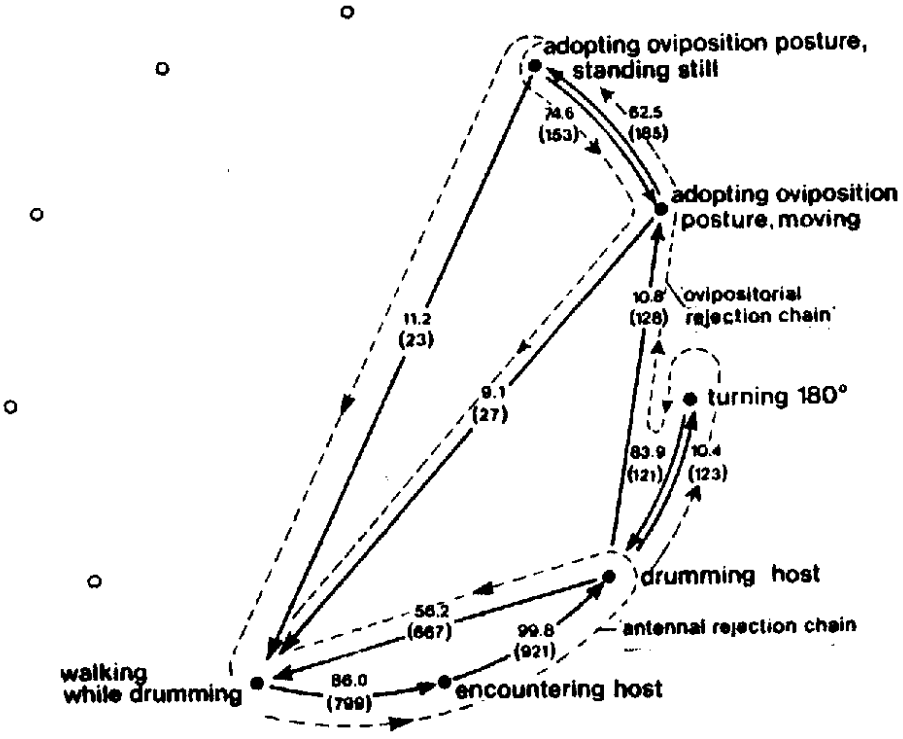
Fig, 5.2. Behavioural components displayed by *Encarsia formosa* when searching for and ovipositing in its host the greenhouse whitefly, *Trialeurodes vaporariorum.* Figure modified from van Lenteren *et al.* (1980).



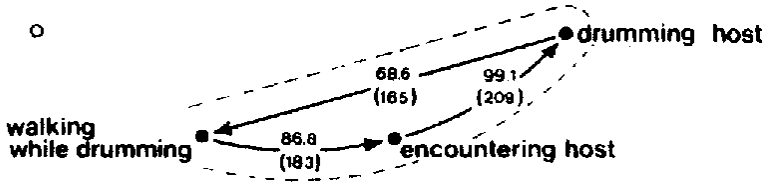
Fig, 5.3. Behavioural sequence of *Encarsia formosa* when ovipositing in the greenhouse whitefly. The figures in the circles represent the frequencies of components that immediately succeed each other. Figure from van Lenteren *et al.* (1980).



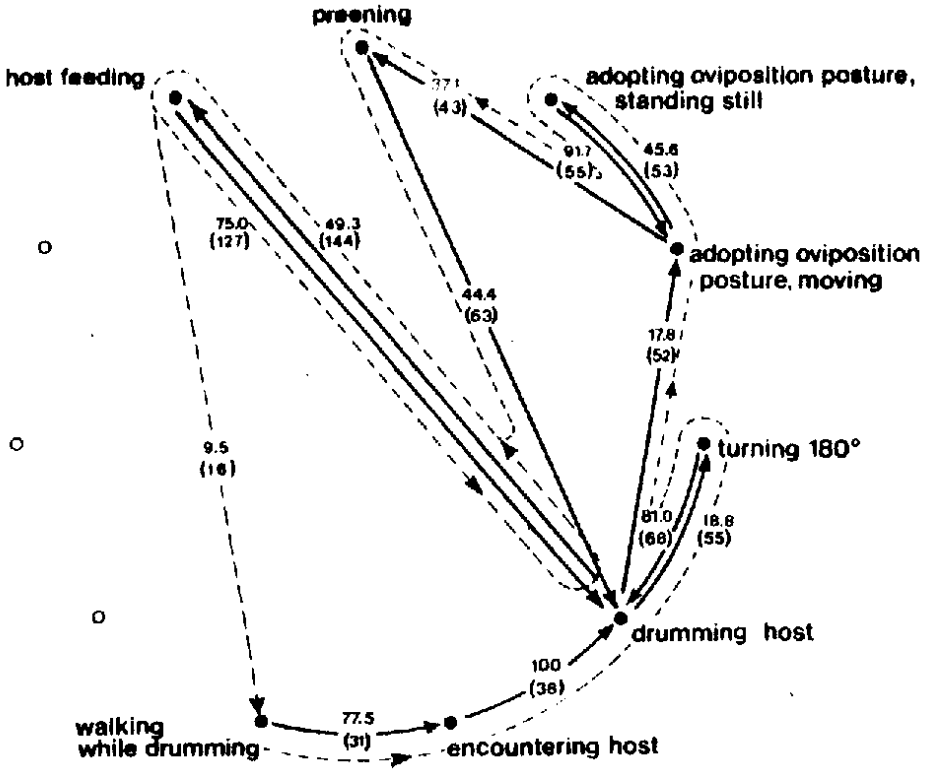
Fig, 5.4. Simplified diagram of the behavioural sequences of *Encarsia formosa* when ovipositing in the greenhouse whitefly. The dashed line gives the usual ovipositional sequence. Figure from van Lenteren *et al.* (1980).



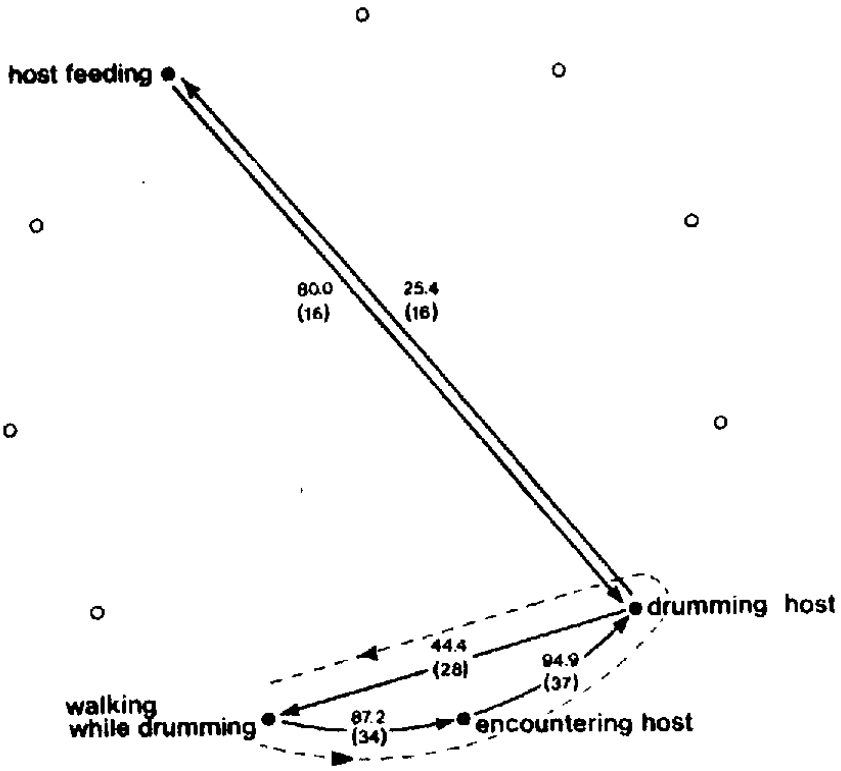
Fig, 5.5. Simplified diagram of the behavioural sequences of *Encarsia formosa* when rejecting unparasitized greenhouse whitefly hosts. The dashed line gives the usual sequence. Figure from van Lenteren *et al.* (1980).



Fig, 5.6. Simplified diagram of the behavioural sequences of *Encarsia formosa* when rejecting parasitized greenhouse whitefly hosts. The dashed line gives the usual sequence. Figure from van Lenteren *et al.* (1980).



Fig, 5.7. Simplified diagram of the behavioural sequences of *Encarsia formosa* when feeding on a greenhouse whitefly host. The dashed line gives the usual sequence. Figure from van Lenteren *et al.* (1980).



Fig, 5.8. Simplified diagram of the behavioural sequences of *Encarsia formosa* when feeding on a greenhouse whitefly host which has been previously fed upon. The dashed line gives the usual sequence. Figure from van Lenteren *et al.* (1980).

Notes

VI. Learning in Natural Enemies

A. Both parasitoids and predators have the ability to learn.
B. Learning has the ability to affect host preference.
C. Associative learning involves learning to link the perception of one (or two) stimulis with the presence of another object or event. Parasitoids may associate secondary stimuli (e.g., host plant odors) with hosts or food sources.
D. Mass reared natural enemies may be less effective in the wild because they have not leaned to associate their hosts / prey with specific odors in nature. Exposure to the target host prior to release may improve this situation.

VII. Attributes of Effective Natural Enemies

A. High searching capacity: Searching ability is a composite of several qualities of the parasite which include:

1. Its power of locomotion;
2. Its power of perception (of the host);
3. Its power of survival; and
4. Its aggressiveness and persistence.

B. Limited host specificity: Most BC successes have resulted from the introduction of host-specific entomophagous species. A high degree of host-specificity indicates good bio-physiological adaptation to the host and a fairly direct dependence on changes in the host's population.

Notes

C. High reproductive potential: This includes a short developmental period and a relatively high fecundity.
D. Wide environmental tolerance: Ideally, the host and parasite would have absolutely equivalent distributions. This in turn means that the parasite would be well adapted to a broad range of climatic conditions.
E. Restriction of oviposition to suitable hosts: Oviposition in previously parasitized hosts or unhealthy hosts would limit the effectiveness of the parasite.
F. Amenability to insectary rearing: This would facilitate the breeding of material for colonization and distribution, and thus would make the early control of the pest more probable.
G. Density-dependent performer: Only those natural enemies that increase mortality levels in their host of prey populations as those populations increase are effective natural enemies. The cause of mortality alone does not mean that a natural enemy will 'regulate' a host or prey population.
H. Good competitive ability: Many natural enemy species may compete for the same host. A good natural enemy may be outcompeted resulting in inefficient control if less effective natural enemies lay their eggs first in suitbable hosts.
I. Synchronization with the host and its habitat. Some natural enemies may not appear in sufficient numbers at crucial times of the year such as spring time, allowing the host to out distance it reproductively.

QUESTIONS

1. What sequence of behaviors is used by predators and parasitoids to find their prey / hosts?
2. What factors influence whether a parasitoid would accept a host individual for parasitization?
3. What are the attributes of effective natural enemies? Do all natural enemies share these attributes?

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