

COMMUNICATION

Herbivory by the weevil *Phelypera schuppeli* (Curculionidae) feeding on the tree *Pachira aquatica* (Bombacaceae) and parasitoid attack

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Resumen: Larvas y adultos del gorgojo *Phelypera schuppeli* (Curculionidae) se alimentan de las hojas nuevas y de la superficie de ramos y frutos de árboles de *Pachira aquatica* (Bombacaceae). Gran parte de las pupas de los gorgojos (94-98%) murieron por una avispa no descrita de la familia Pteromalidae. Hubo una media de 6.8 avispas en cada capullo atacado. Las avispas emergentes presentaron una proporción sexual de 1:1.4 (machos:hembras). La mayor parte de los machos adultos de las avispas (85%) emergió de los capullos antes que las hembras. Hubo una notoria diferencia en la conformación de la cabeza entre los machos adultos de las avispas.

Key words: *Phelypera schuppeli*, Curculionidae, *Pachira aquatica*, Bombacaceae, parasitoid wasps, herbivory.

Studies on host-parasitoid interactions reveal patterns of population dynamics that help to understand interactions in natural communities. As one quarter of all insect species are parasitoids, analyses of these interactions comprise a major step in understanding the functioning of terrestrial communities (Tscharrntke 1992).

The interactions in a patch of a host plant *Pachira aquatica* Aublet, 1775 (Bombacaceae) and its herbivorous hyperine curculionid beetle / *Phelypera schuppeli* Boheman, 1834 and the latter's parasitoid pteromalid wasp were examined in this study.

The present study was conducted in Brasilia near the centre of the cerrado region of Central Brazil (15°46'S - 47°55'W), from May to September 1990 (dry winter season).

The genus *Pachira* is native to Amazonia. Two species, *P. aquatica* and *P. insignis*, are used in several Brazilian cities as shade trees.

On August 22nd, 1990, the beetle populations were surveyed by estimating and counting the numbers of all live stages on 22 trees in one

area (A- a street on the north side of the city). Amounts of young leaves damaged by *P. schuppeli* on the 22 trees were recorded.

The density of beetle cocoons and the wasps were estimated by sampling ten leaves on each of ten trees. The beetles' cocoons were collected and kept in the laboratory until the adults of the beetles and the wasps emerged.

Two other areas at the University campus were also examined: Area B (during August 1990 and August 1992). and Area C (August 1992).

Specimens of *P. schuppeli* and its parasitoid wasp have been deposited in the collection of the Zoology Department in the Brasília University.

Herbivory: *P. schuppeli* is common on *P. aquatica* during May to mid September. Larvae and adults of *Phelypera* beetle are very efficient herbivores in natural (Janzen 1979) and in urban environments (Bondar 1943, Costa Lima 1956, Ferreira and Camargo 1989) and it occurred on different host plant. In Brazil three

species of the *Phelypera* are known to be associated with species of Bombacaceae (Costa Lima 1956, Silva *et al.* 1967, Ferreira and Camargo 1989), while in Costa Rica *P. distigma* is associated with the family Sterculiaceae (Janzen 1979); a family closely related to Bombacaceae. *P. schuppeli* was found on *Pseudobombax longiflorum* (Bombacaceae) in the Cerrado of Goiás State (pers. obs.). No more information is available about the presence of *Phelypera* on plant species in natural habitats, although ten species of Bombacaceae occur in cerrado of Federal District. If it is certain that *P. schuppeli* attacks native plants of cerrado they do with such small intensity that they can not be seen readily during casual observation.

The female of *P. schuppeli* makes a cut in the central vein of a leaf to lay her eggs. Development of the larvae and pupae takes place on the surfaces of the leaves, twigs and fruits. Larvae and pupae are found in groups of up to 50 individuals and are very conspicuous. The larva is said to spin the silk cocoon like *P. distigma* shown by Janzen (1979).

In Area A on 17 (77%) of 22 trees all the new leaves were totally consumed. Only four of these trees produced a second flush of leaves and also produced flowers and fruits. They received low intensities of beetle attack (0-50%). Two years later (August 1992) they looked very healthy and no beetles were observed attacking them.

In Area B attacks on the trees were observed in August 1990 and 1992. In Area C the beetle attack had been observed in 1985 (K. Kitayama, pers. comm.) and were not occurred in subsequent years.

On 22nd August, 1990, larvae, pupae and adults of *P. schuppeli* were present in Area A. Larvae were encountered on only 8 (36%) of the 22 trees with low numbers varying from 5 to 150 per tree. Only one tree bore a high number reaching about 1,000 larvae. The numbers of beetle pupae per tree varied enormously, with 3 to 200 pupae on 7 trees and 500 to 8,000 on 11 trees. The number of adult weevils ranged from 4 to 50 on 8 trees, 100 to 500 on 4 trees and 1,000 to 5,000 on 7 trees.

The intensities of attacks by the larvae and adult weevils varied among the trees. In 3 of them adult beetles had only just started colonization (August) so these trees were the only

ones on which new leaves were not totally consumed.

The 100 leaves sampled (10 per tree) averaged 8.11 ± 2.12 cocoons per leaf with great variation among leaves of the same tree, with a coefficient of variation ranging from 42% to 94%. The frequency of the alive and dead weevils varied significantly among trees ($X^2 = 297.31$ $n=10$ $p < .001$) but it is not correlated with the abundance of the cocoons per tree ($r_s = 0.497$ $p > .05$).

By that time which one 20% of the adult weevils had emerged, 54% were pupae and 26% had died as pupae. The pteromalid wasp had killed 97% of the dead pupae. On three trees which bore the majority (95-98%) of the alive beetle pupae the parasitoid wasps were not encountered.

In the Cerrado area *P. aquatica* is exotic and a population may be attacked for consecutive years or be colonized only occasionally by dispersing adults of *P. schuppeli*. It is not known if the parasitoid wasp follows the same pattern or has an alternative host.

The observations led to the possibility that a tree may respond to the first beetle attack by producing many new leaves and this could also lead to another second more intense attack causing defoliation. A second explanation could be that when the attack is intense the dry twigs greatly reduced leaf production and make the tree unattractive to adult beetles. The shortage of food promotes beetle dispersion thus decreasing attacks in the following years.

Two important points emerge when data from Janzen (1979) are compared with the present study. The first point is that the beetles did not attack the second production of new leaves in *G. ulmifolia* while in *P. aquatica* the flush of new leaves appears to increase the beetles population levels. The second point is the absence of the pteromalid parasitoid on *P. distigma* while in *P. schuppeli* the wasp was very abundant causing very high mortality rates. However, in the *Pseudobombax longiflorum* the parasitoid wasp was not observed.

The parasitoid wasp: The species of the parasitoid belongs to an undescribed genus related to *Psilocera* Walker (Z. Boucek, pers. comm.).

The adult female wasp cuts the silk of the pupal cocoon (K. Kitayama, pers. comm.) and

lays her eggs on the prepupa of the weevil. The pupa of the wasp is attached by a posterior peduncle to the wall of the cocoon.

In order to assess the effect of the pteromalid wasp on the beetle population, beetle cocoons were sampled and were reared *in vitro*. Of the 1,670 cocoons collected 1,079 had been attacked or emerged, and were used in the following analysis (the other 591 cocoons contained alive pupae and were excluded from analysis). Adult beetles emerged from 315 (29.2%) and the remaining 764 (70.8%) beetle pupae died in their cocoons. Most of the beetle pupae were killed by the pteromalid wasp, which emerged from 749 cocoons thus having caused 98% of the total mortality of the beetle. The remaining 15 pre-emergent adult beetles were killed by syrphid larvae.

The occupants of 403 beetle cocoons which the wasps had attacked were reared in the laboratory to determine the numbers of wasp progeny produced. A total of 2,724 wasps and their pupal peduncles were counted, averaging 6.8 ± 3.8 per beetle cocoon.

In a subsample of 202 beetle cocoons a total of 1,017 pupal and pre-emergent adult wasps were encountered. The sex ratio determined from the wasp pupae and pre-emergent adults were 1:1.4. The sex ratios varied among the beetle cocoons. From a subsample of 118 beetle cocoons, only males emerged from 24 (20%); only females from 21 (18%) and both males and females from 73 (62%), the latter category with very variable sex ratios.

From 13 beetle cocoons in the laboratory which contained both sexes of the wasp, males emerged before females from 11 (85%) and the two sexes emerged simultaneously from the other two.

The pteromalid parasitoid can reduce the sizes of herbivore populations from year to year although the damage to the plant has already been done. The high rates of parasitism of the pupae found by us suggest that mortality from this cause plays an important role in influencing the numbers of adult beetles.

A marked polymorphism was discovered among the adult parasitoid wasps. Their eyes ranged from round to triangular shapes and their heads from ordinary to extremely large with disproportionate eyes. The difference

between the male head and that of the female, and the variation in the shape of the head in the male are remarkable and are not known in any genus of that family. The sexual difference in the forewing (pilosity on the underside of the costal cell and the enlarged stigma) are also rare, known in Pteromalidae only in the genera *Dinarmus* Heydon and *Ficicola* Heydon (Z. Boucek, pers. comm.).

The possibility of fecundity variation of these polymorphic males in parasitoid wasps is under investigation (S. Bao and authors).

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