

## HYPERPARASITES OF *APANTELES MILITARIS* (HYMENOPTERA: BRACONIDAE) AT S. MIGUEL ISLAND (AZORES)

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With 2 tables

*ABSTRACT.* Parasites of *Apanteles militaris* (Hymenoptera: Braconidae), a larval parasite of *Mythimna unipuncta* (Lepidoptera: Noctuidae), were first found in São Miguel (Azores) in 1989. In 1990 annual surveys of those hyperparasites were initiated in order to study their distribution throughout the year. During the first two years, *Lisibia* sp. was found at two different altitudes. However, *Trichomalopsis* sp. was only identified at the highest altitude. Two years after the identification of these two genera, a third hyperparasitoid (*Gelis* sp.) was found at both altitudes.

### INTRODUCTION

Hyperparasitism occurs when a parasite develops itself by feeding on other parasite (GAULD & BOLTON, 1988). This is a common phenomenon in Chalcidoidea, Cynipoidea, Ichneumonidae, Ceraphronoidea and Trigonalioidea, and occurs in isolated species of Proctotrupoidea and Braconidae.

*Apanteles militaris* (WALSH) (Hymenoptera, Braconidae) is a larval parasite of *Mythimna unipuncta* HAWORTH (Lepidoptera, Noctuidae), a pest in the Azorean pastures. *A. militaris* is parasitized by *Acrolyta nigricapitata* (COOK & DAVIS) (Hymenoptera, Ichneumonidae), *Eupteromalus viridescens* (WALSH) (Hymenoptera, Pteromalidae), *Gelis* sp. (Hymenoptera, Ichneumonidae), *Lysibia nanus* (= *nana*) (GRAVENHORST) (Hymenoptera, Ichneumonidae) and *Mesochorus discitergus* (SAY) (Hymenoptera, Ichneumonidae) (BREELAND, 1958; GUPPY, 1967; GUPPY & MILLER, 1970).

Following previous studies (OLIVEIRA, 1991, 1992), a survey of *A. militaris* hyperparasites was performed in S. Miguel island between 1990 and 1994. Besides the identification of *A. militaris* hyperparasites, this survey also aimed to determine the proportion

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of cocoons parasitized by different species.

## MATERIAL AND METHODS

The relationship between *A. militaris* and its parasites was studied in three artificial pastures of São Miguel island (Azores) at three different altitudes (Relva, 50 m, Arribanas, 250 m and Altiprado, 550 m). Sampling started in 1990 at Arribanas and Altiprado, and in 1992 at Relva. It was concluded in 1994. *A. militaris* cocoons were weekly collected from June to October. At each site, twenty random 0,25 m<sup>2</sup> units of pasture were thoroughly analysed in order to count cocoons. Collected cocoons were placed in goblets covered by organza until the emergence of the parasites. After the imago's death, species were sorted and the proportion of each hyperparasite was determined.

## RESULTS

### Relva

At this pasture a low number of *A. militaris* cocoons was collected (106 in 1992 and 111 in 1994).

*L. nana*, the only hyperparasite at this site, parasitized 7.8 and 18.9 % of the cocoons in 1992 and 1994, respectively.

### Arribanas

At this site, the highest number of cocoons was found in 1990, while the lowest was collected in 1994 (Table 1). During the first two years, *A. militaris* cocoons were only parasitized by *L. nana*, while in 1992 and 1993 these were also parasitized by *Trichomalopsis* sp. and *Gelis* sp. (Table 1). In 1994 parasitized cocoons of *A. militaris* were not observed. This may be due to the small number of collected cocoons (Table 1).

### Altiprado

The highest numbers of cocoons were found at this site, specially in 1994. The lowest number of parasites was observed in 1992 (Table 2). *L. nana* and *Trichomalopsis* sp. were always found, but *Gelis* sp. was collected only in 1992 (Table 2).

## DISCUSSION AND CONCLUSIONS

To our knowledge, this is the first record of *Trichomalopsis* sp. as a hyperparasite of *A. militaris*. At surveys performed in other Azorean islands (TAVARES *et al.*, 1991, 1992), the three hyperparasites were found in cocoons of *A. militaris* and *A. glomeratus*, a parasite of *Pieris brassicae* L. (Lepidoptera, Pieridae).

*Lisibia nana* parasitizes *A. militaris* in America (BREELAND, 1958; GUPPY, 1967; GUPPY & MILLER, 1970), while the genus *Trichomalopsis* includes parasites of house-flies

(DOBESH *et al.*, 1993) and hyperparasites of *A. plutellae* KURDJ. (CHIEN & CHIU, 1985).

The genus *Gelis* has often been found as an hyperparasite of *A. melanoscelus* (RATZBURG) (WESELOH, 1978, 1979; GIRON, 1979; MADRID & STEWART, 1980; BOURCHIER & NEALIS, 1992), *A. plutellae* (CHIEN & CHIU, 1985) and *Bathyplectes curculionis* (THOMSON) (Hymenoptera: Ichneumonidae) (SIMPSON *et al.*, 1979).

The highest numbers of cocoons were found at higher altitudes, but the highest proportion of hyperparasitism was found at Arribanas, a pasture at medium altitude.

The simultaneous presence of two or three *A. militaris* hyperparasites during the same week was observed in Arribanas and Altiprado. Biological control strategies of *M. unipuncta* based on the population increase of *A. militaris* will have to consider the impact of these hyperparasites, since they might limit the efficacy of the parasite as a biological control agent (ALLEN, 1990; McDONALD & KOK, 1991).

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TABLE 1 - Number of cocoons and adult's rate of *A. militaris* (Apan.) and its hyperparasites captured at Arribanas between 1990 and 1994: *L. nana* (Lis.), *Trichomalopsis* sp. (Tric.) and *Gelis* sp. (Gel.).

| Week /Month | 1990       |         |        |         | 1991       |         |        |         | 1992       |         |        |         | 1993   |            |         |        | 1994    |        |            |         |        |         |        |
|-------------|------------|---------|--------|---------|------------|---------|--------|---------|------------|---------|--------|---------|--------|------------|---------|--------|---------|--------|------------|---------|--------|---------|--------|
|             | N° Cocoons | % Apan. | % Lis. | % Tric. | N° Cocoons | % Apan. | % Lis. | % Tric. | N° Cocoons | % Apan. | % Lis. | % Tric. | % Gel. | N° Cocoons | % Apan. | % Lis. | % Tric. | % Gel. | N° Cocoons | % Apan. | % Lis. | % Tric. | % Gel. |
| 1st Jul.    | 0          | -       | -      | -       | 50         | 100     | 0      | 0       | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| 2nd.        | 130        | 93.4    | 6.6    | 0       | 20         | 100     | 0      | 0       | 117        | 52.4    | 47.6   | 0       | 0      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| 3rd.        | 155        | 100     | 0      | 0       | 0          | -       | -      | -       | 247        | 46.8    | 53.2   | 0       | 0      | 130        | 100     | 0      | 0       | 0      | 0          | -       | -      | -       | -      |
| 4th.        | 480        | 100     | 0      | 0       | 65         | 100     | 0      | 0       | 53         | 21.3    | 78.7   | 0       | 0      | 338        | 98.4    | 2.6    | 0       | 0      | 0          | -       | -      | -       | -      |
| 5th.        | 38         | 100     | 0      | 0       | 0          | -       | -      | -       | 27         | 65.4    | 25.1   | 0       | 11.5   | 304        | 92.7    | 7.3    | 0       | 0      | 0          | -       | -      | -       | -      |
| 1st Aug.    | 0          | -       | -      | -       | 0          | -       | -      | -       | 0          | -       | -      | -       | -      | 33         | 66.9    | 23.9   | 9.2     | 0      | 0          | -       | -      | -       | -      |
| 2nd.        | 0          | -       | -      | -       | 0          | -       | -      | -       | 62         | 46      | 48     | 0       | 6      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| 3rd.        | 0          | -       | -      | -       | 0          | -       | -      | -       | 189        | 67.2    | 18.8   | 7.8     | 6.2    | 24         | 100     | 0      | 0       | 0      | 179        | 100     | 0      | 0       | 0      |
| 4th.        | 71         | 100     | 0      | 0       | 0          | -       | -      | -       | 0          | -       | -      | -       | -      | 63         | 100     | 0      | 0       | 0      | 0          | -       | -      | -       | -      |
| 1st Sept.   | 294        | 100     | 0      | 0       | 31         | 100     | 0      | 0       | 105        | 27.3    | 21.2   | 31.8    | 19.7   | 21         | 47.5    | 52.5   | 0       | 0      | 45         | 100     | 0      | 0       | 0      |
| 2nd.        | 0          | -       | -      | -       | 0          | -       | -      | -       | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      | 6          | 100     | 0      | 0       | 0      |
| 3rd.        | 0          | -       | -      | -       | 46         | 100     | 0      | 0       | 0          | -       | -      | -       | -      | 53         | 47.4    | 52.6   | 0       | 0      | 0          | -       | -      | -       | -      |
| 4th.        | 0          | -       | -      | -       | 0          | -       | -      | -       | 15         | 100     | 0      | 0       | 0      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| 1st Oct.    | 0          | -       | -      | -       | 0          | -       | -      | -       | 41         | 100     | 0      | 0       | 0      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| 2nd.        | 0          | -       | -      | -       | 0          | -       | -      | -       | 0          | -       | -      | -       | -      | 15         | 0       | 63.6   | 0       | 36.4   | 0          | -       | -      | -       | -      |
| 3rd.        | 0          | -       | -      | -       | 97         | 38.9    | 61.1   | 0       | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| 4th.        | 0          | -       | -      | -       | 57         | 100     | 0      | 0       | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      | 0          | -       | -      | -       | -      |
| Total       | 1168       | 98.9    | 1.1    | 0       | 366        | 91.3    | 8.7    | 0       | 856        | 58.5    | 32.3   | 4.4     | 4.8    | 981        | 72.5    | 22.5   | 1.0     | 4.8    | 230        | 100     | 0      | 0       | 0      |

**TABLE 2** - Number of cocoons and adult's rate of *A. militaris* (Apan.) and its hyperparasites captured at Altirprado between 1990 and 1994: *L. nana* (Lis.), *Trichomalopis* sp. (Tric.) and *Gelis* sp. (Gel.).

| Week /Month  | 1990        |             |            |            | 1991        |             |            |            | 1992       |             |             |          | 1993       |            |             |            | 1994     |          |             |             |             |            |          |
|--------------|-------------|-------------|------------|------------|-------------|-------------|------------|------------|------------|-------------|-------------|----------|------------|------------|-------------|------------|----------|----------|-------------|-------------|-------------|------------|----------|
|              | N°          | %           | %          | %          | N°          | %           | %          | %          | N°         | %           | %           | %        | N°         | %          | %           | %          | N°       | %        | %           | %           |             |            |          |
|              | Cocoons     | Apan.       | Lis.       | Tric.      | Cocoons     | Apan.       | Lis.       | Tric.      | Cocoons    | Apan.       | Lis.        | Tric.    | Gel.       | Cocoons    | Apan.       | Lis.       | Tric.    | Gel.     | Cocoons     | Apan.       | Lis.        | Tric.      | Gel.     |
| 1st Jul.     | 0           | -           | -          | -          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 2nd.         | 0           | -           | -          | -          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 3rd.         | 16          | 100         | 0          | 0          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 4th.         | 0           | -           | -          | -          | 0           | -           | -          | -          | 30         | 100         | 0           | 0        | 0          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 5th.         | 0           | -           | -          | -          | 594         | 99.7        | 0          | 0.3        | 55         | 100         | 0           | 0        | 0          | 107        | 100         | 0          | 0        | 0        | 120         | 100         | 0           | 0          | 0        |
| 1st Aug.     | 474         | 94.5        | 5.5        | 0          | 1011        | 96.3        | 1.7        | 2          | 72         | 100         | 0           | 0        | 0          | 55         | 100         | 0          | 0        | 0        | 198         | 100         | 0           | 0          | 0        |
| 2nd.         | 902         | 99.5        | 0          | 0.5        | 20          | 100         | 0          | 0          | 165        | 100         | 0           | 0        | 0          | 28         | 100         | 0          | 0        | 0        | 175         | 61.6        | 38.4        | 0          | 0        |
| 3rd.         | 25          | 100         | 0          | 0          | 0           | -           | -          | -          | 375        | 98.2        | 1.8         | 0        | 0          | 0          | -           | -          | -        | -        | 544         | 83.0        | 15.4        | 0.7        | 0        |
| 4th.         | 41          | 100         | 0          | 0          | 12          | 100         | 0          | 0          | 0          | -           | -           | -        | -          | 118        | 100         | 0          | 0        | 0        | 60          | 70.6        | 29.4        | 0          | 0        |
| 1st Sept.    | 0           | -           | -          | -          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 30          | 57.1        | 42.9        | 0          | 0        |
| 2nd.         | 0           | -           | -          | -          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 3rd.         | 0           | -           | -          | -          | 81          | 83.3        | 16.7       | 0          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 4th.         | 0           | -           | -          | -          | 79          | 100         | 0          | 0          | 0          | -           | -           | -        | -          | 0          | -           | -          | -        | -        | 0           | -           | -           | -          | -        |
| 1st Oct.     | 22          | 100         | 0          | 0          | 60          | 100         | 0          | 0          | 0          | -           | -           | -        | -          | 138        | 100         | 0          | 0        | 0        | 265         | 99.1        | 0.9         | 0          | 0        |
| 2nd.         | 139         | 100         | 0          | 0          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 104        | 100         | 0          | 0        | 0        | 478         | 96.2        | 3.8         | 0          | 0        |
| 3rd.         | 89          | 100         | 0          | 0          | 0           | -           | -          | -          | 61         | 31.1        | 66.7        | 0        | 2.2        | 0          | -           | -          | -        | -        | 213         | 100         | 0           | 0          | 0        |
| 4th.         | 118         | 100         | 0          | 0          | 0           | -           | -          | -          | 0          | -           | -           | -        | -          | 340        | 90.7        | 9.3        | 0        | 0        | 340         | 90.7        | 9.3         | 0          | 0        |
| <b>Total</b> | <b>1826</b> | <b>99.3</b> | <b>0.6</b> | <b>0.1</b> | <b>1817</b> | <b>97.1</b> | <b>2.6</b> | <b>0.3</b> | <b>758</b> | <b>88.1</b> | <b>11.4</b> | <b>0</b> | <b>0.4</b> | <b>870</b> | <b>98.7</b> | <b>1.3</b> | <b>0</b> | <b>0</b> | <b>2421</b> | <b>85.9</b> | <b>14.0</b> | <b>0.1</b> | <b>0</b> |

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