# Is there strength in numbers?

## Gregarious strategy of *Anaphes flavipes* (Hymenoptera: Mymaridae) and its possible role in wasp survival after predator attack

**Bc. Kateřina Špačková**
Department of Plant Protection, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague,
Kamýcká 129, CZ-165 00, Prague 6 – Suchdol, Czech Republic

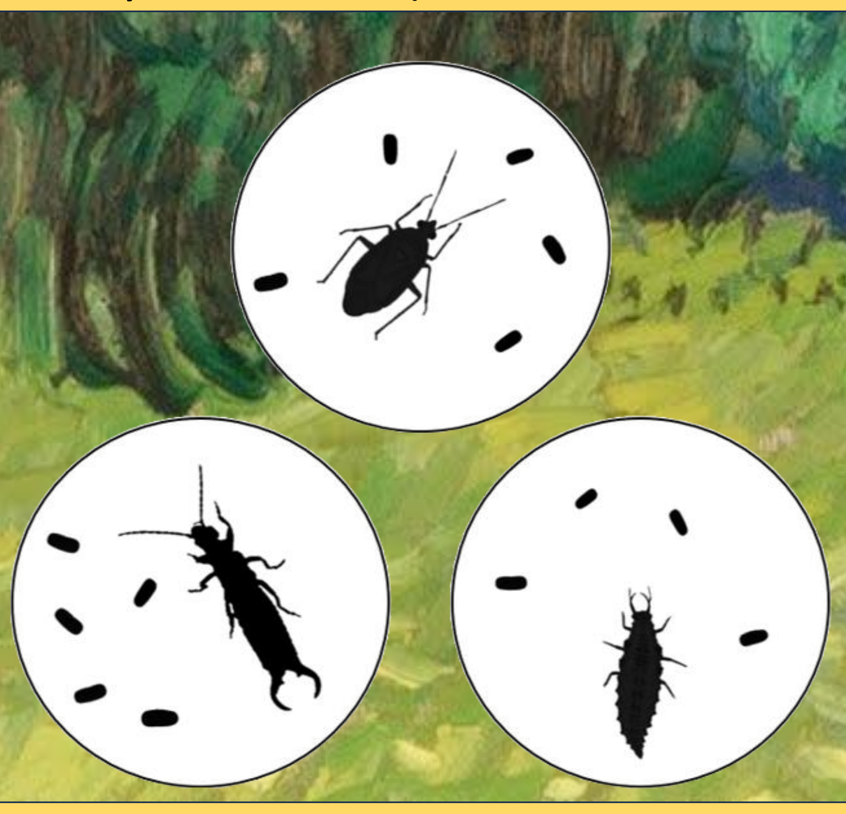
### INTRODUCTION

*Anaphes flavipes* (Hymenoptera: Mymaridae) is a parasitoid wasp, whose larvae develop in the eggs of cereal leaf beetles (*Oulema melanopus* and *Oulema duftschmidi*) both (Coleoptera: Chrysomelidae)[1]. *A. flavipes* uses selective gregarious strategy, meaning it chooses the number of eggs it lays in its host. Research has been conducted previously detailing the biology and ecology of this parasitoid [2, 3, 4], however possible function of gregarious strategy as anti predation strategy hasn't been researched before. Knowledge and mechanisms of gregarious strategy are of importance when using parasitoids who employ this strategy for biological control. In this study laboratory experiment was conducted using *A. flavipes* as parasitoid, cereal leaf beetle eggs as hosts and three predator species with different mouthparts *Chrysoperla carnea (Neuroptera: Chrysopidae), Deraeocoris sp.* (*Hemiptera: Myridae*) and *Forficula sp. (Dermaptera: Forficulidae)*. These organisms either serve as biological control agents or are generalist predators. The experiment was meant to assess the influence of gregarious strategy on the survival rate of the *A. flavipes* offspring after the host egg gets attacked by a predator and to see if there are any differences between the results depending on species of predator. Three analyses were performed to assess the influence of gregarious strategy regardless of predator species, to assess the influence of predator species on survival regardless of gregarious strategy, and to assess the combined influence of both.

### METHODS

The experiment was performer under constant laboratory conditions (22 ± 2 °C and 40- 60% relative humidity under 16:8 h (L:D) photoperiod).

First twenty Oulem complex eggs were placed in Petri dish with at least two *A. flavipes* females. Once the number of parasitoids in the eggs could be determined they were sorted into Petri dishes marked by the number of wasps developing in the egg (1, 2, 3 or 4+).



Predators were put into Perti dishes with parasitized eggs. For each category of parasitized eggs (1, 2, 3, 4+) twenty were offered to each group of predators and left with them, until the first signs of predation. After which the affected eggs were removed.

Afer predation the eggs were moved into Petri dishes containing moistened filter paper with one egg per dish. They were left to finish their development under the laboratory conditions When adults emerged from the predated eggs, they were counted under miscroscope. Amounts of emerged and not emerged individuals of *A. flavipes* were recorded.

### RESULTS

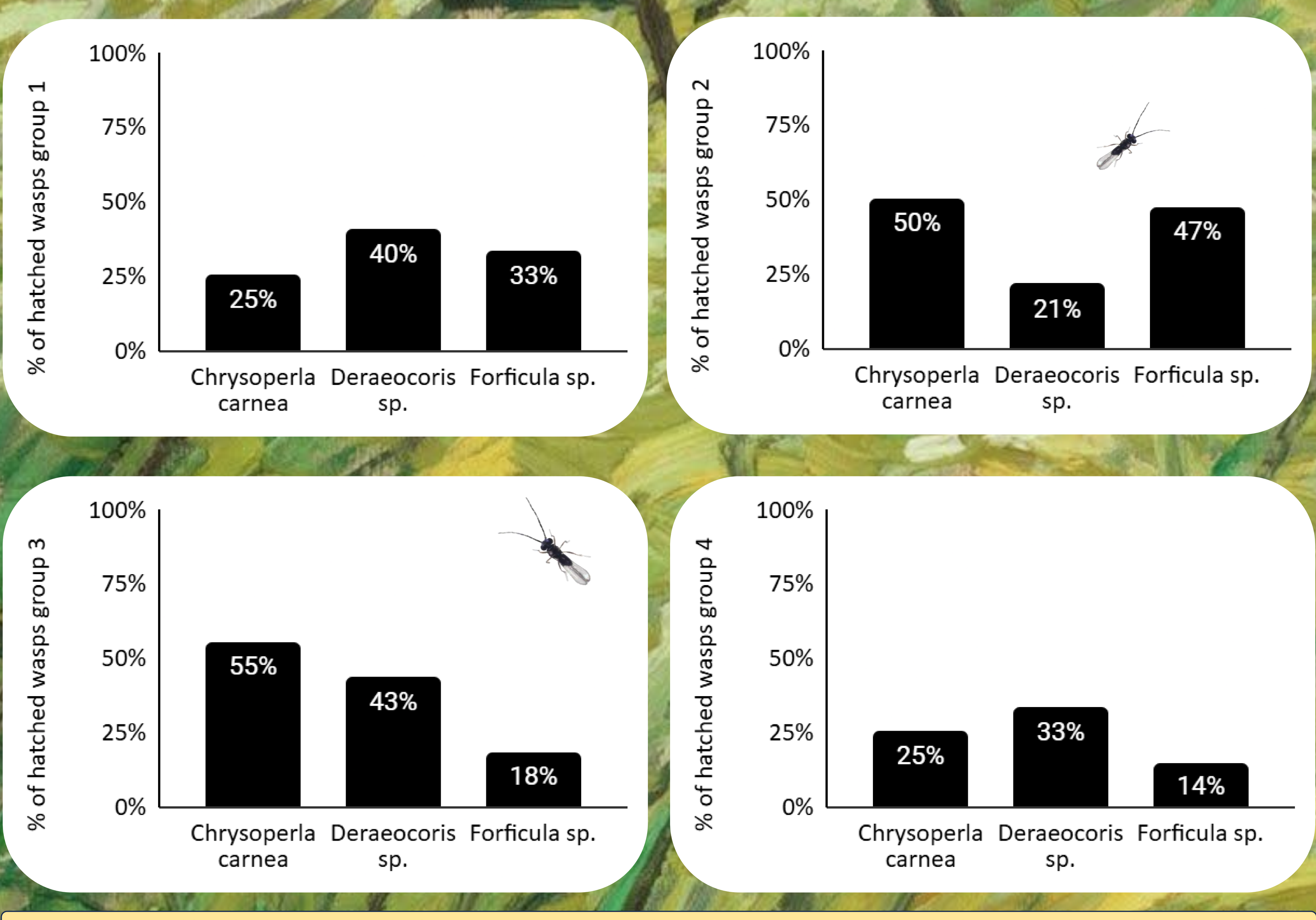
The influence of larval development on survival after predator attack was tested, irrespective of the predator species, by the means of GEE for binomial error distribution (GEE-b). According to this analysis, the number of wasp individuals developing in the egg does not influence survival rate of the wasps after predator attack ($p = 0.825$).

The survival rate of wasps was assessed, considering the predator species, but not the number of wasps developing in the host egg ($p = < 0.005$, test = GEE-b). The survival rate differs between the types of predators. When predators were compared to each other, marginal significance was found ($p = 0.05 < p < 0.1$). Survival rates were lower following attacks by *Forficula* sp. compared to those by *Chrysoperla carnea* and *Deraeocoris* sp.

Both the number of wasp individuals in the eggs and the type of predator were compared ($p = 0.002$, test = GEE-b). More wasp individuals in the egg means higher survival rate for eggs attacked by both *Chrysoperla carnea* and *Deraeocoris sp*. The eggs attacked by *Forficula sp.* show an opposite trend.

| | n 1 | Max. 1 | Real. 1 | n 2 | Max. 2 | Real. 2 | n 3 | Max. 3 | Real. 3 | n 4 | Max. 4 | Real. 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Chrysoperla carnea* | 20 | 20 | 5 | 20 | 48 | 20 | 22 | 66 | 36 | 14 | 56 | 25 |
| *Deraeocoris* sp. | 20 | 20 | 8 | 19 | 38 | 8 | 27 | 81 | 35 | 14 | 58 | 19 |
| *Forficula* sp. | 21 | 21 | 7 | 19 | 38 | 20 | 20 | 60 | 11 | 18 | 72 | 10 |

The number of host eggs offered to predators in each cathegory (1, 2, 3, 4+ wasp individuals per egg), maximum possible number of individuals that can hatch and the real number of hatched individuals.




The percentage of hatched wasp individuals per each cathegory of eggs (1, 2, 3, 4+ wasp individuals per egg) for each predator.

### CONCLUSION

The experiment has shown that the role of gregarious strategy alone is a negligible factor in survival rate of *A. flavipes* offspring in the host eggs predated by different predators. However, the type of predator and combination of the type of predator and gregarious strategy influenced the survival rate. In case of predation by *Forficula* sp. survival rate was the lowest and gregarious strategy was a disadvantage. After predation by *Chrysoperla carnea* survival rate was the highest. The survival rate after predation by *Chrysoperla carnea* and *Draeocoris* sp. benefited from the gregarious strategy. These findings contribute to the knowledge of reproductive strategy of *A. flavipes* as well as evolution of gregarious strategy in general. Additionaly it can be beneficial when using multiple species with different life strategies for biological control.

1 ANDERSON, Robert C.; PASCHKE, J. D. Factors affecting the postrelease dispersal of *Anaphes flavipes* (Hymenoptera: Mymaridae), with notes on its postrelease development, efficiency, and emergence. *Annals of the Entomological Society of America*, 1970, 63.3: 820-828; 2 SAMKOVÁ, Alena, et al. Reproductive strategy as a major factor determining female body size and fertility of a gregarious parasitoid. *Journal of Applied Entomology*, 2019a, 143.4: 441-450; 3 SAMKOVÁ, Alena, et al. Effect of adult feeding and timing of host exposure on the fertility and longevity of the parasitoid *Anaphes flavipes*. Entomologia Experimentalis et Applicata, 2019b, 167.11: 932-938 ; 4 SAMKOVÁ, Alena, et al. Host population density and presence of predators as key factors influencing the number of gregarious parasitoid *Anaphes flavipes* offspring. Scientific Reports, 2019c, 9.1: 6081.

**Contact:**
K.spackova@centrum.cz
This research has been conducted as part of Masters thesis.

Prague - Czech Republic

Czech University of Life Sciences Prague