Aphid colony collapse in an apple orchard with flower strips

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Introduction

- Flowering plants help diversify agroecosystems, increase diversity and abundance of both pollinators and natural enemies of pests (Balmer *et al*. 2013, Simon *et al*. 2017). Introducing alternative sources of pollen, nectar, prey and hosts, or habitat in or near the crop has, in some studies, increased recruitment of aphid natural enemies and intensified suppression of aphid colonies (Wyss *et al*. 1995, Cahenzli *et al*. 2019), while other studies found no significant effect (Fréchette *et al*. 2008).
- This project aimed to complexify the habitat of an apple orchard by establishing flowering strips of native perennial species in the alleyways to promote functional biodiversity. The objective was to compare the colony dynamics of green apple aphids (GAA) (*Aphis pomi*, *Aphis spiraecola*) and the effect of aphidophagous predators in managed versus unmanaged apple plots.

Materials and Methods

Data set : 2021-2022-2023

Measured variables : . Aphid abundance class for each colony (Table 1)
. Number of aphidophagous predators in each colony

Aphidophagous predators : Larvae of Cecidomyiidae, Syrphidae, *Leucopis* sp., *Chrysoperla* sp. and Coccinellidae adults + larvae.

Statistical analyses :

Generalized additive mixed models; significant if ΔAIC >2 (Wood 2017).

Table 1. Colony sizes according to Dib *et al*. (2010)

Abundances Class	0	1	2	3	4	5
Number of Aphids	0	1-5	6-25	26-50	51-125	>125

Results

Aphid colonies (Figure 1)

- There was an interaction between treatment and date (ΔAIC >19)
- Control: colonies reached maximum size between 20-60 d and persisted (until early- and late-June) or declined slightly (mid-July)
- Flower strips: colonies reached maximum size around 20-40 d and collapsed around 60 d (all periods)

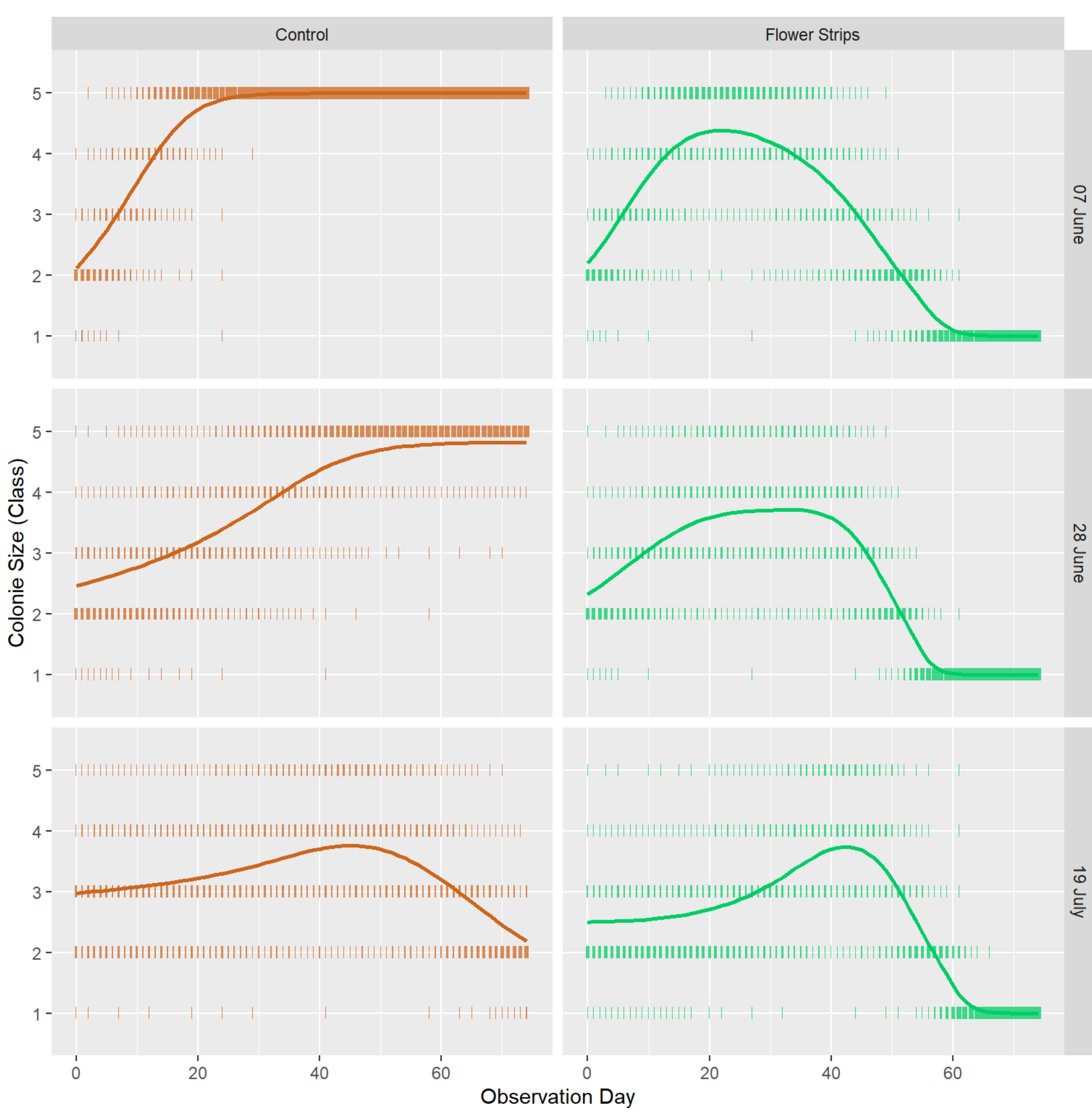

Figure 1. Colony dynamics of green apple aphids in managed (flower strips) and unmanaged (control) plots at three periods during the season (top: a few weeks after colony foundation; middle and bottom: three-week interval).
Pooled data from 2021, 2022 and 2023.

Aphidophagous predators (Figure 2)

- There was an effect of observation day and period of the season without interaction (ΔAIC >27). No difference between treatments was detected (ΔAIC <2)
- A binomial mode of abundance was observed in the flower strips treatment at each period of the season
- Most common taxa: Cecidomyiidae, Heteroptera, Coccinellidae

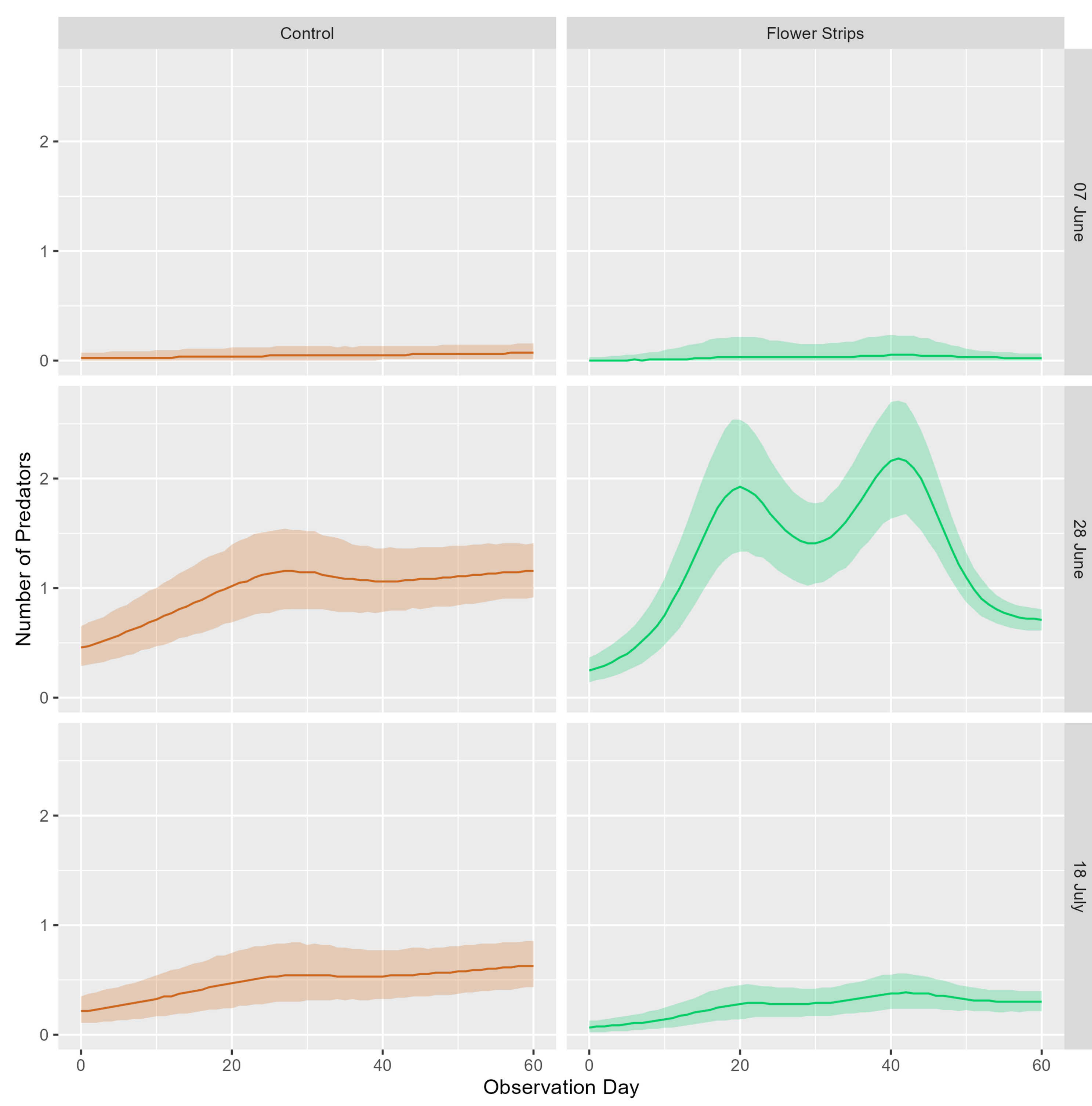

Figure 2. Number (mean ± CI) of aphidophagous predators observed in managed (flower strips) and unmanaged (control) plots at three periods during the season (top: a few weeks after colony foundation; middle and bottom: three-week interval).
Pooled data from 2021, 2022 and 2023.

Discussion

- While the developmental rate of aphid colonies seemed similar in both treatments at each period of the season, maximum colony size was higher in control than in flower strip treatment.
- Colony survival was the major difference between treatments. At each period of the season, aphid colonies in the flower strip treatment collapsed at around 60 days, while those in the control treatment persisted or declined slightly.
- Colony collapse cannot be attributed to aphidophagous predators, due to the absence of treatment effects.
- The effects of aphidophagous predators on aphid colony collapse could be difficult to demonstrate, especially for very mobile predators (Cahenzli *et al*. 2017).
- Our study suggests that an apple orchard managed with flower strips established in alleyways would harbour aphid colonies that will decline more rapidly than those in an unmanaged orchard. However, the cause of this decline is unknown. Naturally present predators, such as spiders, earwigs and Carabidae may have played a significant role (Herz *et al*. 2019).

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