

# Fifty shades of the Harlequin ladybird and a sexually transmitted disease

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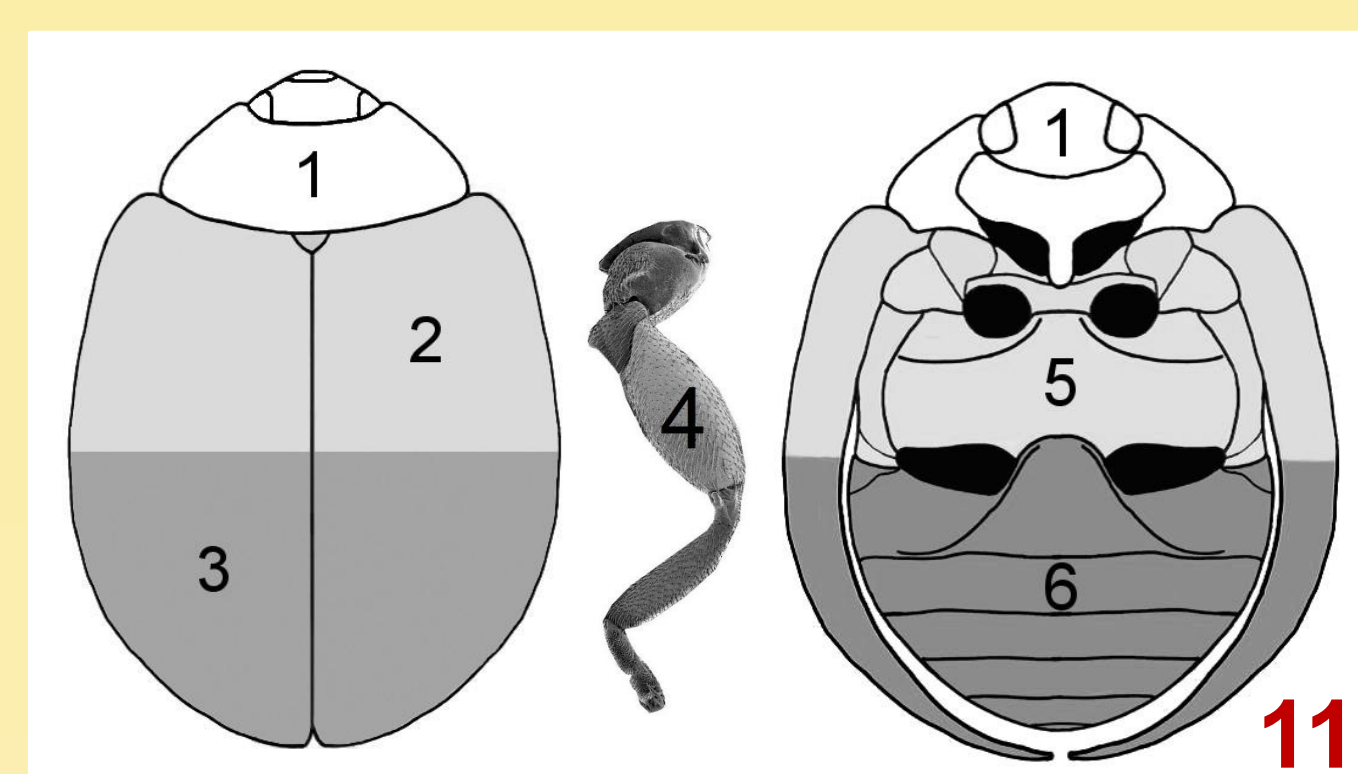
## Introduction

The ladybird *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) migrates to overwintering sites during sunny autumn days from September to November. Since it is multivoltine and long-lived species, the migrating individuals belong to different generations and have variable amounts of time to build up fat reserves and accumulate carotenoids. Here we analyse the physiological and reproductive characteristics and parasites of the harlequin ladybirds collected during autumn migration.



## Material and methods

Adults of *H. axyridis* were collected on building walls in České Budějovice between 9th October and 10th November 2014. Fresh weight, body size, sex and elytra colouration (black pattern extent and red hue) were recorded in every individual. Females were dissected for detection of sperm in spermatheca and part of them was examined for the presence of *Parasitylenchus bifurcatus* Poinar & Steenberg (Nematoda: Allantonematidae) in the body cavity. Location of thalli of the parasitic fungus *Hesperomyces virescens* Thaxter (Ascomycota: Laboulbeniales) [1, 10] was qualitatively mapped on every ladybird's body via six defined zones [11]. Carotenoids were extracted from elytra in ethanol and their concentration was measured spectrophotometrically at 450 nm.



## Results and discussion

There were 287 individuals (26 %) bearing fungal thalli, most commonly in the third body zone [7, 11]. While 36 % of infected females were mated, only 11 % of uninfected females were mated. Therefore *H. virescens* is rightfully considered as sexually transmitted disease. Heavily infected males had lower structural size compared to healthier males (elytral width × elytral length; 26.0±0.1 versus 25.1±0.3 mm<sup>2</sup>;  $F_{(1,577)} = 7.79$ ;  $p = 0.054$ ; mean±SE presented). This does not mean that infection causes less growth but rather that small males were more active in mating or were more sensitive for infection. The co-infection with both parasites occurred in 14 % of the females examined. These females had higher fresh weight and carotenoid contents in elytra compared to uninfected or single infected ones.



## Results and discussion

Out of 1102 individuals, there were 47 % of females and 53 % of males. There were 3 individuals (0.3 %) of the morph *axyridis* [2], 29 individuals (2.6 %) of the morph *conspicua* [3], 88 individuals (8 %) of the morph *spectabilis* [4] and 982 individuals (89.1 %) of the morph *succinea* [5-9]. Out of 982 *succinea* individuals, there were 176 individuals (18 %) with small extent of black elytral pattern [5], 768 individuals (78 %) with medium extent [7] and 38 individuals (4 %) with large extent of black elytral pattern [6]. With respect to the red hue, there were 267 red [7] individuals (27 %), 696 orange [8] individuals (71 %) and 19 yellow [9] individuals (2 %).

Average fresh weight was high on the first day of migration, thereafter decreased and remained low for the rest of migrating period [12] ( $F = 8.02$ ;  $p < 0.001$ ). Adverse conditions later in the season did not allow younger individuals to accumulate much reserves compared to older individuals. Lighter individuals were feeding until they reached sufficient reserves for overwintering.

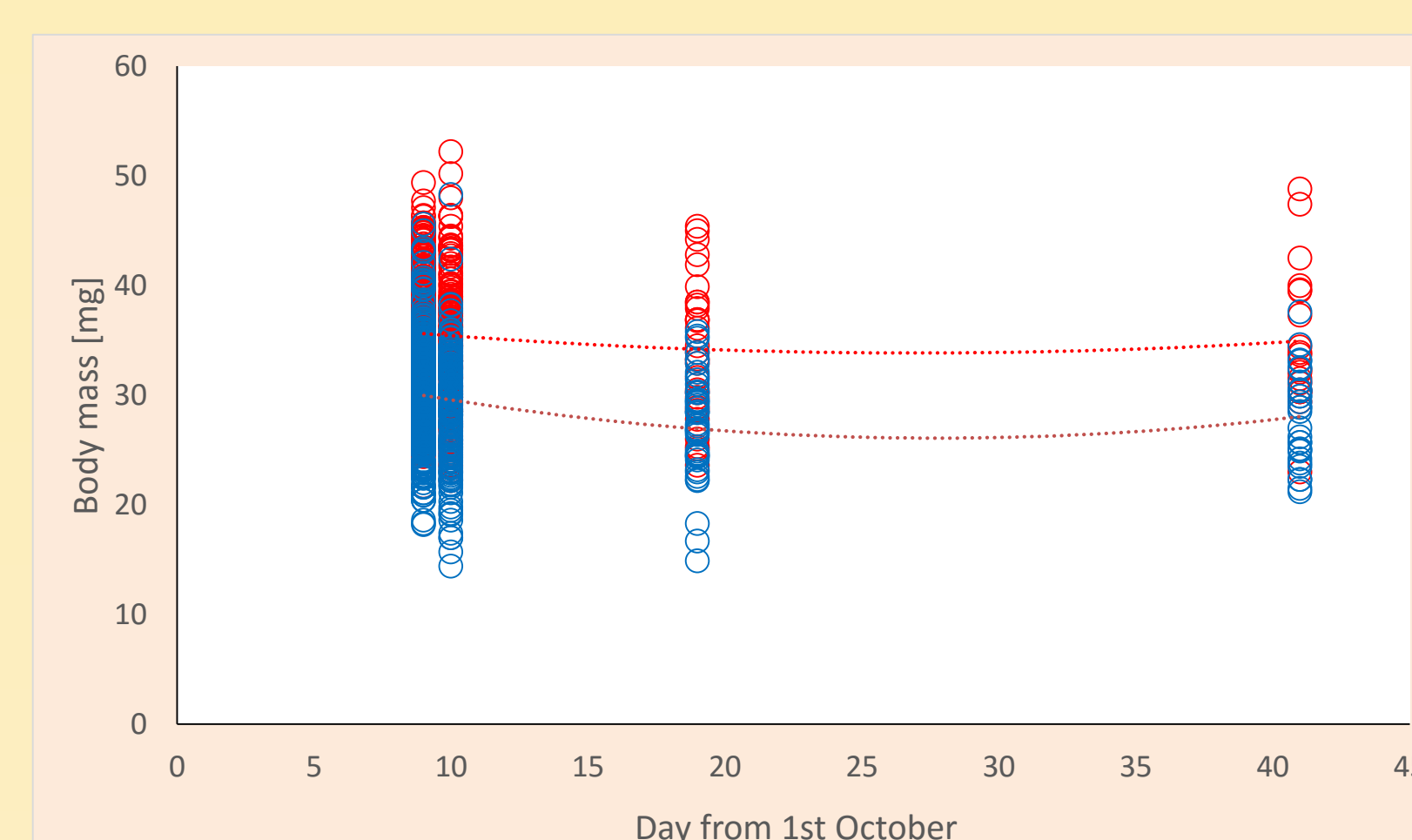
Relative elytral extract absorbance (ratio of absorbance to fresh weight) significantly decreased with time [13] according to a linear function: absorbance / weight = 5.17 – 0.023 × day ( $p < 0.001$ ;  $p = 0.05$ ). The red older individuals migrated as soon as possible, while the younger orange ones came to it gradually.

There were 77 % of the red older females [7] mated, 39 % of the younger orange females [8], 36 % of the yellow females [9] and 48 % of the melanistic females [3, 4] mated. Smaller proportion of young females managed to mate before migration.

There were more *succinea* individuals that were heavily spotted in later samples because they moulted recently before the migration at lower temperatures causing increased melanisation.

*Succinea* individuals with small fraction of the elytra melanised [5] had high carotenoid concentration, followed (in descending order) by individuals with medium extent [7] and individuals with large extent of black elytral pattern [6] ( $F = 5.84$ ;  $p = 0.003$ ). Thus epidermal cells do not store carotenoids underneath the black cuticle.

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