

The effect of environmental condition during the larval period on the development of intraspecific parasitic reproductive behaviour and learning abilities in adult honey bee workers (*Apis mellifera* L.)

Reproductive parasitism, in which one individual discards their eggs (or offspring) to bring up those of another individual, is known primarily in birds. One of the most famous and spectacular examples of such parasites can be found in the cuckoo. However, such parasitism is widespread not only in birds but is also described in a variety of insects such as some species of aphids, ants, bumble bees and beetles. Moreover, unlike the cuckoo which discard their eggs to individuals from another species, some insects cheat individuals of their own species, therefore in this case we can speak about intraspecific reproductive parasitism.

Intraspecific reproductive parasitism can be found most often in the social insects (e.g. ants, bees, wasps), which usually build a large nest and care for their offspring. The honey bee is one of those species in which intraspecific reproductive parasitism can exist. Studies show that due to the often short distances between colonies kept in apiaries, up to 40% of the workers in a colony may be from other colonies. However, they usually don't lay eggs because the presence of the queen in the nest effectively inhibits their ovary activation. It is of the opinion that the drift of workers between colonies is influenced by loss of orientation by the bees. However, in the honey bee, there are situations in which workers can activate their ovaries and lay unfertilised eggs from which can develop males (drones). For such a situation to occur, the adult bees should live in a nest without a queen. Therefore, all foreign workers, which drift into the colony without a queen may have a large reproductive success. However, some studies have shown that honey bee workers are not able to distinguish whether the queen is present or absent in the colony.

In this research the investigators used normal honey bee workers with are characterised by not so high reproductive potential (even if they have the possibility to activate their ovaries) and their life strategy can largely be linked to altruistic behaviour rather than selfish reproduction. A recently discovered new sub-caste of honey bee workers, called 'rebel workers', can shed new light on the topic of intraspecific reproductive parasitism in bees. Rebel workers develop immediately after swarming, which is the only natural means of colony multiplication, and have higher reproductive potential compared to normal workers. Their ovaries are built with a higher number of ovarioles than other workers' ovaries, meaning that they can lay more eggs than normal workers in the same time. Moreover, rebel workers are able to activate their ovaries - even in adult life they are staying in the colony with the queen, which means that their life strategy is more selfish than the typical worker. Observations made in recent years suggest that rebel workers more often drift to foreign colonies than normal workers. This may mean that they have a tendency to intraspecific reproductive parasitic behaviour. The aim of this project will be to test whether rebel workers really do drift more often to foreign colonies and whether rebel workers reproduce more efficiently in these unrelated colonies. The investigator intends to carry out two experiments: (1) in which I plan to test whether the rebel workers more often drift to foreign colonies than normal workers and whether these rebel workers have more developed ovaries than normal workers; and (2) a cross experiment, in which I would like to test how life in the foreign colony affects rebel workers' reproduction. In this project I also would like to test whether rebel workers drift to a foreign colony more often because their learning abilities are lower compared to normal workers. To achieve this I will perform a third experiment in which I compare the speed of learning between normal and rebel workers, and I will also see whether these two groups of workers differ in the level of dopamine in the brain (a neurotransmitter affecting learning).

Due to the fact that intraspecific reproductive parasitism can negatively impact the foreign colony condition (workers from a foreign nest care for the alien larvae and use their resource and time for it), knowledge about this parasitic behaviour in colonies of the honey bee - one of the most important pollinators and honey producers - is very important and desirable.