Impact of social parasitism on colony development of *Bombus ignitus*

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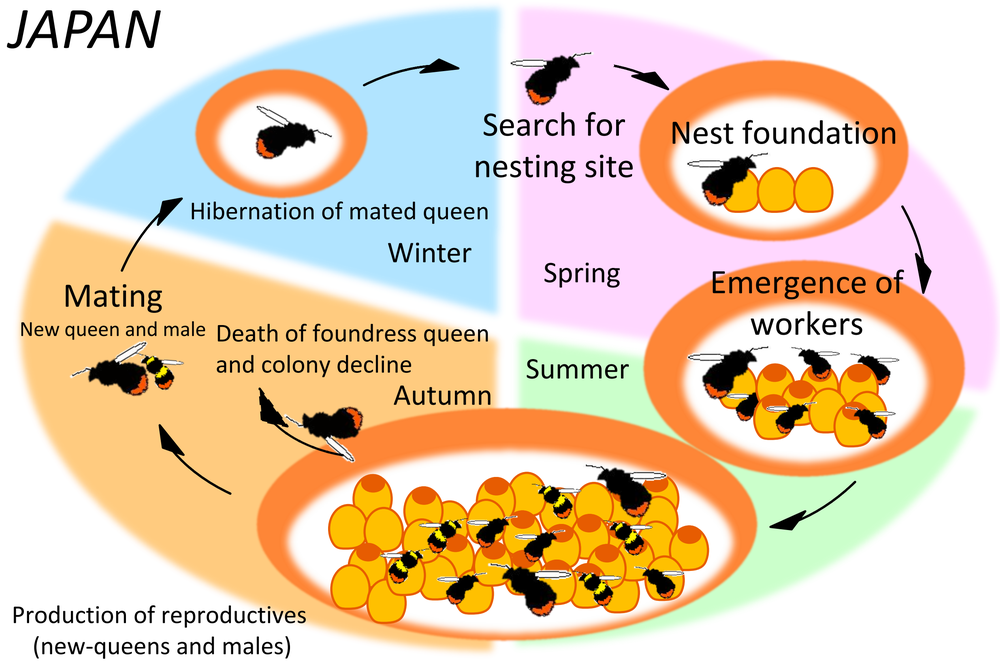
Introduction

There are several reports from Europe and Japan about unrelated bumblebee queens of the same or different species forming a mixed colony, suggesting that nest takeover occurs in nature, although a foundress queen can build a colony herself. A possible cause of this phenomenon may be a limited number of suitable nest sites and variation in when queens wake after overwintering. Clarification of bumblebee life cycles is important in understanding the adaptive significance of social parasitism, but field observation is very difficult.

Therefore, we studied the impact of nest takeover on colony development by *Bombus ignitus* by using laboratory reared colonies.



Annual life history of *Bombus ignitus*

Methods

Experiment 1.

Tendency of takeover behavior by post-hibernation queen

We checked if post-hibernation queen preferred an orphan nest or just an empty cavity as her nesting site. Two orphan nests (number of cocoons 5-10) and two empty boxes put into a larger observation box, then a post-hibernation queen searching for a suitable nesting site was installed (Fig. 1). We observed which nest was chosen by the queen.

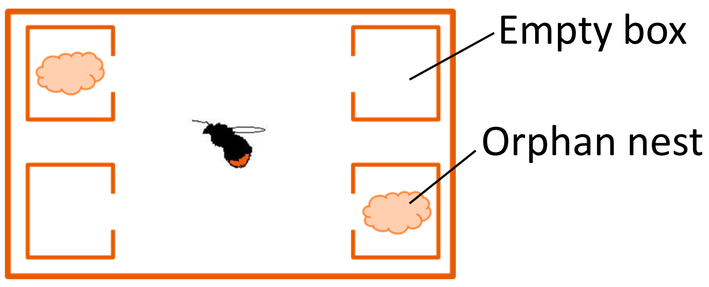


Fig. 1 Design of experiment 1

Experiment 2.

Impact of nest takeover on colony development

We checked if reproductive fitness increased with the nest takeover. The foundress queen was removed from her initial nest, and a fresh post-hibernation queen was installed in the nest (Fig. 2). Then we reared the artificially taken over nest in the laboratory. The number of reproductives (new queens and males) produced from the takeover nests and non-takeover nests (as control) were compared to clarify the adaptive significance.

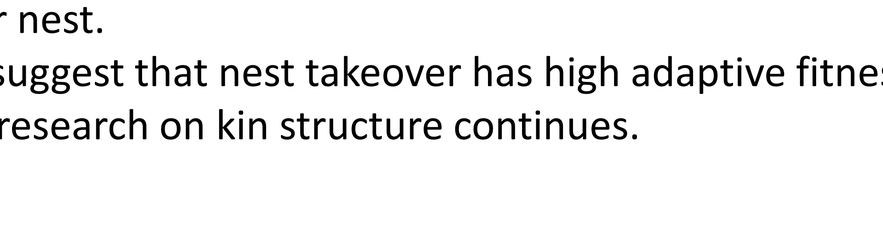


Fig. 2 Design of experiment 2

Conclusions

- Post-hibernation queens prefer orphan nests as nesting sites and the nest takeover by the queens occurs easily in laboratory.
- Ratio of increase in number of egg cups was faster in the takeover nest than non-takeover nest, suggesting brood elicit oviposition by takeover queen.
- Emergence of males and new queen from takeover nest was earlier and number of reproductives was higher than non-takeover nest.
- Results suggest that nest takeover has high adaptive fitness.
- Further research on kin structure continues.

Results

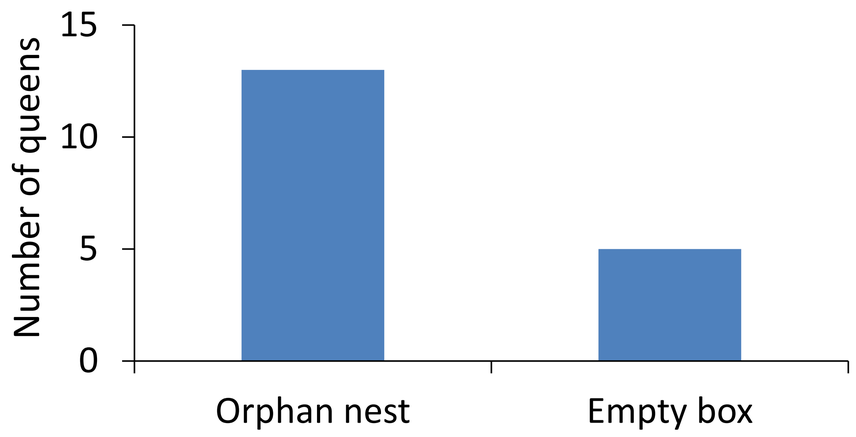


Fig. 3 Preference of post-hibernation queen for orphan nest or empty box as nesting site (Experiment 1)

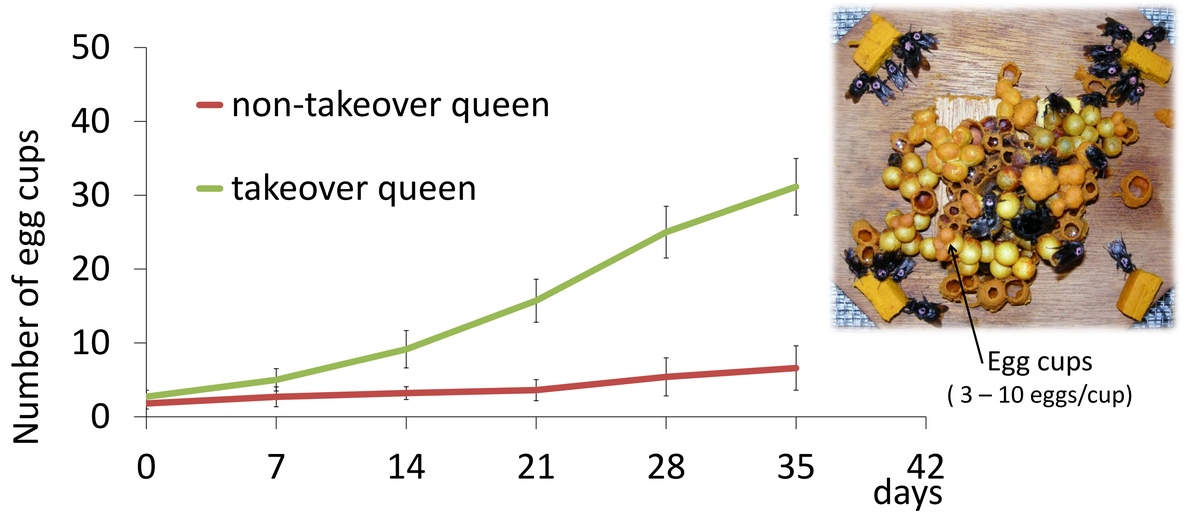


Fig. 4 Comparison of increase in number of egg cups between non-takeover (n=10) and takeover queens (n=6) (Experiment 2).

Table 1 Number of days workers and reproductives (males and new queen) required for emergence (Experiment 2)

mean±SD

	Worker	Male	New queen
Non-takeover queen	31.2±4.5	78.8±12.7	100.0±6.2
Takeover queen	24.7±2.4	69.8±10.3	61.2±14.1

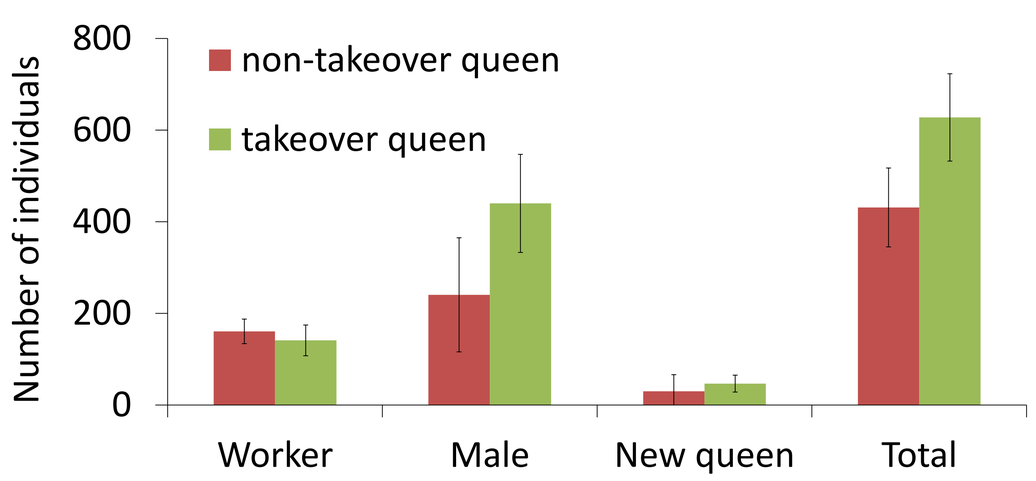


Fig. 5 Comparison of final productivity between the non-takeover (n=6) and takeover (n=6) colonies (Experiment 2)