Roles of Diploid Male Bumblebees in the Maintenance of Their Colonies

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Bumblebees are social insects: one queen and many worker bees live in the nest. In the Japanese bumblebee Bombus ignitus, the queen lays fertilized diploid eggs that develop into female workers in summer. In autumn, the queen switches her egg-laying mode to produce unfertilized haploid eggs that develop into haploid male bees for mating. In some colonies, however, diploid male larvae are frequently found in summer and safely develop into adults. Although diploid male bees seemed inactive and useless in the colony, a doubt arose here that these males should have the reason of being. Here, we report that the diploid males assist brood care by maintaining the nest temperature. Male activities and nest temperatures were analyzed, followed by fluorescence imaging to identify the ploidy of all tested males. After entrainment at a 12L:12D h light cycle, haploid and diploid males showed significant free-running rhythms in constant darkness. Locomotor activities of diploid males were significantly lower than those of haploid males, suggesting that diploid males stayed longer in the brood chamber area. The temperature of the brood chamber area with diploid males was significantly higher than that of the area with no diploid males. These results indicate that seemingly inactive diploid males positively affect brood incubation by maintaining the nest temperature. Finally, fluorescence imaging showed that endoreplication occurred in muscle tissues of haploid males but was suppressed in diploid males. The males of this species can be suitable models for studying endoreplication occurring in human tumors.

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