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Genetic Variation in Eusocial Insects

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Thinking Matters

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Abstract:

How do eusocial species of insects, with a single matriarch, create genetic variation within their populations? This review examines possible answers by looking at research carried out with termite, ant, and bee colonies, with a focus on colonies formed through and maintained in monogyny. Answering the question of genetic variation allows for a better understanding of the inheritance patterns of genetic diseases in these insect populations. Bee populations have been on a path to recovery since reaching their lowest population point in 2008. The drop in population was due to numerous factors that include a lack of biodiversity, as well as parasites and a loss in habitat. Understanding how genetic variation within these populations occurs may suggest methods to promote an increase in biodiversity. Termites and ants have interesting and unique methods of inheritance, and they both play significant roles within their ecosystems as decomposers. It is important to understand how termites and ants create genetic variation, so that they can be better managed in their natural environments and effectively controlled. Researchers have concluded that populations will not undergo a lack of genetic diversity, so long as there are others of their colony type to mate with during their nuptial flights. The worker caste within the colonies do not reproduce, and as such, are unable to pass along their genetic code. Only the reproductives within colonies show inheritance.

Introduction:

The nature of the poster is to discuss the ways in which eusocial insects generate genetic diversity within their respective populations. In order to achieve this goal, there were a few criteria that the insect type had to have in order to be selected for the poster. The first and most important qualifier was that the colony types were monogynous (meaning that they only possess one queen). This was in order to limit the genetic diversity within the populations. The second qualifier was that the insect uses a caste system for colony organization. The use of a caste system allows for easy tracking of reproductive lines. The third and final qualifier was that all queens must be capable of some form of asexual reproduction. This was in order to show how the colonies of the given insect type would survive without male reproductives increasing diversity. Ants(some species), termites, and bees were the most viable candidates. It also turns out that the insects types that were selected also all participate in nuptial flights. A nuptial flight occurs during a certain period every year once a colony has reached the age in which it can produce reproductives. This is where the vast majority of gene transfer occurs, except in the case of termites (the male continues to live with the queen and fertilize).

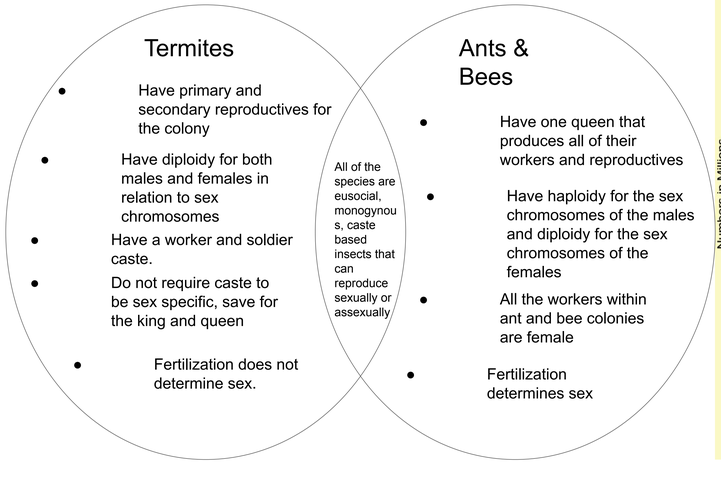
*This was a literature review based upon several different studies. The two articles used to give background for the bee section are “Data in Everyday Life: Are Honey bees on the Decline?” from PQ Systems on May 4th, 2019 by Kiki Schockling and “Are We Handling the Bee Crisis All Wrong?” from Food and Environment Reporting Network on July 24th, 2019 by Rowan Jacobsen. The information for the ant section comes from “Ants change the rules of an evolutionary arms race” from Scitable on april 6th, 2009 by Rachel Davis and “Genomes of two ant species sequenced: Clues to their extraordinary social behavior” from Science Daily on August 27th, 2010 by NYU Langone Medical Center / New York University School of Medicine. The termite section used the articles “Genes Underlying Reproductive Division of Labor in Termites, with Comparisons to Social Hymenoptera.” from Frontiers on April 26th, 2016 by Judith Korb and “Evolution of the asexual queen succession system and its underlying mechanisms in termites” from The Company of Biologists Ltd. on January 1st, 2017 by Matsuura K.

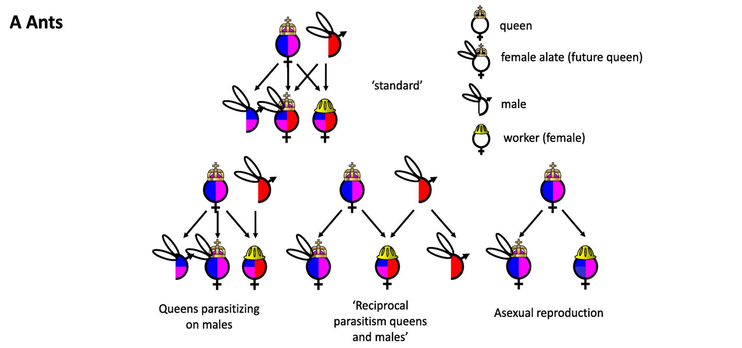
Reasoning behind selections:

Declining genetic diversity within bee populations was the original focus of the poster, but it was confusing how bee populations continued to decline while ant species with the same methods of reproduction and habitat requirements were not declining. It turned out that the way in which the bee populations were housed, along with their lack of genetic diversity due to breeding techniques and habitat loss caused them to be far more susceptible to viral and parasite based outbreaks. Ant populations are not farmed, and as such do not live in areas that restrict their genetic diversity and as such they are more resistant to outbreaks. Termites were used to show both that not all eusocial monogynies reproduce through haploid sex chromosome male reproductives, and also that caste systems within colonies are not always sex determinate.

The importance of genetic diversity:

Genetic diversity allows for a population to slowly develop resistances to viruses and parasites. In the same vein, it also creates the variation within the population that allows for gradual adjustment to environmental factors. Through the use of variation, a population can generate useful genes that allow for a greater chance of survival.





The top image shows the genetic differences during reproduction for termites and ants

The middle image shows the method of reproduction for bees

The bottom image shows the decline in honey bee population within the US