Social insects, your grandma and Darwin

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Darwin was not a fan of social insects, or at least not of those you're likely to step on or be stung by. Some of these critters—notably ants and termites, and certain wasps, bees and aphids—exhibit a high degree of social organization that modern scientists describe as "eusocial." And the thing about eusocial insects is that many of them, whole castes of workers, are sterile. Darwin felt, and rightly so, that sterile workers presented a "special difficulty" for his theory of natural selection.

It was a difficulty he couldn't easily ignore: eusocial insects constitute about 75 percent of all insect biomass, even though only about 2 percent of insect species are eusocial. So what the heck is going on here? Why are so few so abundant? And what was Darwin so upset about anyway?

Eusocial animals live in groups marked by an overlap of generations, cooperative care of the young and a reproductive division of labor. It is this last part that made Chuck cranky: he had a hard time seeing how evolution could select for sterility. Science has answered that in a few different ways, chiefly by switching our focus from bodies, which are temporary, to genes, which are potentially immortal.

Eusociality has turned some organisms into "super-organisms," colonies of animals that work together as if they were part of a single body, and collectively work so that one or a few of their relatives can reproduce.

Honey bees are my favorite super-organism. They rely not only on a reproductive division of labor, but also on a general division of labor within the work force. This allows the colony to accomplish many

different things at once: tending the queen, feeding the brood, expanding the colony, collecting nectar and pollen and other tasks, which they optimize through their highly evolved communication networks.

When tens of thousands of workers are performing optimally, amazing things can happen. Not only do honey bees construct and defend their homes; they also clean them, air-condition them and sometimes heal sick members within them. With skills like those, no wonder eusocial insects are so abundant.

Aside from the threat to his theory of natural selection, there is some irony in Darwin's distaste for eusociality. And that's because these animals sound a lot like us. We live in multigenerational groups, we provide cooperative care of offspring, and we have a division of labor where individuals can maximize their talents. These traits have allowed us to become the single most invasive species on the planet.

But there's another eusocial trait we share with the honey bee, and that's a reproductive division of labor. A large class of humans is almost entirely sterile. They're called grandmothers. Of course, to be a grandmother you have to be a mother first. So unlike worker bees, these individuals are not sterile for their entire lives—but they may be sterile significantly longer than they were fertile.

The rarity in nature of such an extended post-reproductive life span has led science to wonder about grandmothers. The main question mirrors the one we asked about sterile workers in insect colonies: under what conditions would foregoing reproduction actually increase evolutionary fitness? And the answer is the same. Grandmothers may appear harmless, but don't be fooled; they are responsible, at least indirectly, for generating a substantial share of human biomass.

It turns out that having a grandmother nearby increases a couple's

offspring production by lowering the age for a first birth and shrinking the interval between births. You can call this the Nagging Hypothesis if you're brave enough ("When are you going to give me a grandchild? Don't you think your baby needs a younger sibling?"), but the data overwhelmingly support its effectiveness. For every 10 years of postmenopausal life, a grandmother is likely to have two additional grandchildren. This is good for the grandmother and for her children's evolutionary fitness.

Not every family benefits from sterile workers, of course, but many do. I believe humans are so successful precisely because we are eusocial—or "ideally" social, as the term suggests. It's a phenomenon defined more by cooperation than by conflict, and that's something Darwin would have loved, even if he never felt the love for ants.

Provided by Tufts University