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FOCUS

PROJECT

Conflict Resolution in Biological Systems

Scientific progress often comes through the identification of common principles of broad significance. One common principle is that the evolution of more complex biological units (e.g., genomes of many genes, multicellular organisms, societies) causes potential conflicts among sub-units. Furthermore, complex biological units often have mechanisms that reduce conflicts among subunits so that the higher-level unit can function more effectively. Conflicts arise because the interests of the sub-units are typically non-identical. Mechanisms for reducing conflicts typically arise when sub-units can be coerced to act in the interests of the group as a whole.

To give two concrete examples: In a honey bee colony, most of the males are the offspring of the queen, yet each worker possesses functional ovaries and is more related to sons (0.5) than brothers (0.25, the queen's sons). The reason why workers seldom reproduce is that they are prevented from doing so by other workers, which kill worker-laid eggs. This "worker policing" eliminates most of the conflict over male production and improves the functioning of the colony as a whole. Instead of competing over reproduction, the workers work, thereby maximising the survival and reproduction of their colony. In eucaryotic organisms, genes at different locations in the genome are not transmitted with the same probability to offspring. Genes in cytoplasmic organelles (e.g., mitochondria) or symbionts (e.g., Wolbachia) are normally transmitted only to female offspring, whereas nuclear genes are transmitted equally to offspring of both sexes. Mitochondrial genes in plants frequently cause male sterility, but this is often prevented by nuclear genes that restore male fertility.

Biological conflicts occurring at different "levels" have traditionally been studied in isolation. Some researchers focus on conflicts within societies, others on conflicts between partners in mutualisms, while others study conflict within organisms, such as the intragenomic conflict between nuclear and mitochondrial genes. Although these various researchers are aware of each others' work, there is great need for a deliberate attempt at synthesising across the different areas and levels of conflict. Such a synthesis should determine the common principles underlying conflicts and conflict resolution in different social systems and also the idiosyncratic differences due to differences in level and the particular species or system being studied. Allied with the search for these common principles will be the search for underlying unity and consistency in the theoretical framework used for understanding and analysing conflicts.

Recommended Reading

Wenseleers, T., L. Sundström, and J. Billen. "Deleterious Wolbachia in the Ant Formica truncorum." Proceedings of the Royal Society of London. Series B, Biological Sciences

269 (2002): 623-629.

Wenseleers, T., F. L. W. Ratnieks, and J. Billen. "Caste Fate Conflict in Swarm-Founding Social Hymenoptera: an Inclusive Fitness Analysis." Journal of Evolutionary

Biology 16 (2003): 647-658.

Wenseleers, T. and F. L. W. Ratnieks. "Tragedy of the Commons in Melipona Bees. Proceedings of the Royal Society of London. Series B, Biological Sciences

(Supplement) DOI 10.1098/rsbl.2003.0159 (2004): 1-3.

COLLOQUIUM, 07.06.2005

From Genes to Societies: A Biologist's View on Conflict and Conflict Resolution

"They are in you and me; they created us, body and mind; and their preservation is the ultimate rational for our existence. They have come a long way, those replicators. Now they go by the name of genes, and we are their survival machines."

"Let us understand what our own selfish genes are up to, because we may then at least have a chance to upset their designs, something that no other species has ever aspired to do."

Dawkins (1976)

Some male flies inject their mating partner with a toxin. Some bacteria turn their male hosts into females. Tiger shark embryos eat each other inside the womb. These are all manifestations of different biological conflicts - occurring between mating partners, between genes within organisms, and between siblings. They are evolutionary puzzles which can best be understood from the perspective of Dawkins's metaphor of the selfish gene. All that matters in evolution is the differential replication of genes. Most of the genes which replicate best are those that help their host organism or "vehicle" to survive or reproduce better. But some genes replicate better in counterintuitive ways, such as by causing their host to harm its mating partner, change sex, or kill its siblings. Nevertheless, it is not all bad news. Under some circumstance, genetic selfishness can result in the evolution of highly cooperative organisms or societies. Hence, evolution predicts both conflict and cooperation. This point will be illustrated using a range of examples. Towards the end of my talk I will also touch on conflict and cooperation in human society. In what ways are we fundamentally different from animals, and in what ways are we the same? Factors such as gene-culture coevolution, memory of previous interactions and reputation can greatly broaden the scope for cooperation in humans versus animals.

Wenseleers, Tom (Berlin,2011)

Darwins special difficulty the evolution of neuter insects and current theory

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1046032941

Wenseleers, Tom (London [u.a.],2011)

Inclusive fitness theory and eusociality

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1017879834

Wenseleers, Tom (2010)

Social evolution theory : a review of methods and approaches

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=877001405

Wenseleers, Tom (Amsterdam [u.a.],2006)

Kin selection is the key to altruism

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1665053828

Wenseleers, Tom (2006)

Conflict resolution in insect societies

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1047209489

Wenseleers, Tom (2005)

Working-class royalty : bees beat the caste system

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=772399301

Wenseleers, Tom (2005)

A test of worker policing theory in an advanced eusocial wasp, Vespula Rufa

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=772398240

Wenseleers, Tom (2005)

Policing insect societies

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=771340192

Wenseleers, Tom (2004)

Queen execution and cast conflict in the stingless bee Melipona beecheii

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=896083764

Wenseleers, Tom (2004)

Tragedy of the commons in Melipona bees

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