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ABSTRACT BOOK

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GROUP BEHAVIOR / INDIVIDUAL INTERACTIONS

Interaction between individuals: from cooperation to cheating

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Evolution has favoured many interactions between individuals of the same species and between species. The degree of interaction varies from simple parasitism to cooperation (mutualism). The persistence of cooperation is an evolutionary paradox as selection should favour those individuals that exploit their partners (cheating) obtaining benefits without providing a reward in return, resulting in the breakdown of cooperation. To prevent this, mechanisms avoid or retaliate against exploitation by cheaters, maintaining the stability of mutualisms. I will present some examples mainly in ants and micro-organisms.

Interspecific cooperation is well-known in vertebrates, for examples in cleaner reef fishes. Some cleaner will try to feed directly on the client mucus instead of parasites but various strategies will limit the spread of cheating behaviour. Cleaning behaviour has been discovered in ants where a small species licks the bigger harvester ant in Arizona desert. The harvester ant adopts a cleaning posture. We suppose that the benefit of the client is prophylactic. We studied myrmecophile beetles, which enter the nest of the host ants using chemical mimicry. They are tolerated as they have the host colony odour. Are they simple guests? We observed that they spend considerable time licking the ants and the larvae. This may be also an example of cleaning behaviour.

Fungus-growing ants are also a good model for studies in mutualism. 45 million years ago, they have domesticated a fungus used to feed their larvae. There is a parasite fungus which can destroy very efficiently the garden and kill the colony. The ants defend as they have bacteria on their cuticle providing an efficiency antifungal. The symbiosis is much more complicated as yeasts and many other bacteria have been recently discovered; their role being unknown at present.

Micro-organisms are a superb model for evolutionary studies due to their rapid reproduction (in bacteria one generation every 30 minutes). The social amoebae *Dictyostelium discoideum* have been studied using the kin selection theory of social insects. They are clonal organisms that aggregate in multicellular slimes when environmental conditions are not good. They form a fruiting body where cells from the stalk (25% of the cells) dye by apoptosis (programmed cell death) while the other ones become a spore. When two strains are mixed to form the fruiting body, some behave as selfish cheaters: they prefer to take the good place to become spores. These cheaters cannot invade the population as they need the presence of altruists (demonstrated by game theory).

Our last example will be on bacteria. The pyocyanic bacillus *Pseudomonas aeruginosa* is a dangerous pathogen for mammals (nosocomial infections in humans). When injected to mice they kill them in a few days. They produce and excrete siderophores (molecules fixing iron, here a pyoverdine), available for the secretory cell but also for neighbours. It represents a cost for the producer which is altruistic. Cheater mutants do not produce siderophores, but profit of those produced by neighbours. Here again mutants cannot invade the population. A great discover was that mice mortality is lower when a mixture of secretors and cheaters was injected. May be in a few years we will treat infections by injection of cheating strains?