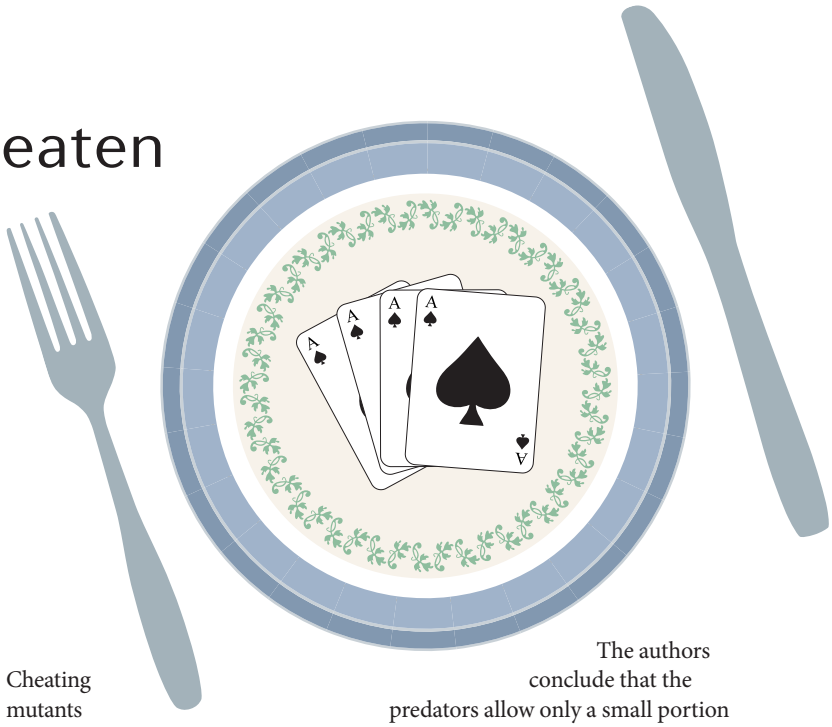
BACTERIAL ECOLOGY

Cheaters get eaten



The rhizosphere, the soil compartment around plant roots, is filled with predators that feed on bacteria. In response, bacteria secrete toxins to ward off these predators. However, the high cost of toxin production induces some bacteria, termed 'cheaters', to stop producing toxins and rely on the defence mechanisms of the other bacteria. Jousset and colleagues describe in a recent issue of *The ISME Journal* how predators maintain the balance between the numbers of cheaters and the numbers of toxin-producing bacteria.

Pseudomonas fluorescens is an example of a bacterium in the rhizosphere. To stave off predators, such as the nematode *Caenorhabditis elegans* and the amoeba *Acanthamoeba castellanii*, it produces several toxic compounds. Synthesis of these compounds is regulated by intercellular signalling, but is metabolically costly for the bacteria, and so-called cheaters, mutant strains that no longer sense the signals that induce the production of toxins and other exoproducts, rapidly evolve in bacterial populations. Jousset and colleagues show that these cheaters have a faster growth rate when grown in the laboratory or in a predator-free soil environment. However, when predators were present, fitness of the cheaters decreased significantly.

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Cheating mutants affected the total number of bacteria in the rhizosphere only in the presence of predators.

Both *C. elegans* and *A. castellanii* preferentially grazed on the mutants, although the amoebae were more selective than the nematodes. Whereas nematodes reduced bacterial numbers irrespective of the percentage of mutants, the amoebae reduced the bacterial population proportionally to the number of mutants. Nematode numbers decreased with lower mutant levels, indicating that the toxins had an inhibitory effect on the nematodes.

The authors conclude that the predators allow only a small portion of the population to cheat. When cheating becomes rampant, toxins that either kill the predator or prevent grazing fall to levels at which individual cheaters are no longer protected, and therefore become more vulnerable to predation. As a result, the predators ensure that the level of cheaters stays low, and provide a balance to the bacterial population.

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ORIGINAL RESEARCH PAPER Jousset, A. *et al.* Predators promote defence of rhizosphere bacterial populations by selective feeding on non-toxic cheaters leaves. *ISME J.* 26 Mar 2009 (doi: 10.1038/ismej.2009.26)