

Different anti-predator defenses induced by roach and signal crayfish in the invader zebra mussel

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Invasive species present exceptional characteristics, which favor their colonization of new ecosystems. One of these characteristics is their high plasticity against the new conditions they find in the new ecosystem such as the presence of new predators. The invasive species may quickly respond to cues released by the predators and develop induced anti-predator defenses.

The aim of our study was to analyze all the specific anti-predator defenses developed by the invader zebra mussel (*Dreissena polymorpha*) induced by two predators with different feeding mechanisms: signal crayfish (*Pacifastacus leniusculus*) and the fish roach (*Rutilus rutilus*). Additionally, we analyzed the anti-predators defenses developed by zebra mussels in presence of both predators simultaneously.

To do this, we carried out a 5 weeks lab experiment where we exposed zebra mussel individuals to 4 different predator treatments: control (without predators), signal crayfish as predator, roach as predator and combined treatment (with both predators simultaneously). After this 5 week experiment we analyzed all the parameters that the zebra mussels individuals could have changed in the different treatments such as shell strength, shell shape, attachment strength, growth, aggregation, distance travelled and selection of attachment sites.

The results indicated that zebra mussels exposed to signal crayfish increased the shell strength and acquired more rotund shell shapes in order to avoid being crushed by them. On the other hand zebra mussels exposed to roach grew more, acquired more elongated shell shapes and travelled less distances in order to avoid being swallowed by them. Indeed zebra mussels exposed to any predators increased their attachment strength in order to avoid being detached from substrate, as this is the first step in the feeding mechanism of both predators. Finally, in presence of both predators simultaneously zebra mussels did not prioritize defenses against any predator. Therefore, we assume that none of the predators is more dangerous than the other, thus zebra mussels do not prioritize defenses against one the predators.

We conclude that zebra mussels acquire specific anti-predator defenses depending on which predator is exposed. This ability might be one of the reasons of their invasion success.

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