Elena Gimmi with ETH Rector Günther Dissertori (Photo: Alessandro della Bella).

ETH Medal for Elena Gimmi

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Topics: Biodiversity | Ecosystems | Climate Change & Energy | Organisation & Staff

ETH Zurich awards the ETH Medal in recognition of excellent master and doctoral theses. Elena Gimmi was presented with the award on 24 January 2025 for her dissertation. The award acknowledges Gimmi's findings on the influence of bacterial "bodyguards" on the co-evolution of the black bean aphid, a major pest in the area of food production, and its natural enemy the parasitoid wasp.

As a PhD student at the aquatic research institute Eawag, Elena Gimmi closely studied the tripartite relationship between the black bean aphid (Aphis fabae), a tiny parasitoid wasp (Lysiphlebus fabarum) and the bacterium Hamiltonella defensa. She was supervised by Prof. Christoph Vorburger and Prof. Jukka Jokela. Vorburger's research group has been following the interplay between the three different organisms for years. Laboratory experiments showed that the bacterium H. defensa lives in the body of the bean aphid as a symbiont. It receives "board and lodging" from the aphid and, in return, protects it against parasitic wasps, the larvae of which devour the aphid. The bacteria presumably produce toxins which kill the eggs of the wasp.

Comprehensive range of data obtained in the field – despite Covid

Elena Gimmi has tested predictions obtained from basic laboratory research in wild populations under natural conditions for the first time. She examined in particular the patterns and seasonal dynamics in the resistance of the aphids. "I found it exciting and challenging to compare known results from laboratory testing with observations obtained from the real world," says the environmental biologist.

The centrepiece of Gimmi's work was a large-scale field study conducted over a two-year period. In

three different areas around Zurich, Gimmi tracked the abundance of the bacteria in the aphids on a monthly basis. Over the same period of time, she also investigated how the risk of the aphid being parasitised by the wasp changed. “It was clear from the start that a lot of things could essentially go wrong. However, thanks to a combination of persistence and luck, the original plans for my thesis turned out quite well,” says Gimmi in retrospect.

> “A tremendous amount of time and effort went into the field work. This was reflected in the high quality of the data collected, which allowed us to ascertain a significant number of new and important findings.”
>
> Christoph Vorburger

Christoph Vorburger emphasises: “A tremendous amount of time and effort went into the field investigations. This was reflected in the high quality of the data collected, which allowed us to ascertain a significant number of new and important findings.” However, the important second year of the field project was put at serious risk by the Covid pandemic. The researcher quickly set up a home laboratory for the study of small insects with the help of her father and engaged her brother as a field assistant. This ensured a continuous flow of data and made it seem as though there had never been any lockdown. Vorburger: “That really was a great effort and I am also very grateful to Elena’s family for their support.”

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Christoph Vorburger and Elena Gimmi (Photo: Eawag).

Surprising influence of ambient temperature

Gimmi’s data provides new and, in some cases, surprising information on the relationship between the three unequal partners. This enabled the researcher to demonstrate that the frequency of the bacteria in the aphid populations fluctuated during the course of the year – and that the ambient temperature might exert a much greater influence than had been suspected. In other words: the warmer it was, the greater the frequency of bacterial “bodyguards” that were identified and the greater the resistance of the aphids. This could indicate that climate warming is impairing the use of parasitic wasps as a means of biological pest control.

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A parasitoid wasp attacking an aphid. The aphids visible in front have already been parasitised by the wasps
(Photo: Christoph Vorburger, Eawag).

Research will be continued at Eawag

Christoph Vorburger has been involved in academic teaching for over 20 years. He describes the award as being very well-deserved: “We were really extremely lucky to have succeeded in gaining Elena for this project. In addition to her talent, she brings a conscientious approach, diligence and a healthy dose of ambition, which helped her purposefully drive the challenging project forward. At the same time, she is an excellent team player. I am also impressed by the fact that just shortly after gaining her doctorate, every chapter of her thesis, without exception, was published in prestigious original publications.”

Gimmi’s findings also form the basis for a follow-up project at Eawag, which will be supported by the Swiss National Science Foundation through to 2027.

Cover picture: Elena Gimmi with ETH Rector Günther Dissertori (Photo: Alessandro della Bella).

Original publications

Gimmi, E. L. (2023) Defensive symbiosis in the wild - patterns and dynamics of symbiont-conferred resistance in natural host-parasitoid communities, 175 p, doi:10.3929/ethz-b-000617575, Institutional Repository
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Gimmi, E.; Vorburger, C. (2021) Strong genotype-by-genotype interactions between aphid-defensive symbionts and parasitoids persist across different biotic environments, *Journal of Evolutionary Biology*, 34(12), 1944-1953, doi:10.1111/jeb.13953, Institutional Repository

Financing / Cooperations

Eawag ETH Zürich

Related Links

Research Group “Evolutionary Ecology”

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