Hitting mosquitos when they are weakest

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Mosquitos. During the summer months they can be annoying, but in the villages around the southern tip of Lake Gruyere, they can become a real pest – if, that is, they are left unchecked. That is why for the past 20 years local authorities have been culling the mosquito population in interventions timed to hit the mosquito larvae with a natural insecticide when they are most vulnerable. To assist decision-makers in planning these interventions, Max Mentha and Morgan Bruhin, both master's students in environmental engineering, worked on the development of an online platform that tracks the larval development around the hotspot.

"You wouldn't expect this area to be infested by mosquitos," says Max Mentha, walking on the parched muddy banks at the southern tip of Lake Gruyere, not a single mosquito in sight. "Right now, we are in the middle of a heat wave. The mosquito eggs are waiting for rain to hatch, but once the temperature and water level of the lake are just right, their population will explode, pestering residents in Broc, Morlon, and other towns within their ten-kilometer flight radius," he says.

The perfect storm of conditions leading to the massive proliferation of mosquito larvae only became possible with the construction of the Rossens dam that transformed a section of the Sarine River into what is now Lake Gruyere. Fluctuating water levels, stagnant puddles of water, and the right type of vegetation all contribute to making the area a haven for proliferating larvae.

Drawing the perfect battle plan

For their design project, Mentha and Bruhin rarely set foot on the idyllic shores of Lake Gruyere. Instead, they spent most of their time in computer labs. "Our project focused on upgrading an existing computer program that tracks the development of mosquito larvae around Lake Gruyere and transforming it into an online application," says Mentha. The platform models the altitude of the lake surface, lake water temperature, and other parameters in a geographical information system, basically a digital map.

"The goal was to enhance the platform by integrating a three-day weather forecast," he explains. The online application is part of swissrivers.ch, a website run by Lausanne based environmental consulting firm e-dric, that provides free forecasting information for rivers across the country.

Ultimately, the module that the students worked on will help authorities determine exactly when and where to intervene with a bacteria-based insecticide, typically dispersed from a helicopter once a year. Integrating the weather forecast could buy the authorities enough time to reserve the helicopter required for the operations.

A natural insecticide

When dealing with mosquitos, the insecticide of choice is not a complex chemical compound, but a bacterium found naturally in most soils: Bacillus thuringiensis israelensis. This bacteria is known to act only on three species of insects, mosquitos, black flies, and fungus gnats, and only during a brief window of their development. By strewing it out of a helicopter when the conditions are just right, a large fraction of the larvae can be killed without further damaging the ecosystem.

"What we really enjoyed about the project was that it was extremely multidisciplinary, involving geographical information systems, computer

science, hydrology, and biology. It also gave us an opportunity to interact with a number of professionals, from ETH Zurich professor Peter Lüthy, who has been managing the mosquito control project for the past 20 years, to the engineers at e-dric, to local residents in the region," says Mentha.

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