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MITRANI DEPARTMENT OF DESERT ECOLOGY

Dynamics of Human-Natural Coupled Systems and the Management of Harmful Species

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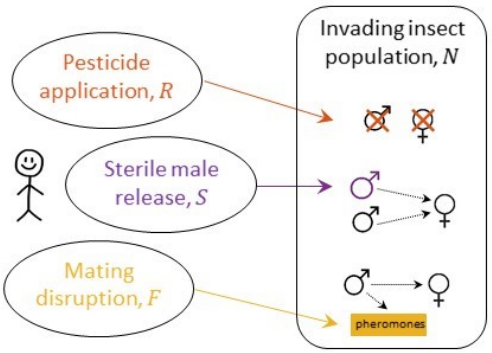
The management of harmful species, including invasive species, pests, parasites, and diseases, is a major global challenge. Harmful species cause severe damages to ecosystems, agriculture, forestry, and human health. To manage harmful species, humans aim to prevent the establishment of the species and to eradicate or control those species populations that have already been established. One question is, therefore, how to combine the available tools and tactics to achieve these goals cost-effectively. Furthermore, the management of harmful species often requires cooperation among multiple agents, such as farmers, land-owners, agencies, and countries. A second question is, therefore, which environmental policy would better incentivize the agents to cooperate. In my talk, I will present two models aiming to address each of these questions, where the novel part is showing how the optimal treatment and policy depend on the biological and ecological characteristics of the harmful species. To address the first question, I will present a model that incorporates the natural dynamics of an invasive insect population and its response to three treatment tactics: pesticide application, sterile male release, and mating disruption. I will show that the combination of treatment tactics that are used should vary over time and depend on the density of the population. To address the second question, I will present a dynamic game-theoretic model and examine how a policymaker should allocate the treatment duties among the agents. I will show that, when a fast eradication is possible, the better policy would be to split and assign only one or a few agents to treat the species in a given location; but if the persistent control of the harmful species population at a low density is needed, the agents should work together in all the locations. These studies suggest that treatment strategies and policies should be developed in accordance with the biological and ecological characteristics of the target species.



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