Researchers developing sustainable ways to manage locust outbreaks worldwide

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This is an Australian plague locust, or APL, (*Chortoicetes terminifera*). Researchers will use artificial diets to study how protein and carbohydrate content affect growth, survival, and development of migratory phenotypes in locusts from Australia, Senegal and China. Credit: Arianne Cease

Locust swarms may seem like a distant chapter from history, but these devastating insects still present a major threat in today's world. They jeopardize food security throughout the Middle East, Asia, Africa and Australia. Locusts, particularly desert locusts, ravage crops and impact

livestock—costing countries billions of dollars in lost harvests and eradication efforts.

A team of scientists from Arizona State, Colorado State, McGill and Yale universities are launching a new collaborative project to learn how human behavior, market forces and ecological systems interact over time to affect the outcomes of locust swarms. The researchers will conduct studies in China, Senegal and Australia—countries that depend on livestock production and each home to locust outbreaks that may be linked to degraded livestock pastures.

The National Science Foundation is funding the four-year, $955,000 project through its Dynamics of Coupled Natural and Human Systems program.

"We are building on our previous research in China, that demonstrated that overgrazing rangelands promotes locust outbreaks, in part because overgrazing lowers the amount of nitrogen in plants," says Arianne Cease, a physiological ecologist with ASU's School of Life Sciences and lead researcher on the project. Surprisingly, plants with lower nitrogen content allow locusts to multiply and form devastating swarms— a situation often caused by overgrazing.

A locust (*Oedaleus asiaticus*) pauses in its preferred habitat -- a field heavily grazed by sheep (background) near the Inner Mongolia Grassland Ecological Research Station in northeast China. Heavy livestock grazing enhances soil erosion and nitrogen depletion which promotes outbreaks of this locust by shifting plant nutrient content toward lower nitrogen conditions favorable to *O. asiaticus*. In contrast to paradigms for nitrogen limitation in herbivores, higher nitrogen diets decrease growth and survival of this locust. Credit: Arianne Cease

"We understand how important it is to look at the whole picture and we're excited about the project's potential," adds Cease, who is also a research associate with the University of Sydney. "We need a better understanding of the links between overgrazing and locusts. And, from a social perspective, we also need a unified framework to implement what we find into practice in each of the regions in a way that improves the lives of local farmers and the longevity of the grasslands."

The diverse research team of three biologists and three social scientists will search for answers to two main questions: First, how do the relationship between insects and nutrients, as well as livestock grazing strategies, interact to affect food prices, food security, and rangeland degradation? And second, how do property rights and ownership affect society's ability to respond to the link between overgrazing and locust outbreaks?

"It is commonly believed that people don't have incentives to care for things that are 'owned' collectively," says Eli Fenichel, a Yale assistant professor, who studies the connections between economic and ecological systems. "However, with what we are learning about locusts, it seems possible that short-sighted environmental management may cause future damage to a community's economic resources and also crises for neighboring communities. So, the more we learn about these systems, the more it seems that we can turn the study of ecology into a direct cost/benefit for society as a whole."

The team's goals are to learn how best to minimize locust outbreaks and to use this knowledge in working with regional governments and communities to devise additional tools for managing the swarms differently. The scientists also want to understand what causes the locust population buildups that lead to migratory swarms.

"A lot of research looks at the deconstructed pieces of a problem, and not the larger scale," says Brian Robinson, an assistant professor at McGill University. "It's important to find connections between the pieces and with our research team, we have the people in place to do that. Managing grasslands may help manage locusts, as well as minimize crop and feed loss for animals. But we need to understand how best to do these things on the ground, and how management must be adapted to different ecological and social contexts."

The goal of this collaborative research is to learn how to minimize locust outbreaks and to use this knowledge to work with regional governments to manage the swarms differently. The scientists also want to understand what causes locust populations buildups that lead to migratory swarms. Credit: Arianne Cease

To develop new and sustainable management strategies, the team will study livestock markets, grazing practices, grass ecology, and property rights in relationship to locust dynamics.

The study will include the efforts of five ASU undergraduate researchers and two doctoral students from Yale and Colorado State universities. The students will work with ASU School of Life Sciences Professors Jon Harrison and James Elser and may travel to China, Senegal or Australia during their research training.

Along with Cease, the research team includes: Elser, an ASU ecologist; Harrison, an ASU physiologist; Fenichel, a Yale bioeconomist; Robinson, a McGill ecosystem services researcher and Joleen Hadrich, an agricultural economist with Colorado State University.

Provided by Arizona State University