中央研究院生物多樣性研究中心
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Terrestrial Biodiversity and Ecosystems

Of Pests and Prey: Investigating the Dual Role of Rodents from Responses to Predation Risk to Their Involvement as Pests in Agriculture

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Doctoral Dissertation Defense Presentation

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Abstract

Rodents, a ubiquitously distributed and pervasive taxonomic group, are common prey to a suite of predators, and as a result have been the subjects of countless studies manipulating predation risk. These small mammals are equipped with antipredator defenses, which includes the ability to discriminate predator odors through olfaction and subsequently modify their behavior to avoid potentially fatal encounters. How different species respond to risk may also vary between species, and these mechanisms may be linked to physiological, morphological and life history traits. Behaviors of species across different contexts may be associated with pace-of-life (POL) following a fast-slow continuum and boldness-shyness axis. Since rodents also cause devastating losses to agricultural industries on a global scale, innovative methods incorporating perceived predation risk to discourage rodents as pests have been the subject of consideration. This method could be an ecologically friendly alternative to conventional chemical approaches, such as rodenticide application, and reduce risks for non-target wildlife. A major component of this thesis was to test the efficacy of predator odors at instigating antipredator behavioral responses in different species of rodents from wild populations. Another component of this thesis was to survey an agricultural area to understand the impact rodents have on various crops and what proportion of farmers use rodenticides and other chemical-based pest management.

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For my first project (Chapter two), I investigated the behavioral responses of four rodent species in Hualien County, of eastern Taiwan, exposed to a novel microenvironment and cue from an allopatric predator, the leopard cat (*Prionailurus bengalensis*). Three of the wild-caught rodent species were native (*Mus caroli*, *Apodemus agrarius*, *Rattus losea*) and one invasive (*R. exulans*) and all were subjected to two consecutive nights of experimental trials in a laboratory setting. Rodents did not respond to the predator odor by increasing the amount of time exhibiting defensive behaviors. Instead, inter-specific behavioral variation was observed exemplified by the smaller species performing more behaviors for boldness and the larger species exercising more caution in response to the risky contexts. These results are in accordance with a growing consensus that behavior is linked to pace-of-life (POL); differences in life history traits are associated with behavioral traits following a fast-slow continuum.

For my second study (Chapter three), I conducted a giving-up density (GUD) experiment complemented with camera traps in Miaoli County, where leopard cats are found, to investigate how indirect (e.g. vegetation cover) and direct (e.g. predator odors) risk cues influence the foraging behavior of wild populations of rodents. I tested whether the odors of the native leopard cat, introduced domestic cat (*Felis catus*), and exotic bobcat (*Lynx rufus*) would have differential effects on rodent communities. Visitation, foraging and seed consumption at the experimental food patches were not affected by any of the predator odors, but instead by microhabitat type; rodents consumed more seeds in food stations under vegetation cover compared to exposed stations.

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Additionally, based on the camera trap data, the smaller species (*A. agrarius*) demonstrated a higher proportion of behaviors conferring boldness compared to the larger rat species (*R. losea*). These results are similar to those from chapter one, and also largely adhere the hypothesis that behavior is linked to POL.

In Chapter four, I describe my study where I conducted a survey for farmers in an agricultural area of Miaoli County to investigate the extent of pest-related damage caused by rodents, pest control practices employed by farmers, their attitudes toward rodents, and willingness to change their pest management. Rodents were reported to be the worst pest for the crop category rice, but not vegetables nor fruit. Furthermore, only about one-third of farmers indicated they currently use rodenticides. The most important predictors for rodenticide use were type of crop grown and extent of problems caused by rodents. Intuitively, farmers were more likely to use rodenticides if they perceived rodents to be very problematic and cause damage. Despite the low frequency of reported rodenticide use, most participants had negative attitudes toward rodents, with extent of rodent problem having the strongest influence on attitudes. Moreover, participants with negative attitudes toward rodents were found to be more likely to use rodenticides. Therefore, experiential factors, including perceived damage caused by rodents and farmers' attitudes toward the pest likely facilitate their pest control practices. Moreover, the use of rodenticides may be a reactive measure, indicated by the severity of problems and damage inflicted by rodents.

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In both studies described in Chapter two and three, predator odors did not elicit defensive behaviors and suppress foraging activity, even in response to the native leopard cat cues. Therefore, the application of these direct risk cues simulating the 'landscape of fear' as an ecologically based management strategy for rodents as pests may not be the most effective and will require further attention to better understand the capabilities of predation risk-related pest control. Concomitantly, inter-specific behavioral variation occurs between different rodent species, therefore, their roles as pests may not all be equal.