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Escape with crepitation sounds in the Chinese grasshopper Acrida cinerea

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論 文 名　：Escape with crepitation sounds in the Chinese grasshopper *Acrida cinerea*
(ショウリョウバッタにおけるキチキチ音を伴う逃避)

区　　分　：甲

論 文 内 容 の 要 旨

Various prey animals exhibit conspicuous behavior while escaping from approaching predators. Intuition suggests that such conspicuous behaviors will attract the attention of predators and increase predation risk for the prey animals. Contrary to this intuition, theoretical studies have shown that conspicuous behaviors can act as antipredator defense tactics for prey animals. However, empirical studies that identified the antipredator benefit of conspicuous escape are limited because of the difficulty in empirical studies on actual predator-prey interactions.

Many species of grasshoppers produce loud sounds while escaping by flying. Their noisy flight has been considered as a flash behavior, which makes predators misunderstand the position of grasshoppers and decreases their predation risks, without empirical evidence. To explore the function of the noisy flight of grasshoppers experimentally, I focused on the Chinese grasshopper, *Acrida cinerea*, which often exhibits noisy flight against approaching human in Japan.

First, I examined the mechanism of sound production during a flight in *A. cinerea*. I observed the flight behavior of male *A.cinerea* under tethered conditions. The males always clapped their left and right hindwings at the occurrence of loud pulse sounds. When the clapping of hindwings was prevented, the number of loud pulses produced by the males decreased. These results indicate that the males make sounds during tethered flights by wing clapping. The sound production by the wing clapping was not specific to the tethered condition because the males also clapped their hindwings during free flights and made pulse sounds at the time of the wing clapping. I found that the females have the ability to make pulse sounds by wing clapping, which is the same mechanism as the males.

Second, I explored environmental factors, prey and predator traits, and escape tactics related to the noisy escape of *A. cinerea* with a field experiment (Chapter 2) because not all individuals always produce sounds while escaping. I approached *A. cinerea* as a predator model and examined the relationship between the frequency of the noisy escape and the following factors: ambient temperature and relative humidity as environmental factors, sex, body length, body weight, and limb autotomy as prey traits, and repeated approach as a predator trait. I also examined the relationship between the noisy escape and the flight initiation distance, which is a predator-prey distance when prey starts to escape, the distance fled, which is a distance where prey moves for escape, and the mode of locomotion, which is classified as either flying or jumping for *A. cinerea*. The noisy escape was observed in only the males that flew, and the males that jumped and the females always escaped silently. For the males that escaped by flying, the frequency of noisy

flight increased with the ambient temperature and distance fled and decreased for individuals that autotomized one of their hind legs. There was no significant relationship between the noisy escape and flight initiation distance. These results suggested two hypotheses on the function of the noisy escape in *A. cinerea*: the conspicuous sound may be an antipredator signal that conveys the high flight performance of the grasshopper and deters the predatory attack, and a by-product of the wing clapping motion made for the increase in aerodynamic forces.