



Conference Abstract

Comparative study of biology on ground beetles (Coleoptera: Carabidae) - flight ability, feeding habits and fecundity

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Abstract

We studied flight ability, feeding habits and fecundity in carabids. Based on these traits, we investigated characteristics of five species of *Harpalus*, *Synuchus* and *Carabus* as bioindicators of changing environments.

Three species of *Harpalus*, *H. griseus*, *H. eous* and *H. tridens*, showed different degrees of flight ability. We examined the morphology and the length of hind wings, and also investigated by dissection the phenology of flight muscles. The ratio of hind wing to body length (HWBL) was 0.93 in *H. tridens*, 0.99 in *H. eous* and 1.02 in *H. griseus*. The aerial catches ratio to total catches (aerial / aerial+ pitfall traps) of *H. tridens* was lower (16%) than the other two (72, 76%), and the proportion of individuals with flight muscles of *H. tridens* (29%) was lower than the other two (71, 77%), indicating *H. tridens* has lowest flight ability. All three species exhibited flight muscle polymorphism. The hind wings of *Synuchus cycloclerus* were mono-morphic macropterous with 0.75 (HWBL). However, no individuals were caught by aerial traps, and none possessed the flight muscles, indicating this species does not fly. The hind wings of *Carabus procerulus* were mono-morphic stick-shaped brachyptery without the flight muscle.

Flight is important trait for food searching and dispersal. Gut dissection revealed that three *Harpalus* species depended mainly on seeds and partly on arthropods. The fact that

animal fragments were found more frequently in the guts of *H. tridens* than the other two indicated a close relationship between flight ability and diet. Through gut dissection, we found *S. cycloderus* was a generalist predator. It preys not only on larvae but also adults of small arthropods including collembola. The food remains of guts of *C. procerulus* consisted of amorphous fluid, and cuticles were hardly detected. It suggested that the inside of prey was exclusively consumed by extra-oral digestion rather than chewing.

Fecundity was assessed by gonad dissection through the number of ovarian eggs and their size. *S. cycloderus* had many eggs with small size, by contrast *C. procerulus* and three *Harpalus* species had few-large eggs.

Many studies have shown that ground beetles responded differently to vegetation disturbances. We interpreted these results from their ecological traits. Our previous study of the vegetation disturbance effects on ground beetles demonstrated that *C. procerulus* declined in number was accompanied with decline in body size. Food shortage induced the reduction in both number and body size of *C. procerulus*. On the other hand, the number of *S. cycloderus* significantly increased. Although some of their prey were reduced, as generalist predators, they alternatively consumed other prey that has increased greatly in number. The trait of *S. cycloderus* with many eggs has also great potential for population explosion. The numbers of *H. griseus* and *H. eous* were not affected by the disturbance, while *H. tridens* decreased. Shortage of prey organisms caused negative effects on *H. tridens* compared to *H. griseus* and *H. eous* which depend more on seeds.

We have been studying ground beetles in Japan, and already have some basic knowledge, such as hind wings, flight ability, feeding habits, reproductive phenology and seasonal activity for 78 key species. Ground beetles are excellent bioindicators. Our bottom up approach by the dissection of ground beetles collected periodically through the year would be essential when we have to face with extreme conditions, such as global warning.

Keywords

bioindicator, brachyptery, diet, dissection, flight muscle, gut contents, hind wing, macroptery

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