

Short communication

A golden soldierfly, *Ptecticus aurifer*, hints suitable locations for automatic trail camera targeting Japanese badger

Chiho SAKURABA¹, Shuji KOBAYASHI¹, and Hiroyuki TAKASAKI^{1*}

キイロコウカアブはニホンアナグマを対象とした自動撮影カメラの設置適地を教えてくれる

櫻庭知帆¹・小林秀司¹・高崎浩幸^{1*}

Introduction

Using a trail camera, we attempted to track the habitat use of the Japanese badger (*Meles anakuma* [Fig. 1], Mustelidae, Carnivora; formerly *M. meles anakuma*). As there were more than 30 sett entrances in the study area, it was impracticable to set trail cameras at all of them. Our manpower and budget were limited. Therefore, choice of appropriate locations for setting the camera was crucial to the success of our research. Through repeated observations, we found that the presence of territorial flight of a golden soldierfly (*Ptecticus aurifer* [Figs. 2 and 4], Stratiomyidae, Diptera) around a sett entrance is usable for judging whether or not the sett is currently used by the badger. Regular inspection of the vicinities of setts revealed the soldierfly responds to fresh dung of badgers, and forms a mating territory near a sett entrance or open latrine on the ground. In other words, we may judge that a sett or latrine where the soldierfly makes a territory is probably in use by a badger. Setting a trail camera in the vicinity of such a place makes our study more efficient. This search technique is likely applicable to studies of badgers and some other mammals having latrines not only in the part of Asia where *P. aurifer* occurs but also in regions where occur closely related soldierflies showing similar behavior.



Fig. 1. A Japanese badger (*Meles anakuma*, Mustelidae, Carnivora) recorded with the trail camera (28 September 2015).

Study area and apparatus

Our study area was the campus of Okayama University of Science (OUS, around 34.696222°N, 133.925953°E), on the northern edge of urban areas in Okayama City, southwestern Honshu, Japan. The habitation of the Japanese badger on the campus and its vicinities started not later than 1 June 2006, when a photo of feces of the animal was taken (Kobayashi, unpubl. data). The campus lies on the hilly terrain east of Mt. Daimisen (highest point 160.35m a.s.l.). The slopes between the buildings on the campus are covered with various types of vegetations, of which wooded areas are transient from the secondary forest dominated by the deciduous oaks *Quercus serrata* and *Q. variabilis* to the evergreen forest composed of *Q. glauca* and *Ilex chinensis* typical in this

*To whom correspondence should be addressed. E-mail: takasaki@zool.ous.ac.jp

1. 岡山理科大学理学部動物学科 700-0005 岡山市北区理大町1-1 Department of Zoology, Okayama University of Science, 1-1 Ridai-cho, Kita-ku, Okayama-shi, Okayama-ken 700-0005, Japan.



Fig. 2. A golden soldierfly pair (*Ptecticus aurifer*, Saraginae, Stratiomyidae, Diptera) in the ventro-dorsal copulatory posture of the male on the female (10 October 2015).

warm temperate region around the Seto Inland Sea. We used a single trail camera (SG968K-10M manufactured by BMC).

A soldierfly found near a sett entrance

While searching for appropriate locations for setting the camera by trial and error, we noticed *P. aurifer* flying with occasional resting on a stone in front of an entrance of a sett situated in the dark basal area of a building. The darkness of the site seemed strange for flight of the diurnal soldierfly. Later we judged that it was the territorial flight of the male soldierfly for mating.

Trail camera setting

We started the trial use of the camera to set at this spot on 10 September 2015, the very day of the above finding. Around 19:30 the camera captured the sight of a badger. Subsequently additional 3 photos were recorded that night, and a video sequence was also recorded. Thereafter, neither photo nor video was recorded, while the soldierfly also disappeared. On 18 September, we moved the camera to another sett, of which entrance was occupied by a soldierfly. Around 6:30 the next morning, a badger returning to the sett was recorded in a photo. On the evening of the same day and the next morning, an additional photo and video were recorded. At 8 other points in total (7 points in the study area, and another on the neighboring Handayama Hill peaked by Daimisen), we found presence of *P. aurifer* at the sett entrances. At all sites, the badger was known to have been witnessed in the vicinity, or footprints and/or traces of foraging on the ground surface for food in the nearby areas indicated that all were often used.

Fresh dung attracting the soldierfly

On 1 October, we took from a pit in a latrine a mass of fresh dung dropped on the night of 30 September and another a few days old. We placed each in a waste container of instant noodles tightly covered with scrap newspaper. In this condition, we left them outdoors under a roofing against rain. On the following 2 October, when we inspected the nearby latrine, we noticed no soldierfly. Probably the rain on 1 October had erased the smell of the feces in the air. As soon as we opened the container of the fresh dung, however, 4 soldierflies came and began chasing one another, circling near the container. Soon one pair began to fly in the ventro-dorsal copulatory posture of the male on the female (Fig. 2). The container of the old dung, when opened, attracted none. On 3 October, when we opened the containers again, no soldierfly came. The experiment showed only fresh dung attracts the soldierfly.

The congeneric European badger (*Meles meles*) makes latrines in the sett as well as outside (Roper 1992), and infants of the Japanese badger (*M. anakuma*) are known to defecate in the sett (Iwase 1975). For the Japanese badger, too, there has been recently recorded a latrine in the sett (<http://seibutsu.biology.kyushu-u.ac.jp/~yahara/badgerhole/badgerhole.html>; accessed 12 October 2015). If the scent of the badger attracts the soldierfly, during the daytime when the camera video-recorded a badger, the soldierfly may have likely been video-recorded together. We have not captured such a scene yet. On 7 October 2015, however, we spotted a few soldierflies hovering around openings between the coverings of a rainwater drainage ditch made of concrete. As the photo taken within the ditch shows (Fig. 3), there was no trace of the animal's feces but dry grasses used by it for resting on the dry ditch floor. Therefore, we cannot deny possible attraction of *P. aurifer* by the scent marked with the anal gland secretion of *M. anakuma*.

Other evidence for soldierfly-badger association

Presence of the golden soldierfly may be associated with habitation of the Japanese Badger. At Sayo Konchukan (35.099037°N, 134.4277°E), an inland forest locality in Hyogo Pref., Japan, Fujie et al. (2011) made a 7-month survey of flying insects, e.g. *Hymenoptera* and *Diptera*, using a Malaise trap. Their trap captured 2 *P. aurifer* (1♀, 25.IX-2.X.2010; 1♂, 9-31.X.2010). The location and vegetation of the area (artificial stands of *Cryptomeria* and natural stands of broadleaf trees around 230m a.s.l.; Fujie et al. 2011) as well as



Fig. 3. In a rainwater drainage ditch, over which a few soldierflies were found hovering around openings, there was no trace of the animal's feces but dry grasses used by it for resting on the ditch floor (7 October 2015).

Google Map aerial and street views seemed to indicate natural habitation by *M. anakuma* there. Indeed, the habitation of this mammalian species in the area was confirmed via Internet search in a blog record for 9 October 2012 at Sayo Konchukan (<http://konchukan1.exblog.jp/18050965/>; accessed 9 October 2015). In additional web search, the occurrences of *P. aurifer* (Matsumoto et al. 2007) and *M. anakuma* (Mikuriya 1993) were found to coincide at Tama Forest Science Garden. The same co-occurrence was also found at Kyushu University Shiiba Research Forest (<http://www.forest.kyushu-u.ac.jp/miyazaki/index.php?database>; accessed 12 October 2015). Furthermore, in the insect specimens collected by an OUS student and stored at OUS Department of Zoology, we identified a male *P. aurifer*, with its labeled capture record on 16 May 2014 beside a campus building, coll. A. Inoue (Fig. 4). Under this particular building, there have been known to be sett entrances used intermittently for years.

Conclusion

This study found it usable to spot *P. aurifer* for the choice of trail camera setting sites. The stratiomyid fly larva feeds on rotting matters such as feces and compost, on which the adult soldierfly female oviposits (Max 1967). From our observations of *P. aurifer* and 5 specimens (all males) collected at sett entrances, we inferred that, as the soldierfly female comes to favorable oviposition sites with fresh dung available in setts and latrines in use by badgers, the male makes a mating territory there. Choice of such a place for setting a trail camera will enhance the camera's probability of recording badgers. The same approach for selection of automatic camera setting



Fig. 4. A specimen of *Plecticus aurifer*, with its capture record on 16 May 2014 beside a campus building, coll. A. Inoue (20 October 2015).

sites for studies of badgers may be usable not only in the part of Asia where *P. aurifer* occurs (Rozkošný and Courtney 2005) but also in other regions where occur flies of the Stratiomyidae with similar habits. We only need to pay attention to the territorial behavior of the soldierflies. This technique is also likely applicable to studies of some other carnivorous and omnivorous mammals which make latrines.

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和文要約

トレイルカメラを用いて、ニホンアナグマ (*Meles anakuma*) の生息地利用の調査を、岡山理科大学構内で試みた。しかし、調査地内のニホンアナグマの巣穴は30ヵ所を超え、その全てにトレイルカメラを設置することは、労力や費用の面で不可能であった。したがって、カメラの効果的な設置が、調査に

は不可欠であった。試行錯誤のすえ、巣穴が現在利用されているか、否かの判断に、キイロコウカアブ (*Ptecticus aurifer*; ミズアブ科) の巣穴入り口での占有飛行が利用できることを発見した。巣穴周辺の定期的な観察から、キイロコウカアブがアナグマの新鮮な糞のにおいに反応し、巣穴の入口付近や溜め糞に、オスが繁殖縄張りを形成することがわかった。すなわち、「入口周辺にキイロコウカアブが飛び回る巣穴は、高確率でアナグマが利用中である」と判断できる。付近にトレイルカメラを設置することによって、キイロコウカアブの成虫期には効率的なアナグマの調査が可能となる。

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