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# First discovery of a cave-dwelling Tineid moth (Lepidoptera, Tineidae) from East Asia

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**Abstract:** In this study, we report *Monopis crocicapitella* (Clemens, 1859) (Tineidae), which was collected from bat guano in a cave in the southern region of Korea, for the first time from East Asia. We briefly redescribe and illustrate the external morphology and genital structures of both sexes. Also, we discuss the local habitat characteristics and some of the ecological information that was observed during our field investigation.

**Keywords:** *Monopis*, Tineidae, Lepidoptera, Bat guano, new record, Korea, East Asia.

## Introduction

Here we will report on a moth species inhabiting bat guano in the caves of East Asia. It is a species of the genus *Monopis* Hübner

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[1825], *M. crocicapitella* (Clemens 1859) belonging to the family Tineidae; we discovered it for the first time in East Asia, during the course of a study on cave-dwelling insect fauna in the southern part of Korea in 2013.

The members of the genus *Monopis* have been reported as keratophagous or chitinophagous; they also feed on a variety of organic materials, e.g., feathers, fur, wood, hides, guano in bird's nests, and animal remains in general (Robinson and Nielsen 1993; Xiao and Li 2006). External characteristics include translucent and light spots in the middle part of the forewing and the forewings are brown and dark brown color without a particular pattern.

There are about 100 described species in the genus *Monopis*. These species are distributed widely across the Old World (Asia, Europe, Africa), while it has been poorly investigated in the New World (America) (Robinson and Nielsen 1993). In Korea, the first record of the genus *Monopis* was *M. monachella* (Hübner 1796) (Park 1983). Since, *M. pavlovskii* (Zagulyaev 1955) and *M. laevigella* [Denis et Schiffermüller, 1775] have been additionally reported (Ponomarenko and Park 1996). Recently *M. flavidorsalis* (Matsumura, 1931) was added (Sohn 2007). Consequently the genus *Monopis* from Korea became four species (Byun et al. 2009). In addition, China has 15 species (Xiao and Li 2006) and Japan, three species (Sakai 2013). The genus *Monopis* Hübner is characterized by forewings with a hyaline spot and vein M3 stalked with CuA1 (Xiao and Li 2006). In Japan, three species are reported through the research about feeding habits of the genus *Monopis*, that are feeding bird guano or animal keratin in owl nests (Nasu et al. 2007). In contrast, the larviparous species of the genus *Monopis*, includes 11 species in Europe (Diakonoff 1955; Gozmány and Vári 1973; Robinson and Nielsen 1993); one species, *M. congestella* (Walker 1864), in Japan (Nasu et al. 2008); and one species, *M. trapezoids* Petersen and Gaedike, in China (Xiao and Li 2006).

In the larviparous species, there are cases containing 40–60 individuals of first larvae before pupation in their abdomen

(Nasu et al. 2008; Robinson and Nielsen 1993). However, the moths inhabiting guano in the cave are not well known in Korea, and in this area, this study is the first report on their special habitat.

## Materials and methods

The research site is a cave in Tongyeong-City, Gyeongnam province, in the southern part of Korea. Moths are collected inside the cave and brought to laboratory, for taxonomic study through breeding research. Specimens examined in this study are now deposited in the entomological collection of Hannam University (EHNU). Photos of adults and pupae were taken by digital camera (Canon EOS-550D). Male and female genital characteristics were observed with stereo-microscope (Carl Zeiss Stemi 2000-C, Göttingen, Germany) on permanent slides, using Euparal mountant. Also, we observed the detailed characteristics of the adult moth head by digital microscope (Dimis-ME, Siwon Optical Technology, Anyang, Korea).

## Taxonomic accounts

Order Lepidoptera Linnaeus, 1758.

Family Tineidae Latreille, 1810: 347, 363.

Genus *Monopis* Hübner, 1825: 401.

(Type-species: *Tinea rusticella* Hübner, 1796)

=*Blabophanes* Zeller, 1852:100.

=*Hyalospila* Herrich-Schäffer, 1853: pl. 10, fig. 14.

=*Rhitia* Walker, 1864: 818.

=*Eusynopa* Lower, 1903: 237.

*Monopis crocicapitella* (Clemens, 1859) (Figs. 1-9)

*Tinea crocicapitella* Clemens, 1859:258, 260. Busck, 1903: 184.

*Monopis crocicapitella*: Dietz, 1905:33; Hinton, 1956:328; Petersen, 1957:168, figs.139, 140.

**Diagnosis:** This species is very similar to *Monopis obviella* (Denis et Schiffermüller, 1775), but it can be distinguished by a slightly marked area along the dorsum of the forewing and pale gray hindwing.

**Adult** (Figs. 1-3): Wingspan 10–15 mm. Antenna filiform, narrowed toward termination; vertex covered with rough brownish-yellow scales. The first segment of labial palpus short, flattened; the end of the second segment with several setae terminally. Body is somewhat yellowish, similar to vertex in coloration. Forewing has ground color in blackish gray, without apparent spot or pattern; dark yellowish area running from base to three quarters of the dorsum. Hindwing is brownish gray with long and brownish gray cilia and rather long near base, grayish yellow in coloration.

**Male** (Fig. 4): R4 and R5 close to each other, R5 and M1 distant,

M3 and CuA1 branched. Base of Sc with retinaculum, hindwing with one frenulum on base. **Female** (Fig. 5) R5 and M1 short branched, M3 and CuA1 long, branched, hindwing same as male.

**Pupa** (Figs. 6, 7): Pupation taking place in the case made of bat guano. Pupa are light yellowish brown and around 10 mm in length, with appearance similar to adults, enough to be distinguished with exposed antenna and head part externally.

**Male genitalia** (Figs. 8, 8a, 8b): Uncus with two triangular projections, with many moderate hairs around the basal area. Valva somewhat rectangular, with straight costa, terminal area oblique, like a knife cutting, with numerous short hairs along terminal area. Saccus as long as 1.5 times of valva, slightly sinuated terminally. Gnathos triangular with base extended to tegumen, hooked and sharpened apically. The aedeagus is as long as saccus; cornutus half of the aedeagus in length.

**Female genitalia** (Figs. 9, 9a, 9b, 9c): Papillae anales are small, slightly elongated, with several short hairs. Ostium bursae are semi-triangular, narrowed medially. Apophyses posteriors are a little bit longer than apophyses anteriores, sinuated terminally. Apophyses anteriores are rather thin, instead somewhat thick in apophyses posteriors. Corpus bursae are sack-shaped, with a bundle of signa, bearing numerous push-pin shaped signa.

**Material examined:** 6♂, 4♀ Dosan-myeon, Tongyeong, Prov. Gyeongnam, Korea, 31. I. 2013 (D.S. Kim)-coll. EHNU.

**Distribution.** Korea (new record), Europe, USA. Nearly world-widely distributed. In this study, this species is reported for the first time from East Asia.

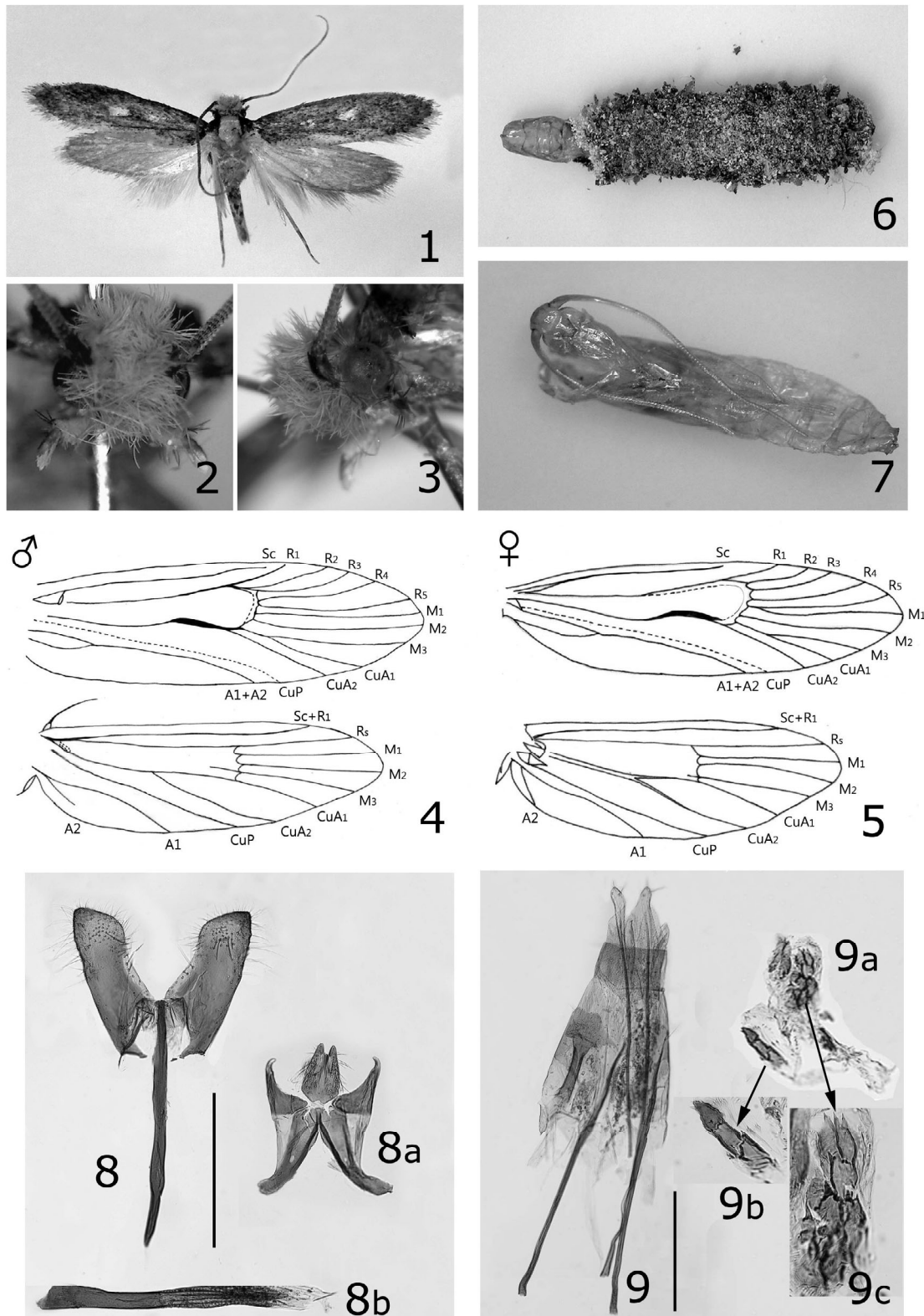
**Host:** In this study, the moth is reported for the first time in Korea, using bat guano as food source.

**Remarks:** This genus was first described from United States (Zimmerman 1978). The larvae feed on dried animal and vegetable refuse. They have been found in debris, in a dead rat, textiles, and pigeon guano, as well as bird's nests, and stored products of vegetable origin (such as flour, corn, and felt) in Europe and Hawaii, United State (Prins 1998; Zimmerman 1978). It is distributed mainly in the southern half of Britain and in Ireland, and the adults fly between June and October (Heath and Emmet 1992).

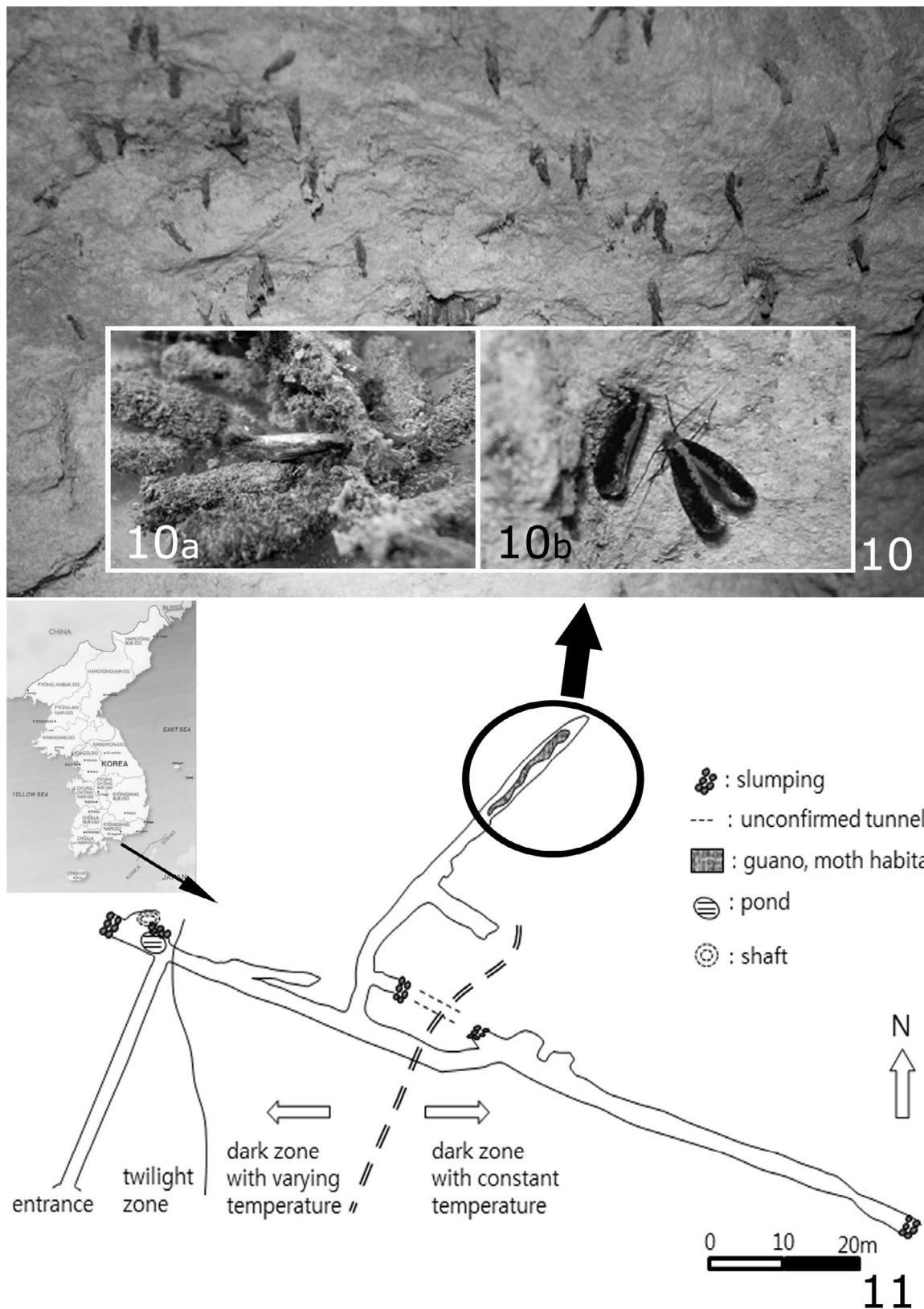
In this study, *Monopis* Hübner, is reported for the first time in East Asia. This species is not well known to date, because they are living in a cave where research activities have been limited. The moths rely on bat guano, found just inside the mouth of the cave, as both a food source and construction material (Fig. 11). They are using bat guano to make a case and live inside, and then small larvae hang crawled up cave wall (Fig. 10).

Because the cave inside is so dark, it is difficult to pinpoint the period of larvae and pupae. So we brought pupae to the laboratory and reared, as a result, we found that they become adults

roughly 4–5 days after being placed in room temperature.



**Figs. 1-9:** *Monopis crocicapitella* (Clemens, 1859): 1. adult; 2. front view of head part; 3. lateral view of head part; 4. wing venation of male; 5. wing venation of female; 6. pupa with pupal case; 7. pupa; 8. male genitalia; 8a. uncus and tegumen; 8b. aedeagus; 9. female genitalia; 9a. corpus bursae; 9b, c. signa. <scale bars: 0.5 mm>



**Figs. 10-11:** Habitat in cave and collecting site of *Monopis crocicapitella* (Clemens, 1859): 10. habitat in cave; 10a. pupa within pupal case on the wall of cave; 10b. emerged adults; 11. collecting locality (Tongyeong, Korea)

## Discussion

The moth species living in the cave, *Monopis* Hübner, is an important taxonomic group because they live in a particular, relatively small environment to maintain their life cycle. Also, the genus *Monopis* have peculiar feeding habits, including bat or bird guano and animal keratin substances. The species living in the bird's nest and having bat guano or bird's feather keratin component as food source have been reported in Japan.

Several larvae and pupae of *Monopis crocicapitella* (Clemens 1859) were found in vicinity of Tongyeong, southern part of Korea. In the present study, this species is reported for the first time from East Asia as well as Korea. They inhabit the bat guano deposits of cave and feed them within a case made of bat guano. When they become pupa, they hang on the cave wall and become adults. Because of this challenging, almost inaccessible habitat, active research has not been done.

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