First record of Lepidoptera from Ural owl nests in Japan

Yoshitsugu NASU,1,* Shiro MURAHAMA,2 Hiroyuki MATSUMURO,3 Daisuke HASHIGUCHI2 and Chieko MURAHAMA2

1 Osaka Plant Protection Office; Habikino, Osaka 583–0862, Japan
2 Wildlife Conservation Laboratory Co. Ltd.; Yodogawa, Osaka 532–0003, Japan
3 4–2–35, Aomatani-nishi, Minoh, Osaka 562–0021, Japan

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Abstract

Four species of Tineidae (Niditinea baryspilas (Meyrick), Monopis pavlovskii (Zagulajev), Mon. flavidorsalis (Matsumura), Mon. sp.) and one species of Oecophoridae (Martyringa ussuriella Lvovsky) were reared from the detritus found in four Ural owl (Strix uralensis Pallas) (Strigidae) nest boxes that had been abandoned by young birds in Wakayama, Osaka, and Shiga Prefectures, Japan. This is the first report of moths from owl nests in Japan. Tineid larvae feed on keratin sources in the detritus of the nest boxes that include pellets, fur, and feathers; the oecophorid possibly feed on decaying wood chips. Biological information regarding N. baryspilas and Mon. pavlovskii are presented for the first time, accompanied by photographs of their immature stages. It is likely that owl nests provide a suitable habitat for keratophagous tineids in nature because of a wide variety of keratin sources in the nests.

Key words: Tineidae; Strix uralensis; keratin; keratophagy; nidicolous fauna

INTRODUCTION

Insect fauna associated with bird nests have been well studied in Europe and North America, and species of several Lepidoptera families have been identified (Oecophoridae, Tineidae, Pyralidae, etc.) (Nordberg, 1936; Hicks, 1953, 1959, 1962; Woodroffe, 1953). Many species of the subfamily Tineinae (Tineidae) such as Tinea, Niditinea, and Monopis have been reported in bird nests, feces, and wool products (Nordberg, 1936; Woodroffe, 1953; Hinton, 1956; Hicks, 1959, 1962; Petersen, 1963; Opheim, 1973; Jalava, 1980; Pelham-Clinton, 1985; Robinson and Nielsen, 1993), where their larvae feed on keratin and chitin sources such as feathers, fur, pellets, arthropod remains, guano, and wool (Robinson and Nielsen, 1993; Robinson, 1998, 2004). In contrast to the situation in the West, the moth fauna of Japanese bird nest has not been well investigated. Kiritani (1959) found Pyralis falinalis (L.) (Pyralidae) in the nests of Passer montanus (L.) (Ploceidae) and Plodia interpunctella (Hübner) (Pyralidae), and also Tinea translucens Meyrick (Tineidae) in the nests of Hirundo daurica L. (Hirundinidae); Uchikawa (1970) found Tineidae larvae in Delichon urbica (L.) (Hirundinidae) nests, whereas Tomioka and Nakamura (2000) documented Aglossa dimidiata (Haworth) (Pyralidae), Py. falinalis, T. translucens, and the larvae of Tineidae in Columba livia Gmelin (Columbidae) nests, and T. translucens in H. rustica L. nests.

Jalava (1980) reported five Tineidae species, T. pellionella L., T. svenssoni Opheim, N. striolella (Matsumura) (=piercella Bentinck), Mon. laevigella (Denis and Schiffermüller) (=rusticella Hübner), and Mon. fenestrellata (Heyden), in 12 Strix uralensis Pallas (Strigidae), Ural owl, nest boxes in Finland. We have successfully reared four tineids and one oecophorid from the nest box detritus of the same Ural owl species in Japan. These five species of Lepidoptera have been previously reported from Japan, but their biology and immature stages remained unknown. We report here on these five species found in Ural owl nest boxes in Japan for the first time, and we present new biolog-
ical information about the moths. We also discuss the relationships between the keratophagous Tineidae and Ural owl nests.

MATERIALS AND METHODS

Four nest boxes for Ural owls were deployed at four localities: Hashimoto (forest edge), Wakayama Prefecture, Minoh (in forest) and Hirakata (in forest), Osaka Prefecture, and Takashima (forest edge), Shiga Prefecture all in the Kinki district of Japan. Each box was set in a tree at a height of about 4 m in November–December 2005. Three of the nest boxes were made of wood, 40×40×50 cm in size. The box used at Takashima was made of polyethylene, 26×26×30 cm. Four to five liters of cut rice straw, bark chips, and wood chips were placed in the nests at Hashimoto, Minoh, and Hirakata, respectively, as nest materials. Two liters of wood chips were used at the Takashima site. Eggs were laid by Ural owls in every nest during late March 2006, and one or two young birds per nest fledged by mid- to late May (Fig. 1F).

Detritus was collected from the bottom of the nest boxes on June 17, 2006 at Hashimoto, on June 25 at Minoh and Hirakata, and on September 29 at Takashima. Feathers and pellets were separated from the detritus, and all identified moth larvae were reared in the cases (ht. 3 cm, dia. 9 cm) at 25°C under a natural photoperiod cycle, providing pellets as food. The remaining detritus was put into large cases (30×23×10 cm) under the same laboratory conditions.

Scientific names of birds and carnivores follow the Committee for Check-List of Japanese Birds (2000) and Abe et al. (2005). All moth specimens were preserved in the private collection of the first author.

RESULTS

Four species of Tineidae (Niditinea baryspilas (Meyrick), Monopis pavlovskii (Zagulajev), Mon. flavidorsalis (Matsumura), and Mon. sp.) and one of Oecophoridae (Martyringa ussuriella Lvovsky) were successfully reared from the pellets and detritus of the four nest boxes (Table 1).

The upper layers of the nest box detritus were very wet, and consisted of a mixture of nest material, pellets (small bones and fur of mice, bones of small birds, etc.), owl feces, bird bones and plumage, fur and bones of small animals, and dead leaves (Fig. 1L). The collected feathers and fur were not permeated by fungal mycelia. Some of the feathers were only rachis without barbs, perhaps damaged by larvae of Tineidae (Fig. 1M).

Lepidoptera from Ural owl nest boxes
Family Tineidae
Subfamily Tineinae
Niditinea baryspilas (Meyrick) [Japanese name: Usuguro-iga]
Three moths developed from the detritus at Hashimoto from July 25 to August 2, 2006, and over 100 moths at Hirakata from July 6 to August 10. Over 50 moths of the next generation also developed from larvae in the same detritus at Hirakata from early September to early October. The immature stages are illustrated here for the first time.

Adult (Fig. 1A): Forewing length 5–7.5 mm. Forewing yellowish brown, with five to six dark patches and numerous small dark dots.

Distribution: India, Middle Asia; Japan (Honshu).

Biology: Larvae fed on fur and feathers in nest box detritus, and constructed a long, tubelike larval case of fine wood chips (Fig. 1G). Pupation took place in a spindle-shaped cocoon of fine wood chips (Fig. 1H). The pupa protruded from the cocoon before emergence. According to Moriuti (1982), the moth is common indoors and adults have been collected from April to June and in October. Moths have also been reared on dried bonito (Moriuti, 1982).

Monopis pavlovskii (Zagulajev) [Japanese name: Maemonkuro-hirozukog]
Over 100 moths developed from the pellets and detritus at Hashimoto from July 5–30, 2006, over 40 moths at Minoh from July 7 to August 10, 14 moths at Hirakata from July 10–14, and two moths at Takashima from October 24 to November 2. The immature stages are illustrated here for the first time.

Adult (Fig. 1B): Forewing length 6–9 mm. Forewing black, with a conspicuous large white patch on costa.

Distribution: Iran, Pakistan, China, Korea, Far East of Russia; Japan (Honshu, Shikoku, Kyushu).
Biology: The moths appear in urban to montane areas (Oku, 2003). In the present study, larvae fed on pellets, fur, and feathers in nest box detritus, and constructed a tubelike larval case made of fur (Fig. 1I). Pupation took place in a flat oval cocoon of fur (Fig. 1J). The pupa protruded from the cocoon before emergence (Fig. 1K).

Monopis flavidorsalis (Matsumura) [Japanese name: Atoki-hirozukoga]

Two moths developed from the detritus at Minoh on July 21, 2006.
**Adult** (Fig. 1C): Forewing length 6–7 mm. Forewing dark brown, dorsum red-brown, with a transparent patch before the middle.

**Distribution:** Japan (Hokkaido, Honshu).

**Biology:** Larvae fed on fur and feathers in nest box detritus.

**Monopis** sp. [Japanese name: Atousuki-hirozukoga]

A moth developed from the detritus at Hashimoto on August 1, 2006. This species was previously reported in a house by Koshino (2001).

**Adult** (Fig. 1D): Forewing length 5.5 mm. Forewing dark brown, dorsum pale pink-brown, with a large transparent patch at the middle.

**Distribution:** Japan (Honshu).

**Biology:** Larvae are thought to have fed on fur and feathers in nest box detritus. According to Suzuki et al. (2006), the larvae also attacked wool products in a house.

**Family Oecophoridae**

**Subfamily Oecophorinae**

**Martyringa ussuriella** Lvovsky [Japanese name: Nisekoku-maruhakibaga]

A moth developed from the detritus at Hirakata on June 28, 2006.

**Adult** (Fig. 1E): Forewing length 9 mm. Forewing pale brown, with two to three small black patches at the middle.

**Distribution:** Far East of Russia, Japan (Chishima, Hokkaido, Honshu).

**Biology:** Moths have been previously bred from larvae that fed on decaying wood, the bark of Japanese cedar, and dead leaves (Saito, personal communication). In the present study, larvae may have fed on decaying wood chips in nest box detritus.

**DISCUSSION**

In the present study, Lepidoptera from Ural owl nest boxes has been recorded in Japan for the first time. This report was the second record on Lepidoptera from the owl nest. *Niditinea baryspilas* was found in two nest boxes at Hashimoto and Hirakata, and *Monopis pavlovskii* in all four boxes (Table 1). Both species are common in Japan. *Mon. flavidorsalis* was found in the nest box at Minoh, and *Monopis* sp. in Hashimoto. A number of *N. baryspilas* were reared from the detritus at Hirakata, where the nest material was wood chips. Many *Mon. pavlovskii* were reared from the detritus at Hashimoto, where the nest material was cut rice straw. Therefore, wood chips may be adequate for the development of *N. baryspilas*, and cut rice straw for *Mon. pavlovskii*. However, the great variation in the types of Lepidoptera occupying various nests may depend on their location, e.g. forest edges and in the forest. All species of *Monopis* previously recorded in Japan were reared from nest box detritus, so it is likely that Ural owl nests are an important habitat for the species of that genus.

A great number of tineid moths were reared from the pellets and detritus of two nest boxes (Table 1). Over 100 *N. baryspilas* emerged from larvae in the detritus at Hirakata from July to August, and over 50 moths of the next generation from September to October. Over 100 *Mon. pavlovskii* moths emerged from larvae in the detritus at Hashimoto from July to August, and over 40 moths at Minoh. The great viability of the moth larvae shows that many keratin sources remained in the detritus as food for the tineids, even though many feathers were removed from each detritus sample. *Mon. pavlovskii* emerged from larvae in

<table>
<thead>
<tr>
<th>Nest box No.</th>
<th>Locality</th>
<th>Nest material</th>
<th>Tineidae</th>
<th>Oecophoridae</th>
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<tr>
<td></td>
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<td></td>
<td><em>Niditinea</em></td>
<td><em>Monopis</em></td>
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<tr>
<td>1</td>
<td>Hashimoto, Wakayama Pref.</td>
<td>Cut rice straw</td>
<td>3</td>
<td>100+</td>
</tr>
<tr>
<td>2</td>
<td>Minoh, Osaka Pref.</td>
<td>Bark chips</td>
<td>0</td>
<td>40+</td>
</tr>
<tr>
<td>3</td>
<td>Hirakata, Osaka Pref.</td>
<td>Wood chips</td>
<td>100+</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Takashima, Shiga Pref.</td>
<td>Wood chips</td>
<td>0</td>
<td>2</td>
</tr>
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*a* Detritus of nest boxes were collected in mid–late June 2006, and the adult moths emerged from early July to early August.

*b* Detritus of nest box were collected in late September 2006, and the adult moths emerged from late October to early November.
the detritus from Takashima under laboratory conditions from late October to early November. This suggests that the species is able to propagate within the detritus. Ural owl nests generally contain many feathers and pellets after fledging of the young owls (Higuchi, personal communication). We consider that after breeding, the owl nests have keratin sources sufficient for at least two generations of the tineid. Jalava (1980) reported total of 2,534 moths of five tineid species (maximum 900 moths of two species per nest) in 12 nest boxes in Finland. This finding also supports the idea that there are abundant keratin sources in owl nests after breeding.

Larvae of keratophagous Tineidae prefer soiled keratin sources rather than those free of organic contamination such as urine or sweat. When fed on only feathers or animal hair, their growth rate is much slower and mortality much higher compared to other diets (Hinton, 1956; Robinson, 1979, 1988, 1990). The present observations reveal that pellets and feathers in the owl nests were heavily soiled by the feces of juvenile owls. The soiled feathers, pellets, and fur are probably optimal substrates for keratophagous tineids.

In experiments by Robinson (1988) using artificial feather traps in the rain forests of Southeast Asia, traps were rapidly attacked by tineid larvae and also colonized by fungi. A dense mat of mycelia was obvious. However, Tineidae failed to infest the traps in dry conditions, and fungi also failed to colonize with no obvious mycelia. The failure of Tineidae to infest traps in dry tropical conditions may reflect the failure of such feather traps to attract colonizing fungi. Fungi act as mediators of insect attacks on keratin, but their precise role is still uncertain (Robinson, 1990). Some tineid larvae require wool fibers to have been permeated by mycelia before can consume it (Robinson, 1990). The fungal infestation is necessary for keratin digestion. Utilization of fungal enzymes or symbiotic micro-organisms in the larval gut may be involved (Robinson and Nielsen, 1993). However, obvious mycelia on organic matter were not recognized in the present study. In temperate regions, further research is necessary to show the relationship between tineids and keratin sources and/or fungi.

Ural owls occur widely in the frigid to subfrigid zones of Eurasia and live year-round in the lowland to subalpine forest zones in Japan north of Kyushu. They breed in hollow trees (Abe, 1997). In Nagano Prefecture, the same pair of owls bred in the same hollow tree for 20 consecutive years (Miyazaki, 1976). According to Sugiyama (1998, 2002), owls reared 18 broods over the course of three years in 10 hollow trees in Aichi Prefecture, and 58 broods during nine years in 24 nest boxes. Sixteen of these boxes were utilized in two consecutive years, and one box for five consecutive years. In Shiga Prefecture, the same pair of owls bred biennially in the same nest box from 2002 to 2006 (Ishii, personal communication). Thus Ural owls tend to utilize the same hollow tree and/or nest box for breeding, suggesting that many keratin sources are provided as potential food for tineids in the owl nests every year.

Consequently, Ural owl nests may provide a suitable natural habitat for keratophagous tineids because they provide many favorable keratin sources stained with feces from juvenile owls. The moths are expected to play an important role in decomposing keratin sources such as feathers and fur in the owl nests. It is also possible the nests of other owls and raptors could provide suitable habitats for tineids because they also provide keratin sources. Further surveys of bird nests in Japan may result in the discovery of moths unique to these other nests.

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