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Larval biology of *Mongoloraphidia sororcula* (H. Aspöck & U. Aspöck, 1966)

(Neuropterida, Raphidioptera, Raphidiidae)

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Mongoloraphidia sororcula (H. Aspöck & U. Aspöck, 1966) was reared in the lab from field collected specimens for two generations starting in 2012. The natural habitat in Mongolia, where adults and one larva were found, is described. Based upon specimens of the offspring the morphology of the larva is described for the first time together with information on the development. This is the first description of the larva of the subgenus *Mongoloraphidia* sensu stricto.

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Introduction

Mongoloraphidia sororcula (Fig. 1) is one of the many Central Asian Raphidioptera species with so far unknown larvae. The species was described in 1966 (H. Aspöck & U. Aspöck 1966) from a single male collected by the Mongolian-German Biological Expedition 1964 (H. Aspöck & U. Aspöck 1967). In the monograph of Raphidioptera, the same authors mention several records in the north-western part of Mongolia (Aspöck et al. 1991). To our knowledge, no other record has been published since that time (but see Gruppe 2014).

During a field trip to Mongolia in 2012, AG was able to collect some specimens of the species close to the locus typicus. Females laid eggs in the lab and the offspring was reared for two consecutive generations. Here, we present pictures of adults, describe larvae for the first time and give information on the natural habitat and development of this poorly known species. This is also the first description of a larva of the subgenus *Mongoloraphidia* sensu stricto.

Material and methods

Adults of *Mongoloraphidia sororcula* were collected at two sites in Mongolia in 2012. Females were kept individually in plastic vials according to H. Aspöck & U. Aspöck (2009) for oviposition and were fed with killed, squashed insects during the field trip and later on in the lab. Hatched larvae were reared individually in the same vials until pupation and emergence of adults in an incubator at 20 °C, long day condition (16 h light) and approximately 60 % relative humidity. If humidity was below 60 % a bowl of water was placed into the incubator. They were fed with pieces of mealworms (*Tenebrio molitor*) once a week. Hibernation was in a climate chamber without light at 4 °C from October to March each year. During hibernation, larvae were supplied with pieces of mealworms every four weeks. This protocol was applied until adults emerged, i. e. for one, two or three years. Couples of emerged adults were kept at room temperature and natural light in 1 l plastic boxes fitted with some filter paper and wooden sticks for mating. They were fed with pieces of mealworms, honey and water ad libidum. Females were transferred individually to vials for oviposition after 5 days, e.g. after mating was assumed. With this protocol, two consecutive generations were reared in the lab.



Fig. 1. Female (left) and male (right) of *Mongoloraphidia sororcula* (H. Aspöck & U. Aspöck, 1966) (F1-Generation).

Larvae of many Raphidioptera were described by H. Aspöck, U. Aspöck and Rausch (see Aspöck et al. 1991 and references therein). These authors use specific terms for markings on the thorax and abdomen which first were described by Aspöck et al. (1974) in German language. To be consistent with previous descriptions, we use translations of these German terms which were suggested by H. Aspöck and U. Aspöck (Vienna, Austria). On thorax and abdomen three different markings can be separated: dorsal figure, lateral figure and ventral figure. Longitudinal bright stripes within or between the figures are called fascia, i.e. median fascia, lateral fascia. The last abdominal segments exhibit a paired caudal part of the dorsal figure ("Füßchen" in Aspöck et al. 1974) whose branches might reach the end of the segments.

Results

Habitat

At two sites less than 80 km south of the locus typicus in the northwest of Mongolia adult *M. sororcula* (Fig. 1) were collected. At the first location (Mongolia; Province Bayan-Ölgii; valley of River Khovd; 18.7 km NE Ölgii; 1730 m a.s.l.; 90.18° E, 49.06° N; leg. A. Gruppe) 3 ♂ and 6 ♀ were beaten from a single flowering *Caragana* sp. bush on the sandy valley margin of river Khovd on 06.06.2012 (Fig. 2). No individuals were found on adjacent trees (*Populus*, *Larix*, *Betula*), on bushes (*Caragana*, *Salix*) or on other annual vegetation nearby. At the second location (Mongolia; Province Uvs; rock 6.2 km NW Bayan Nuur; 1780 m a.s.l.; 91.32° E, 049.15° N; leg. A. Gruppe) 15 ♂ and 7 ♀ were collected on several *Caragana* sp. and *Amelanchier* sp. bushes growing in crevices of a big rock one day later (07.06.2012) (Fig. 3). Here one mature larva was found between debris and bigger stones on the ground close to a

Caragana sp. shrub. No other larva was found at any site, neither on the ground nor on the rough bark or on dead stems of the shrubs.

Description of mature larva

The last larval instar is about 1.3–1.5 cm long with a brown to reddish-brown coloration (Fig. 4). Meso- and metathorax as well as all abdominal segments exhibit species specific yellow markings. Coloration and markings are shown in Fig. 4 (dorsal), Fig. 5 (lateral) and Fig. 6 (ventral).

The shape of the head is rectangular with dark red-brown coloration, in some individuals brighter markings might occur.

The coloration of the pronotum resembles the head but is partly brighter with median fascia and edges, which are always conspicuously lighter brown. The dorsal figures on meso- and on the metanotum are similar, dark brown but less red shade than head and pronotum. They are, broad and range from the cephalic to the caudal margin of the segment. The median fascias are yellow to bright brown, narrow and partly interrupted at the margin of the segment. The dorsal figure on the thorax is limited by a wide, light yellow lateral fascia, which does not reach the caudal margin of the segment.

The dorsal figures (Fig. 4) on the abdomen are dark brown, similar to the meso- and metanotum, broad and sharply delimited, with a protrusion near the cephalic and caudal margin of the segment. The median fascias of all segments are yellow, narrow, partly interrupted at the cephalic margin of the segment. In some segments they widen caudally. The dorsal figure of segment eight exhibits paired caudal parts which do not reach the caudal edge of the segment in some individuals. The dorsal figures are continuously delimited by the narrow, light yellow lateral fascia. The lateral figure (Fig. 5) is of brown and consists of two elements, i.e. of a continuous dorsal stripe and a more lateral stripe with brightening and triangular protrusion. The ventral figure (Fig. 6) is separated from the lateral figure by a narrow yellow stripe and continuously wide, brown stripes. The figure itself is rectangular and yellowish brown, partly with a variable yellow

dot at the cephal margin of the segment. Typically it bears one or more symmetrical pairs of bright points.

Development of larvae

Starting with adults collected in the field in June 2012 we were so far able to rear two consecutive generations in the lab. All specimens hibernated as larvae and pupated within two months after the end of hibernation. Duration of pupal stage was between six and ten days. Under lab conditions, most specimens developed within two years. However, in both generations a few adults emerged after one year only (Tab. 1). In the second generation roughly fifty percent of the specimens did not pupate after second hibernation, but exhibited abnormal prothetely.

Discussion

Larvae of many Raphidioptera are known, but only few were so far described (Aspöck et al. 1991). Larvae exhibit a characteristic shape and structure of the head and species specific markings on thorax and abdomen which were named in German by Aspöck et al. (1974). In accordance with theses authors we define English terms for that markings and use a systematic description of all of the structures. The markings of *M. sororcula* are distinct from that of other species of the same genus. However, the present description is the first for a species of *Mongoloraphidia* s. str. (Aspöck et al. 1999a,b).

A development of *M. sororcula* in the litter or detritus was expected by Aspöck et al. (1991) at least on rocky ground. The larval habitat at River Khovd is unclear, but records of adults on shrubs and trees in floodplains and on sandy ground are also mentioned by Aspöck et al. (1991). These authors suggest that shrubs and trees in floodplains might be colonized by adults but larval development might happen in adjacent rocky areas. We collected nine specimens from a single *Caragana* bush but none from nearby plants, although both were located close to each other (Fig. 2). Rocky ground as alternative larval habitat occurred about 10 m away. Thus, it seems likely that adults had developed either on the shrub itself which exhibited dead branches with loose bark and some cracks and holes in the wood, or in the litter below the shrub, or in the sandy soil. However, the sandy soil on the base of the bush was sieved to find larvae of Myrmeleontidae, the pitfalls of which were present, but no snake fly larva was found.

Three other species of Raphidioptera were described from the same region by Aspöck et al. (1991), all of them belonging to the genus *Mongoloraphidia* s. str., *M. sajanica* (H. Aspöck, U. Aspöck & Mar-

Table 1. Time of emergence of adult *Mongoloraphidia sororcula* reared ex ovo in two consecutive generations.

Oviposition = generation	Adults after 1st hibernation	Adults after 2nd hibernation	Adults after 3rd hibernation
2012 = F1	1	36	0
2014 = F2	2	24	27



Fig. 2. Locality of *M. sororcula* at the valley margin of River Khovd (06.06.2012, 48.15°N, 091.74°E; 1270 m a.s.l.). Specimens were beaten from the *Caragana* bush in the center of the picture.



Fig. 3. Locality of *M. sororcula* close to Bayan Nuur (the lake is visible in the back ground) (07.06.2012, 49.15°N, 091.32°E; 1780 m a.s.l.). *M. sororcula* was beaten from small bushes in the lower part of the picture.



Fig. 4. Dorsal view of mature larva of *Mongoloraphidia sororcula* reared in the lab ex ovo (F1).

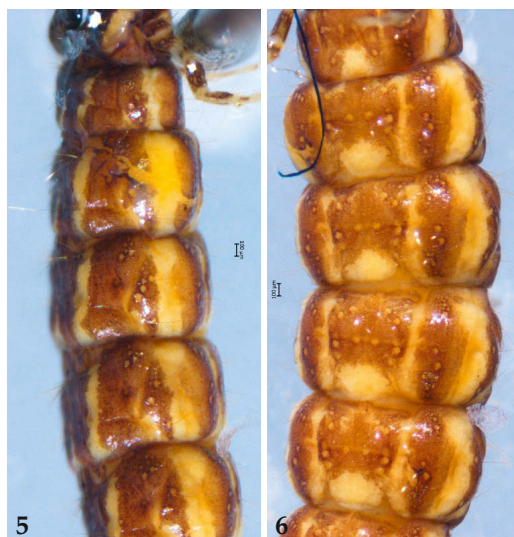


Fig. 5,6. Mature larva of *Mongoloraphidia sororcula* reared in the lab ex ovo (F1). 5. Lateral view; 6. ventral view.

northernmost part of Mongolia and Russia (Hilbig 2006, Aspöck et al. 1991). The other two species were collected on *Caragana* sp. in steppe or desert steppe habitats similar to those where *M. sororcula* was found. However, *M. altaica* is known from the southern Altai mountain only and Aspöck et al. (1991) expect the species in China, too. Most likely, there might be sympatric populations of *M. sororcula* and *M. kaszabi*, because the known locations of *M. kaszabi* are close to or overlap with the western part of the area of *M. sororcula* (Aspöck et al 1991).

In this paper, we have described the larva of *Mongoloraphidia sororcula* for the first time. The pattern of coloration distinguishes them from other known *Mongoloraphidia* species (see Aspöck et al. 1999a,b, 2002). However, larvae of two species, which might occur in the same area, are not known. The larvae live in debris on the ground and, judged from observations in the lab, develop mostly within two years, but both, faster and delayed development, was observed as well.

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tynova, 1968), *M. altaica* (H. Aspöck. & U. Aspöck, 1966) and *M. kaszabi* (H. Aspöck & U. Aspöck, 1967). Larvae of these species are so far unknown and nothing is known about sympatric occurrence. Regarding the scarce information on the habitat in the literature (Aspöck et al. 1991), sympatry of *M. sororcula* with *M. sajanica* is unlikely, because the habitat of the second species are deciduous forests at lower elevation (1400 m a.s.l.) of Taiga in the

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