Introduction

*Brachyzapus nikkoensis* (Uchida 1928) is a member of the *Polysphincta* genus-group (Hymenoptera, Ichneumonidae, Pimplinae, Ephialtini), all members of which are solitary koinobiont ectoparasitoid of spiders with high host specificity (Gauld & Dubois 2006; Matsumoto 2016). The genus *Brachyzapus* currently consists of fourteen species distributed in Eurasia and Africa (Gauld & Dubois 2006; Pham et al. 2012; Uchida 1928, 1941; Uchida & Momoi 1958; Varga et al. 2018; Yu et al. 2016) but the only species for which a host spider has been recorded is *B. nikkoensis*. It has been reared exclusively from Agelenidae spiders: *Agelena silvatica* Olinger 1983 (Iwata 1942; Matsumoto 2009; Takasuka et al. 2018; Tanaka 1992; Uchida 1941), *Allagelena opulenta* (Koch 1878) (Tanaka 1992) and *Tegenaria domestica* (Clerck 1757) (Uchida 1941).

Member of the family Agelenidae, called funnel web spiders, generally construct a funnel-sheet web with a tunnel (tubular retreat) to hide in. These are made variously on vegetation, among rocks or on manmade structures (Bee et al. 2017; Cowles 2018; Dalton 2008; Preston-Mafham 1991). They are members of the RTA-clade which are entirely cursorial spiders or 2D ground-web weavers (Wheeler et al. 2017).

The parasitoid *B. nikkoensis* seems to be exclusively associated with agelenid spiders, and its oviposition behaviour is highly adapted to the web structure of this spider, but has thus far only been observed *Ag. silvatica* with the female wasp diving into the funnel-sheet web to entice out the host and then sting the spider (Iwata 1942; Matsumoto 2009; Tanaka 1992).

Although Tanaka (1992) mentioned its parasitism on *Al. opulenta* in an ecological paper, there seems to be no evidential specimen regarding this host record. Thus this study reports *B. nikkoensis* parasitizing *Al. opulenta* for the second time with the first voucher specimen. It discusses the probable natural history of the parasitoid as inferred from current knowledge. Reference to literature in Japanese (illustrated books) is done only when it mentions seasonal prevalence and body length of each spider species.

**Materials and Methods**

An adult female *Al. opulenta* parasitized by a young polysphinctine larva attached to the posterior margin of spider’s cephalothorax (Fig. 1) was found in Kodaira-shi, Tokyo, Japan by Mr. Takeaki Ichikawa on 23 September 2016. The spider was placed into a 2 l PET bottle laid sideways and cut its one side to make an openable lid. The spider constructed a funnel-sheet web with a tunnel in this container as in the field. The spider was fed with flies or tiny caterpillars until the parasitoid larva killed her to complete its growth. The emerged wasp was identified by an ichneumonid taxonomist, Dr. Kyohei Watanabe (Kanagawa Prefectural Museum of Natural History, KPMNH). The specimen with a cocoon and the spider carcass is deposited in KPMNH with a depository number, KPM-NK 5006649.

**Results**

Based on morphology, the emerged wasp was identified to be a female *B. nikkoensis*, representing the second record of...
Al. opulenta parasitized by the wasp.

When the spider was active, the wasp larva only fed from its cephalothorax (Figs. 1–3), but after the spider became completely immobile and was dying, the larva also fed from spider’s abdomen. After killing the spider, it started to spin its cocoon (Fig. 4) on 1st October 2016 over the course of one day. Its meconium was excreted and stuffed in the distal end of the cocoon. The wasp emerged from the middle part of the cocoon (Fig. 4) on 12 October 2016, in contrast to the anterior end previously observed in the same species parasitic on Ag. silvatica (Matsumoto 2009).

Discussion

Although Tanaka (1992) already suggested that B. nikkoensis may shift its host spider between Ag. silvatica and Al. opulenta dependent on their body size and seasonal prevalence, I reconsider this hypothesis reviewing current knowledge.

All records of parasitism of Ag. silvatica so far are restricted to the period from late April to July (Iwata 1942; Matsumoto 2009; Takasuka et al. 2018; Tanaka 1992) and three generations of B. nikkoensis utilizing Ag. silvatica during this period is suggested (Tanaka 1992). From the previous observations, utilization of Ag. silvatica seems exclusively to involve immature spiders (instar 2–6) with the highest rate on instar 3 and no parasitism observed on adult hosts (Tanaka 1992); host immaturity can be clearly ascertained from the pictures in other papers (Matsumoto 2009; Takasuka et al. 2018). Agelena silvatica is univoltine in Aichi prefecture (Tanaka 1992) and reaches to adulthood from July (Shinkai 2017; Tanaka 1992; Tokyo Spider Study Group 2015). This means that suitable Ag. silvatica become no longer available for B. nikkoensis in the end of July. Utilization of immature spiders is the general tendency among polysphinctines probably because adult spiders are too big to attack or consume, and probably less

Figs. 1–4. Larva of B. nikkoensis upon cephalothorax of Al. opulenta (1–3) and its cocoon (4). 1, young instar larva photographed on 26 September 2016; 2, middle instar larva photographed on 28 September 2016; 3, penultimate instar larva photographed on 30 September 2016; 4, cocoon.
The second time of *B. nikkoensis* parasitizing *A. opulenta* seems likely but remains to be verified. (Matsumoto & Takasuka 2010), overwintering as a prepupa Matsumoto & Takasuka 2010; Takasuka & Tanaka 2013), they would be unable to exploit the overwintering eggs and tiny spiderlings. As in a few very rare cases observed such as those of *Megaetaira maddida* (Haliday 1838) (Fitzón et al. 1988) and *Zatypota maculata* Matsumoto & Takasuka 2010 (Matsumoto & Takasuka 2010), overwintering as a prepupa or as an adult seems likely but remains to be verified.

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