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Report on the host associations of the genus *Macrosiagon* (Coleoptera: Ripiphoridae) in Sulawesi (Indonesia)

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Abstract. The wasp hosts of three species of the genus *Macrosiagon* Hentz, 1830 (Coleoptera: Ripiphoridae: Ripiphorinae: Macrosiagonini) are recorded from Central Sulawesi (Indonesia). *Macrosiagon nasuta* (Thunberg, 1784) was reared from the nests of *Rhynchium haemorrhoidale* (Fabricius, 1775) and *Epsilon manifestatum crassipunctatum* (Gusenleitner, 1991) (both Vespidae: Eumeninae), *Macrosiagon* cf. *punctulaticeps* (Blackburn, 1899) was reared from the nests of *Pison* sp. (Crabronidae: Trypoxylonini) and *Chalybion* sp. (Sphecidae: Sceliphronini), and *Macrosiagon pusilla* (Gerstaecker, 1855) was reared from the nests of *Auplopus* sp. (Pompilidae: Auplopodini). A review of known associations between the hosts and reared parasitoids is provided. The family Pompilidae is recorded as a host group for the genus *Macrosiagon* for the first time.

Key words. Coleoptera, Ripiphoridae, *Macrosiagon,* Hymenoptera, Crabronidae, Pompilidae, Sphecidae, Vespidae, Oriental region, Sulawesi, Australia, Solomon Islands, parasitoids, host associations, trap nest

Introduction

Species of the genus *Macrosiagon* Hentz, 1830 (Ripiphoridae: Ripiphorinae: Macrosiagonini) are known to parasitize different groups of aculeate hymenopterans (such as the Apidae, Crabronidae, Halictidae, Scoliidae, Sphecidae, Tiphiidae and Vespidae – Falin 2002) but their bionomics are poorly known. As in other genera of the subfamily Ripiphorinae, the eggs are laid on different parts of plants where the newly hatched first instar larvae of the parasitoid, generally called 'triungulins', actively attach to the body of the host wasp or bee and are transported into the host nest. *Macrosiagon* is widely distributed in all continents except for cold polar areas, and some species of the genus have large distributions throughout several zoogeographical regions (Batelka 2004, 2007).

More than 150 specimens of three species of *Macrosiagon* were reared from hymenopteran brood cells while examining the influence of land use on the biodiversity of tropical agroforestry systems in the Lore Lindu National Park (Central Sulawesi, Indonesia). In this paper we provide and discuss the results of this research, and review previously published host association data of the three *Macrosiagon* species.

Materials and methods

Region and landscape. The study was conducted on the western margin of the Lore Lindu National Park in Central Sulawesi (Indonesia) in the surroundings of the Toro village (E 120°02´, S 1°30´, 800-1100 m a.s.l.), about 100 km south of the region's capital Palu. In 2005, annual rainfall in the study area was 2480 mm, average temperature was 24.2 °C and humidity 84 %. The area is characterized by a small-scale mosaic landscape dominated by natural and disturbed tropical forests, cacao agroforestry systems of differing intensity, and open areas such as grasslands and paddy fields.

We selected plots forming a gradient in land use intensity from closed and diverse forests, with high buffering abilities for microclimatic conditions, to high intensity agroforestry systems. We refer to a plot as a site with homogeneous land use practices of a given type and a minimum core area of 30 x 50 m. The four different habitat types were (A) natural forest and (B, C, D) three different intensities of cacao agroforestry. The cacao agroforestry systems formed a gradient according to the composition of shade tree species: B = low management intensity agroforestry, where natural forest trees are included as shade trees; C = medium intensity systems with a diverse shade tree community planted entirely by farmers; D = = high intensity plots with only a few shade tree species, mostly *Gliricidia sepium* (Jacq.) and *Erythrina subumbrans* (Hassk.). The number of shade tree species is strongly correlated with canopy cover (Spearman: $R = 0.609$, $p = 0.0073$) and corresponding microclimatic conditions such as temperature (Spearman: $R = -0.489$, $p = 0.0001$) and humidity (Spearman: $R = 0.705$, $p < 0.0001$). Four replicates were chosen for each plot type. In our study plots, farmers grew a variety of field crops between the cacao and shade trees. Pumpkin, vanilla, chilli pepper, pineapple, clove, tapioca, coffee, corn and cucumber were among the most frequently planted cash crops contributing to the overall floral diversity within the plots.

Trap nests. Trap nests offer nesting sites for above-ground nesting bees and wasps and can therefore be used to study these insects experimentally. We used a PVC tube with a length of 25 cm and a diameter of 14 cm that formed the outer case of the nest (Fig. 1). Internodes of the grass *Saccharum spontaneum* (R. Br.) A. Camus (Poaceae) with varying diameter (3-25 mm) and a length of 20 cm were inserted into this tube. Trap nests were hung on trees in three different heights. We placed 16 nests per plot (four in 1.5 m height in the shadow, four in 1.5 m in the sun, four in 6 m, and four in the canopy) from October 2004 until September 2005. We harvested occupied internodes every month and applied glue to the edge of the PVC tube to deter ants from colonizing the trap nest. Occupied internodes were easily identifiable by clayey soil closures of the internodes. We put these internodes in glass tubes which we closed with cotton to deter ants and to allow for air circulation, and stored them in a dark and warm

Fig. 1. Case of the trap nest in the field. (Photo P. Hoehn).

room until each insect hatched. Each internode was labelled with the month it was collected, the trap nest (including the information for habitat type and height) where we found it, and a serial number for later attributions as there were more than one occupied internode per trap nest and date.

The following codens identify the collections housing the material examined:

BMNH Natural History Museum, London, United Kingdom (Maxwell V. L. Barclay);
IPBC Bogor Agricultural University, Institut Pertanian Bogor collection, Bogor, Indonesia (Damayanti Buchori);
JBCP Jan Batelka collection, Praha, Czech Republic;
MNHN Muséum National d'Histoire Naturelle, Paris, France (Isabelle Bruneau de Miré, Azadeh Tagavian);
PHCG Patrick Höhn collection, Göttingen, Germany.

The specimens of *Macrosiagon* were identified by both authors; the identifications of hymenopteran host species were provided by Josef Gusenleitner (Linz, Austria) for *Rhynchium haemorrhoidale* (Fabricius, 1775) and *Epsilon manifestatum crassipunctatum* (Gusenleitner, 1991), Raymond Wahis (Gembloux, Belgique) for *Auplopus* sp., and Michael Ohl (Berlin, Germany) for *Pison* sp. and *Chalybion* sp.

Collection data for reared *Macrosiagon* are cited as follows: month, code of trap nest, number of parasitized nests (numbers in bold), serial number of specimen(s) (NA if not available). Exact label data are cited for the material deposited in the BMNH and MNHN; lines are indicated by single slash (/), separate labels are indicated by double slash (//), and our remarks and additions are found in square brackets: [p] – preceding data are printed, [hw] – preceding data are handwritten.

Results

Macrosiagon nasuta (Thunberg, 1784)

Material examined. Host species *Rhynchium haemorrhoidale* (Vespidae: Eumeninae) for all following reared specimens: April, E1U2, **1**, 6; April, E2U3, **1**, 8; April, F4I4, **1**, 18; April, E1U, **1**, 19; April, F1C3, **1**, 41; April, F4I1, **1**, 47; April, F4I4, **1**, 97; April, E1U8, **1**, 98; April, E1U4, **2**, 105; April, E3I2, **1**, 137; April, F4I3, **1**, 179; April, F1U6, **1**, 196; April, F4U2, **1**, 222; April, E1I4, **1**, 235; April, D2U3, **1**, 284; April, F1U7, **1**, 349; April, F4U2, **1**, 197; Dec, E2I4, **2**, 256; Dec, F2C2, **1**, 133; Dec, F4U1, **1**, 173; Dec, D3I3, **1**, 179; Dec, D4U1, **1**, 230; Dec, D2C3, **1**, 407; Dec, E2I4, **1**, 479; Dec, F4U5, **1**, 10; Dec, F4U3, **1**, 200; Feb, F1U6, **1**, 128; Feb, F1U6, **1**, 147; Feb, E1U6, **1**, 359; Feb, E3I3, **1**, 403; Feb, E4U8, **1**, 487; Feb, E3U4, **1**, 801; Feb, E1U7, **1**, 839; Feb, F4U2, **1**, 856; Feb, F2U8, **1**, 859; Feb, F1U2, **1**, 71; Jan, E1U1, **1**, 59; Jan, D5U7, **1**, 76; Jan, D4U7, **1**, 326; Jan, D4U5, **1**, 345; Jan, E3U4, **1**, 381; Jan, F4U7, **1**, 481; Jan, F4U5, **1**, 504; Jan, D4U4, **1**, 561; Jan, E1U5, **1**, 584; Jan, E2C1, **1**, 612; Jan, D4U4, **1**, 656; Jan, E1I4, **1**, 674; Jan, F4U7, **1**, 731; July, F4I4, **1**, 65; July, F1U8, **1**, 71; July, F1U6, **1**, 82; July, F1C3, **1**, 89; July, E3U6, **1**, 119; July, E3U6, **2**, 120; July, D3C1, **1**, 194; Jun, D2U7, **1**, 93; Jun, F1U4, **1**, 115; Jun, D3U6, **1**, 129; Jun, F1U2, **1**, 148; Jun, F1U4, **1**, 164; Jun, F1C2, **1**, 172; Jun, F4C2, **1**, 269; Jun, F4C1, **1**, 278; Jun, F4U3, **1**, 281;Jun, F4I2, **1**, 296; May, F4C1, **2**, 4; May, F4I4, **1**, 33; May, D4U6, **1**, 35; May, E1U1, **3**, 59; May, D2U6, **1**, 99; May, D2U7, **1**, 116; May, E2U5, **1**, 133; May, D2U7, **1**, 136; March, E2I4, **1**, 3; March, E2U3, **1**, 64; March, E2U7, **1**, 66; March, D2U2, **1**, 128; March, E4I1, **1**, 217; March, E4I1, **1**, 230; March, E4U1, **1**, 237; March, E3U4, **1**, 245; March, E3U7, **1**, 255; March, E3U7, **1**, 257; March, E3U8, **1**, 258; March, E3U8, **1**, 265; March, E3U7, **1**, 280; March, E3U7, **1**, 281; March, E1U5, **2**, 288; March, E1U8, **1,** 293; March, E1U8, **1**, 294; March, E1U8, **1**, 295; March, E1U8, **1**, 301; March, E1U8, **1**, 302; March, F1U7, **1**, 381; March, F1U6, **1**, 396; March, F4C3, **1**, 420; March, F4U3, **1**, 440; March, F4U3, **2**, 450; March, D4U7, **1**, 527; March, E3U8, **1**, 612; March, F2U7, **1**, 630; March, E3U8, **1**, 656; March, F4I3, **1**, 679; March, F1U6, **1**, 696; March, F4I3, **2**, 708; March, F3U8, **1**, 724; March, F4U5, **1**, 765; March, F4U5, **1**, 769; March, F3U6, **1**, 779; March, D5U4, **1**, 789; Nov, D5C3, **1**, 148; Nov, E4U1, **1**, 316; Nov, F3U2, **1**, 405; Nov, F3U1, **1**, 483; Nov, D3C2, **1**, 488; Nov, F3U2, **1**, 503; Nov, F3U3, **1**, 585; Nov, D3C2, **1**, NA; Nov, D3I3, **1**, NA; Nov, F4U6, **1**, 346; Oct, D2C1, **1**, 6; Oct, D2C1, **1,** 7; Oct, D2C1, **1**, 9; Oct, D2C1, **1**, 12; Oct, D2C1, **2**, 13; Oct, E1U1, **1**, 37; Oct, E1U1, **1**, 43; Oct, E1I4, **1**, 46; Oct, E2U6, **1**, 71; Oct, E2U1, **1**, 79; Oct, E1I4, **1**, NA; Sept, D3U6, **1**, 28; Sept, E4U6, **1**, 125; Sept, E4U3, **1**, 139; Sept, E1I4, **1**, NA (JBCP, PHCG, IPBC; host species PHCG). Parasitism rate was 1.97 % (7,397 individuals (nests) of this eumenid were examined, 146 of which were infested by *M. nasuta*). **Host species *Epsilon manifestatum crassipunctatum*** (Vespidae: Eumeninae): April, D3U3, **1**, 136; March, F3U5, **1**, 164 (PHCG, IPBC; host species PHCG).

Observations. Infested nests of the most abundant host *Rhynchium haemorrhoidale* had on average 1.93 ± 0.076 breeding cells, 1.07 ± 0.024 of which were parasitized by *M. nasuta*. Two subspecies of *R. haemorrhoidale* (*R. h. haemorrhoidale* and *R. h. umeroater* Gusenleitner, 1991) were present together in the research area, and it is not possible to identify the host precisely because no adult wasps were present in the infested nests. Additionally, three nests of *R. haemorrhoidale* were infested each with three individuals of the parasitoid *Chrysis* (*angolensis* group) sp., three with *Chrysis* (*smaragdula* group) sp. 1 and one with *Chrysis* (*smaragdula* group) sp. 2 (Hymenoptera: Chrysididae) and one individual from the family Trigonalidae (Hymenoptera). *Macrosiagon nasuta* further infested two nests of *Epsilon manifestatum crassipunctatum* (Gusenleitner, 1991) with one individual each.

Macrosiagon nasuta made small holes in the partition walls to get out of the nest, with the dead host larvae remaining in the infested cell. *Macrosiagon nasuta* usually hatched earlier than the remaining host individuals, perhaps to avoid contact with *R. haemorrhoidale* in the nest. Nevertheless, we did not observe aggressive behaviour of the host against the parasitoid when both met in the glass tube.

In the field we observed *M. nasuta* many times on the inflorescences of the invasive plant species *Hyptis capitata* (Jacq.) (Lamiaceae). This native of Central America is common in

disturbed areas. Interestingly, *H. capitata* seems to be highly attractive to *R. haemorrhoidale* and *E. manifestatum crassipunctatum* due to the high nectar supply of the plant. Popularity of this plant among eumenid wasps has been observed e.g. by Keller & Armbruster (1989) in Panama, Central America. Iwata (1975; fide Itino 1986, p. 192) assumes that the 'ripiphorid beetle, *Macrosiagon nasutum* [sic!] Thunberg may probably lay many eggs in flowers ... and ... that the hatched beetle larvae are transported into the wasp nest attaching themselves to the host wasp when the wasp visits on flowers'. Thus it is likely that the triungulin larvae of the parasitoid and the host make contact in the inflorescences. However, as the plant is an invasive species, its presence might alter the interaction between the two insects and favour higher parasitism rate of the parasitoid.

Remarks. *Macrosiagon nasuta* was first recorded from Sulawesi by a single specimen three years ago (Batelka 2004). This study provides confirmation of its occurrence on the island. *Rhynchium haemorrhoidale* had previously been known as a host species of *M. nasuta* only in Japan (see Conclusions). *Epsilon manifestatum crassipunctatum* is a new host record for this ripiphorid.

Distribution. *Macrosiagon nasuta* is widely distributed in Southeast Asia: China, Indonesia (Borneo, Sumatra, Sulawesi), Japan, Korean Peninsula, Nicobar Islands, Philippines, and Taiwan (Batelka 2004).

Macrosiagon cf. *punctulaticeps* (Blackburn, 1899)

Material examined. Host species *Chalybion* sp. (Sphecidae: Sceliphronini): Jun, E2U5, **1**, 78 (JBCP; host species PHCG). A total of 827 cells of *Chalybion* sp. were examined. **Host species *Pison* sp.** (Crabronidae: Trypoxylonini): Feb, F4U5, **2**, 94 (JBCP, PHCG; host species PHCG).

Observations. We found all three individuals of *Macrosiagon* cf. *punctulaticeps* (Blackburn, 1899) inside the host's cocoon. In five breeding cells of one *Pison* sp. nest, we found two cells occupied by the parasitoid. *Chalybion* sp. usually has one breeding cell per nest; hence we found one parasitoid in one nest and no surviving host.

Remarks. The species is recorded from Sulawesi for the first time. No previous host associations for *M. punctulaticeps* have been made.

The species belongs to the *Macrosiagon* '*bifasciata*' species-group sensu Batelka (2004). In this group, however, two 'subgroups' can be identified. The first one is characterized by a shortened and robust metatarsomere 2, and includes two species in the Oriental Region, *M. bipunctata* (Fabricius, 1801) and *M. dohertyi* Pic, 1949. The former species is widely distributed in the Afrotropical Region; it has been recorded from Yemen and it is known from all over the Indian subcontinent. The latter species, described from Bali, is known only from the type specimen deposited in coll. M. Pic (MNHN). The type was examined to prove its possible conspecificity with the reared specimens; it is a male labeled: 'Bali [hw] / Doherty [p] // type [hw] // type [p – red label] // Dohertyi / mihi [hw]'. However, *M. dohertyi* is not similar to the reared species. Moreover, no difference between *M. bipunctata* and *M. dohertyi* were observed; further research may show that these species are identical.

The second 'subgroup' includes all other Palaearctic and Oriental species related to the '*bifasciata*' group, i.e. *M. bifasciata* (Marseul, 1876), *M. medana* Pic, 1910, *M. medvedevi* Iablokoff-Khnzorian, 1973, *M. meridionale* (Costa, 1859), and *M. raffrayi* (Fairmaire, 1873). Surprisingly, the second *Macrosiagon* species reared in this study is identical with a species

occurring in Australia and the Solomon Islands. This species differs from other Oriental and Palaearctic members of this group by the strongly acute elytra and poorly visible light markings on a dull black background. We examined the following specimens of this species deposited in BMNH: four females labeled 'Australia: N. Q. / Redlynch, 21.x.1938 / R. G. & J. Ch. Wind. / B. M. 1939 – 572 [p]' and one female labeled: 'Solomon Is. / Guadalcanal / Gold Ridge / 1-2000 ft / P. G. Fenemore / C. I. E. Coll. 16348 [p] / 21.ix.1958 [hw] // Solomon Is. / Pres. / P. J. M. Greenslade / B. M. 1966 – 477 [p] // Macrosiagon / sp. nr. punctulaticeps / Blackb. [hw] / E. A. J. Duffy det. 1959 [p]'. For the purpose of this paper we accept Duffy's determination. However, examination of the type of *M. punctulaticeps* is needed. In any case, it is the first record of an Australian *Macrosiagon* species in the Oriental Region.

Macrosiagon pusilla (Gerstaecker, 1855)

Material examined. Host species *Auplopus* sp. (Pompilidae: Auplopodini): July, F3U4, **1**, 10; Dec, E2U8, **1**, 424 (PHCG, IPBC; host species PHCG).

Observations. We found one individual of *M. pusilla* in each of two nests of *Auplopus* sp., with on average four cells per nest.
Remarks. *Auplopus* sp. is a new host record for this species. The family Pompilidae is recorded as a host group for the genus *Macrosiagon* for the first time.
Distribution. *Macrosiagon pusilla* is widely distributed in the Palaearctic and Oriental Regions: China (Fujian, Guandong, Hebei, Hunan, Sichuan, Xizang, Yunnan), India (Assam, 'Bengale: Barway', Meghalaya, Uttaranchal), Indonesia (Sumatra), Japan (Hokkaidō, Honshū, Shikoku), Korean Peninsula (including Cheju Do Island), Laos, Malaysia, Nepal, Russia (Far East), Thailand, and Vietnam (Batelka 2007). This represents the first record from Sulawesi.

Conclusions

Macrosiagon nasuta. Of the three *Macrosiagon* species we discuss in this paper, *M. nasuta* seems to be most thoroughly investigated for its host requirements. The following host species have been reported thus far (all records are from Japan): *Anterhynchium flavomarginatum* (Smith, 1852) (Iwata 1939, Kôno 1936); *A. flavomarginatum micado* (Kirsch, 1873) (= *Rhynchium japonicum* Dalla-Torre, 1894, *Rhynchium micado* Kirsch, 1873) (Kifune 1956, Matsumoto 2002); *A. flavopunctatum flavopunctatum* (Smith, 1852) (= *R. mandarineum* Saussure, 1855); *Discoelius zonalis* (Panzer, 1801) (= *D. japonicus* Pérez, 1905) (Kifune 1956); *Eumenes fraterculus* Dalla-Torre, 1894 (Iwata 1939, Kifune 1956); *E. micado* Cameron, 1904 (Matsumoto 2002); *E. rubrofemoratus* Giordani Soika, 1941 (Kifune 1956, Matsumoto 2002); *Euodynerus quadrifasciatus* (Fabricius, 1793) (Kifune 1956); *E. notatus* (Jurine, 1807) (= *Odynerus* (= *Pseudepipona*) *nigripes* Herrich-Schaeffer, 1839) (Iwata 1939); *Orancistrocerus drewseni* Saussure, 1857 (= *Ancistrocerus fukaianus* Schulthess, 1913) (Iwata 1939, Kifune 1956, Matsumoto 2002); *Oreumenes decoratus* Smith, 1852 (= *Eumenes harmandi* Pérez, 1905) (Kifune 1956, Matsumoto 2002); *Pararhynchium ornatum* (Smith, 1852) (Kifune 1956); and *Rhynchium haemorrhoidale* (Fabricius, 1775) (Iwata 1939, Kifune 1956) (all Vespidae: Eumeninae).

From these published data and our observations, it can be concluded that *M. nasuta* attacks only members of the subfamily Eumeninae (14 recorded hosts).

Seasonality (Figs. 2-3). The number of individuals of *M. nasuta* had a clear peak in March and a low in August, as did the host species *R. haemorrhoidale* (1,033 individuals in March and 179 in August). Indeed, the density of the parasitoid is strongly correlated with host density per month and plot (Spearman's rank correlation: $R = 0.47$, $p < 0.000$, $N = 142$).

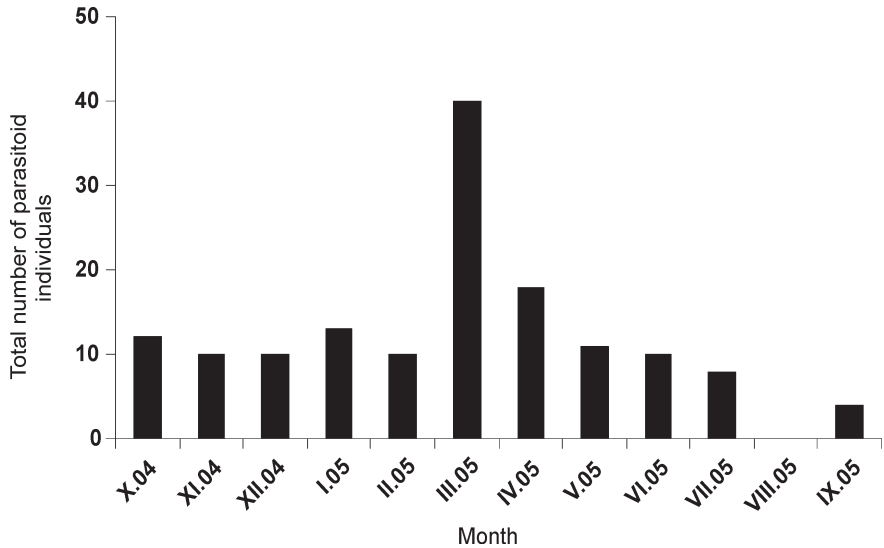

Fig. 2. Seasonality of *Macrosiagon nasuta* (Thunberg, 1784) (host: *Rhynchium haemorrhoidale*).

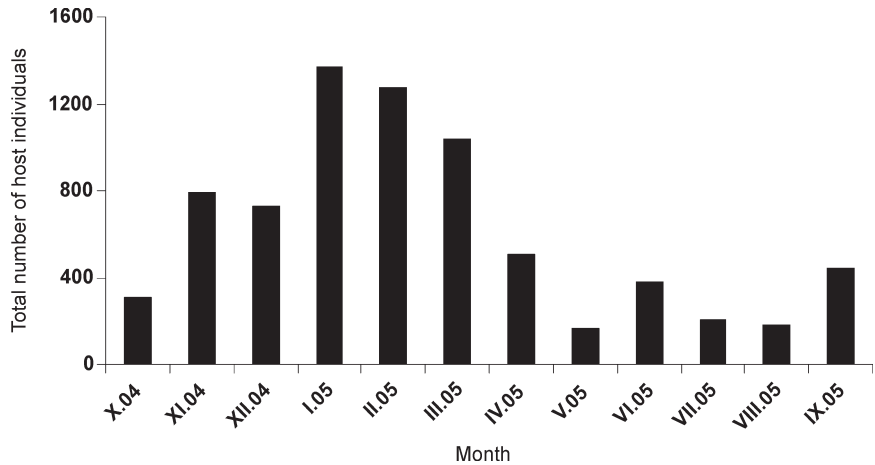

Fig. 3. Seasonality of *Rhynchium haemorrhoidale* (Fabricius, 1775).

***Macrosiagon* cf. *punctulaticeps*.** Until now, one *Macrosiagon* species has been known as a parasitoid of the genus *Pison* Spinola, 1808 (Crabronidae: Trypoxylonini), and several species as parasitoids of the genera *Chalybion* Dahlbom, 1843, and the closely related *Sceliphron* Klug, 1801 (Sphecidae: Sceliphronini). In this paper, representatives of both tribes are recorded for the first time as host species for one *Macrosiagon* species simultaneously. The published records comprise *Pison spinolae* Schuckard, 1838, which is reported to be parasitized by *Macrosiagon diversiceps* (Blackburn, 1899) in Australia (Callan 1981). The same ripiphorid is also regarded to parasitize *Pison marginatum* Smith, 1856 (Evans et al. 1980). The latter record was based on a small free parasitoid larva (of an advanced instar according to the attached figure) feeding on the host's egg. However, larvae of Ripiphorinae are known to eat last larval instars or prepupae of the hosts, which would be impossible in this case as the egg had been eaten first.

Mud dauber wasps *Sceliphron formosum* (Smith, 1856) were reported as a host of *Macrosiagon semipunctata* (Lea, 1904) in Australia (Callan 1981), *Sceliphron assimile* (Dahlbom, 1843) as a host of *Macrosiagon excavata* (Champion, 1891) in Panama (Hunt 1993), and *Sceliphron asiaticum* (Linnaeus, 1758) as a host of one unidentified species of *Macrosiagon* in Trinidad (Hunt 1993).

All Japanese records associating mud dauber wasps and *M. bipunctata* (Iwata 1939, Kifune 1956) are likely to belong to *M. bifasciata*. In the Oriental Region, *M. bipunctata* seems to be restricted to the Indian subcontinent (Sri Lanka, India, Kashmir and Nepal). All verified specimens from Japan, Korean Peninsula and China from this group belong to *M. bifasciata* (Batelka 2004, 2007). The following hymenopterans were reported in connection with *M. bifasciata*: *Chalybion japonicum* (Gribodo, 1883) (= *Ch. inflexum* (Sickmann, 1894)) (Iwata 1939, Kifune 1956), *Sceliphron deforme* (Smith, 1856) (Iwata 1939, Kifune 1956), *S. madraspatanum* (Fabricius, 1781) (Iwata 1939), *S. madraspatanum tubifex* (Latreille, 1809) (Sphecidae: Sceliphronini) (Iwata 1939), *Ancistrocerus fukaianus* Schulthess, 1913 (Vespidae: Eumeninae) (Iwata 1939), and *Cerceris sobo* Yasumatsu & Okabe, 1936 (Crabronidae: Philanthinae) (Kifune 1956). Hymenopterans listed by Kifune (1956) were undoubtedly mentioned as host species. The paper of Iwata (1939) is in Japanese as well but the names of hymenopterans are incorporated in the text, so it is not clear to us if they were all considered by the author as hosts. *Ancistrocerus fukaianus* as the host of *M. bifasciata* does not fit the idea that this ripiphorid species parasitizes only mud dauber and crabronid wasps. Snelling (1963) mentioned *Macrosiagon cruenta* (Germar, 1824) hosted by the eumenid wasp *Ancistrocerus campestris* (Saussure, 1852), which utilized empty cells in an old nest of *Sceliphron caementarium* (Drury, 1773) in Georgia, USA. Hunt (1993) speculated that the parasitoids associated with *S. assimile* in his study in Panama 'might all be hosted by the inquilines as well as by *S. assimile*'. The inquilines in his study included *Pachodynerus nasidens* (Latreille, 1817) (Vespidae: Eumeninae), *Trypoxylon* (*Trypargilum*) *saussurei* (Rohwer, 1912) (Crabronidae: Trypoxylonini), and *Chalybion zimmermanni aztecum* (Saussure, 1867) (Sphecidae: Sceliphronini). As eumenids and other wasps sometimes reuse nests of *Sceliphron*, they should not be rejected or confirmed as the hosts in some cases without additional data.

***Macrosiagon pusilla*.** The only known host record for *Macrosiagon pusilla* was published by Clausen (1940), who reported the tiphiid wasp *Tiphia pullivora* Allen & Jayres, 1930 (Tiphiidae: Tiphiini), with a 28.4% infestation rate of its cocoons in India. Our two observa-

tions from July and December could hardly be regarded as coincidental, and *Auplopus* sp. is therefore another confirmed host species of *M. pusilla*. This widely distributed ripiphorid species is apparently able to attack hosts from different families of Vespoidea, and additional host genera or even families can be expected.

KLEIN et al. (2002) mentioned one species of Mordellidae ('Mordellidae gen. sp. 1') reared from the nests of *Rhynchium haemorrhoidale umeroater* and *Subancistrocerus clavicornis* (Smith, 1859) in a similar research project in Lore Lindu National Park on trap-nesting bees and wasps. These records probably belong to some *Macrosiagon* species as representatives of the family Mordellidae are true herbivores, although ŠVÁCHA (1994) reported a few occasional observations of aggressive or predatory behaviour of their larvae.

The host(s) of *Macrosiagon spinicollis* (Fairmaire, 1893), previously reported from Sulawesi (BATELKA 2003) and seemingly closely related to *M. pusilla*, remain unknown.

From the results and data available, it is impossible to conclude whether some host-specific relationships exist between different *Macrosiagon* species and hymenopterans. However, we can conclude that some *Macrosiagon* species or groups of species prefer hosts of certain genera or subfamilies of bees or wasps.

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