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Agaonidae (Hymenoptera Chalcidoidea) and *Ficus* (Moraceae): fig wasps and their figs, ix (*Waterstoniella*)

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ABSTRACT

A key to the species of *Waterstoniella* Grandi, pollinators of figs of the *Ficus*-section *Conosycea*, with description of new species from Indonesia (E. Kalimantan), viz., *W. brevigena* (ex *F. pellucidopunctata* Griffith), *W. calcaria* (ex *F. sumatrana* Miq. var. *microsyce* Corner), *W. cuspidis* (ex *F. crassiramea* Miq.), *W. delicata* (ex *F. delosyce* Corner var. *obtusa* Corner), and *W. obvenata* (ex *F. acamptophylla* Miq.). *W. grandii* (ex *F. xylophylla* Wall.) is described from Malaysia. The host of *W. fiorii* Grandi in the Philippines (Luzon) is *F. crassiramea* var. *clementis* (Merr.) Corner. Two species are re-allocated, viz., *Deilagaon clavatum* (Wiebes) nov. comb. (from *Waterstoniella*) and *Waterstoniella elisabethae* (Grandi) nov. comb. (from *Ceratosolen* Mayr).

INTRODUCTION

New material of *Waterstoniella*, most of it collected by Dr. M. Leighton in E. Kalimantan, substantially adds to our knowledge of the genus and its host relations. All *Ficus*-species recorded were identified by Prof. Corner. Except for the one aberrant record of a species of *Eupristina* from *F. forstenii*, those from series *Validae* (with *Platyscapa* and *Deilagaon*), and some subseries of series *Drupaceae* (with *Eupristina*), the figs of subsections *Conosycea* and *Dictyoneuron* have *Waterstoniella*, and those from *Benjamina*, *Eupristina*. See table 1 and compare the table in Wiebes (1992).

Waterstoniella Grandi

Waterstoniella Grandi, 1921, Ann. Mus. Stor. nat. Genova 49: 305–306 (subgenus of *Blastophaga*); Grandi, 1922, Boll. Lab. Zool. Portici 15: 212–213 (do.); Wiebes, 1982, Proc. Kon. Ned. Akad. Wet.

(C) 85: 399–400, table 1 (host relations): Bouček, 1988, Australasian Chalcidoidea: 193 (Papua –Solomons).

The female head is shorter than wide across the compound eyes (ca. 0.85), but it may be as long as wide. The compound eyes are large, mostly three or more times as long as the cheek, but in a few species only two times, or even equal to

Table 1. *Waterstoniella* and the *Ficus*-section *Conosycea* (numbers refer to Corner's check-list of 1965).

Section *Conosycea* (Miq.) Corner	
Subsection *Conosycea*	
[series *Validae* Corner	*Platyscapa & Deilagaon*]
series *Drupaceae* Corner	
[subseries *Drupaceae*	*Eupristina*]
[subseries *Indicae* Corner	*Eupristina*]
subseries *Zygotricheae* Corner	
36. *F. consociata* Bl.	*W. malayana* Wiebes
subseries *Crassirameae* Corner	
	W. masii-group:
38. *F. stupenda* Miq.	*W. masii* (Grandi)
39. *F. crassiramea* Miq.:	
– from Kalimantan	*W. cuspidis* Wiebes
– var. *clementis* (Merr.) Corner	*W. fiorii* Grandi
– var. *patellifera* (Warb.) Corner	*W. solomonensis* Wiebes
– from Java	*W. jacobsoni* (Grandi)
41. *F. xylophylla* Wall. ex. Miq.	*W. grandii* Wiebes
[42. *F. forstenii* Miq.	*Eupristina aurivillii* Mayr]
Subsection *Dictyoneuron* Corner	
series *Glaberrimae* Corner	
47. *F. glaberrima* Bl.	*W. williamsi* Wiebes
[series *Dubiae* Corner	?]
series *Subvalidae* (Miq.) Corner	
50. *F. sundaica* Bl.	*W. sundaica* (Wiebes)
53. *F. sumatrana* Miq.:	
– from Luzon	*W. sumatrana* Wiebes
– var. *microsyce* Corner	*W. calcaria* Wiebes
54. *F. delosyce* Corner	*W. delicata* Wiebes
59. *F. retusa* L.	*W. javana* Wiebes
series *Perforatae* Corner	
60. *F. pellucidopunctata* Griff.	*W. brevigena* Wiebes
63. *F. binnendijkii* Miq.	*W. borneana* Wiebes
64. *F. acamptophylla* Miq.	*W. obvenata* Wiebes
Some lines in the table of *Eupristina* (Wiebes, 1992) came out in the wrong place. It should have been:	
Subsection *Benjamina* (Miq.) Corner	
series *Benjamineae* Miq.	
66. *F. subcordata* Bl.	*E. (E.) philippinensis* Wiebes
67. *F. stricta* Miq.	*E. (P.) cyclostigma* Wiebes
etc.]	
	caught at light: *W. modiglianii* (Grandi)
	W. elisabethae (Grandi)
	W. straeleni Grandi

the length of the cheek. The ocelli are in reduction: some species have three large ocelli, but several have two (laterals) or none, and in some the number is variable. In most species, the third segment of the antenna has a long, attenuate appendage, but it may be short and wide; there are eleven segments (the ninth to eleventh forming a club), with oblong sensilla in one, two, or two to three rows. The mandible has one apical tooth and in most species a subapical, but in a few there is only one, cuspidate apical; the appendage bears ventral lamellae, the proximal two or three of which may be produced. The labium has two apical, and the maxilla two subapical setae.

The thorax has small pollen pockets. All veins of the fore wing are well-developed; the disk is hirsute, the fringe is of moderate length. The fore coxa does not have a corbicula, the tibia has a dorsal comb consisting of two or three teeth.

The hypopygium has a long spine in most species, but a short one in some. The spiracular peritremata of the eighth urotergite are small, subcircular.

The total length (head, thorax and gaster) is 1.3 to almost 3 mm; the ovipositor valves are as long as the gaster, or two times as long, and occasionally up to more than three times as long. The colour is yellow-brown, but darker brown (well-chitinized) in some species.

The male is rather depress. The head is wider than long. The antenna has one, two, or three funicular segments. The thorax has characteristic pronotal expansions, situated anteriorly and/or antero-laterally; in most species the propodeum is laterally separate from the metanotum, but fused in the middle. The mesonotum and the metanotum are fused. In most species all tarsi are pentamerous. The genitalia are simple. The length of the head and thorax is 0.8 – 1.1 mm.

Next to the species treated in the present paper, there were several described by Grandi (1921: 306, 1922: 216–217, 1924: 11 – *W. modiglianii*, 1932: 6–7 – *W. straeleni*) and Wiebes (1980: 106–107 – *W. solomonensis* [see also Bouček, 1988: 194], 1982: 403–405 – *W. williamsi*, p. 405–407 – *W. javana*, and p. 409–411 – *W. sumatrana*); the species described as *Ceratosolen elisabethae* Grandi (1923: 101–105, 1924: 18–23) is treated as *Waterstoniella elisabethae* **comb. nov.**. One species described in *Waterstoniella, i.e., W. clavata* Wiebes (1977: 157–158), now is taken out: *Deilagaon clavatum* **comb. nov.**

There are now 19 species known, and for most the host fig was collected and identified. Three species were caught at light and the hosts remain unknown. I have quite a collection of light catches from all over the area, but they are not treated in the present paper, which is mainly concerned with host relations. Some samples, the identification of the host fig of which is unknown or uncertain, are also left out.

Waterstoniella masii and relatives form a distinct group, but they do not seem to be related to *W. malayana* and *W. grandii* from the same fig-series. The variation of the pollinators of *F. crassiramea* and also *F. sumatrana*, is much larger than that of their hosts. There is some coherence between the pollinators

of series *Subvalidae* and *Perforatae*, but apparently no close fit with the classification of the figs.

There is a conspicuous misfit in the classification of species of fig and wasp at the lowest taxonomical level, e.g., in the *W. masii*-group and *F. stupenda* and *F. crassiramea*, in *W. sumatrana* and *W. calcaria* as pollinators of *F. sumatrana*, and also in the pollinators of *F. xylophylla*.

The species can be identified by the following key (for the males see also table 2).

KEY TO THE SPECIES OF WATERSTONIELLA

1. Females 2
– Males 20
2. The compound eye is rather short, about equal to the length of the cheek. There are three ocelli. The number of lamellae on the mandibular appendage is ca. 15 3
– The compound eye is at least two times as long as the cheek. In most species there are two ocelli (one species has three, two have none). The number of lamellae on the mandibular appendage is ten or less 4
3. The antenna is more or less clubbed; from the seventh onwards, the segments bear oval sensilla in two rows. The mandibular appendage has 16 or 17 ventral lamellae. Caught at light (Indonesia: Sumatra) . . . . . *W. elisabethae* (Grandi)
– The antennal segments nos. five to eleven bear one row of oblong sensilla. The (15) ventral lamellae of the mandibular appendage are shaped so as to form small teeth. *Ficus glaberrima* Bl. var. *bracteata* Corner (Philippines: Luzon) . . . . . *W. williamsi* Wiebes
4. The fore tibia has two teeth in the dorso-apical comb 5
– The fore tibia has three teeth in the dorso-apical comb 15
5. The antennal segments have only one (sometimes irregular: do count those on the segments of the club) row of long sensilla 6
– The antennal segments have two or three rows of sensilla 9
6. The spine of the hypopygium is short and wide 7
– The spine of the hypopygium is lond and acute 8
7. The compound eye is 2–2½ times as long as the cheek. The axial tooth of the hind tibia is not longer than the antiaxial. *Ficus sumatrana* Miq. (Philippines: Luzon) . *W. sumatrana* Wiebes
– The compound eye is ca. 4½ times as long as the cheek. The axial tooth of the hind tibia is spur-like. *Ficus sumatrana* Miq. var. *microsyce* Corner (Indonesia: Kalimantan) . . . . . *W. calcaria* Wiebes
8. The compound eye is nine times as long as the cheek. The appendage of the third antennal segment is short and blunt. *Ficus pellucidopunctata* Griffith (Indonesia: Kalimantan) . . . . . *W. brevigena* spec.nov.
– The compound eye is shorter, four or five times as long as the cheek. The appendage of the third antennal segment is long and acute. *Ficus delosyce* Corner var. *obtusa* Corner (Indonesia: Kalimantan) . . . . . *W. delicata* spec. nov.
9. The appendage of the third antennal segment is short and blunt. *Ficus binnendijkii* Miq. (Malaysia: Sarawak; Indonesia: Kalimantan) . . . . . *W. borneana* Wiebes
– The appendage of the third segment is long and acute 10
10. The ovipositor valves are 3½ times as long as the gaster. *Ficus consociata* Bl. (Malaysia: Selangor; Indonesia: Kalimantan) . . . . . *W. malayana* Wiebes
– The valves are at most ca. 2 times as long as the gaster 11
11. The compound eye is short (not much over two times as long as the cheek). *Ficus sundaica* Bl. (Malysia: Sarawak; Indonesia: Kalimantan) . . . . . *W. sundaica* (Wiebes)
– The compound eye is 3–4 times as long as the cheek 12

12. The ovipositor valves are longer (two times or a bit more) than the gaster. The postmarginal vein of the fore wing is ca. two times as long as the stigmal. 13
– The ovipositor valves are not much longer than the gaster (ca. 1.2–1.4 times). The postmarginal vein of the fore wing is ca. $1\frac{1}{4}$ times as long as the stigmal. 14
13. The hypopygium has a very short and blunt spine; heavy ridges form a ventral chiasma. The compound eye is four times as long as the cheek. *Ficus retusa* L. (Indonesia: Java) . . . . . *W. javana* Wiebes
– The spine of the hypopygium is longer. The compound eye is three times as long as the cheek (2.5–3.5). *Ficus crassiramea* Miq. (Indonesia: Java) . . . . . *W. jacobsoni* (Grandi)
14. There are three ocelli. *Ficus xylophylla* Wall. (Malaysia: Pahang). . . . *W. grandii* spec. nov.
– There are two ocelli. *Ficus acamptophylla* Miq. (Indonesia: Kalimantan). . . . . *W. obvenata* spec. nov.
15. The antennal segments bear one row of sensilla. *Ficus crassiramea* Miq. var. *patellifera* (Warb.) Corner (Solomon Isl.: Ysabel, Malaita; Papua New Guinea). . . . . *W. solomonensis* Wiebes
– The antennal segments bear two rows of sensilla. 16
16. The apical tooth of the mandible is very long and falcate 17
– The apical tooth of the mandible is not very long and it bears a subapical one. 18
17. The compound eye is ca. three times as long as the cheek. The ovipositor valves are ca. two times as long as the gaster. Caught at light (Indonesia: Sumatra). . . *W. modiglianii* Grandi
– The compound eye is ca. five times as long as the cheek. The ovipositor valves are ca. three times as long as the gaster. *Ficus crassiramea* Miq. (Indonesia: Kalimantan). . . . . *W. cuspidis* spec. nov.
18. The compound eye is ca. two times as long as the cheek. Caught at light (Indonesia: Sumatra); *Ficus crassiramea* Miq. var. *clementis* (Merr.) Corner (Philippines: Luzon) . *W. fiorii* Grandi
– The compound eyes are longer: ca. three times as long as the cheek. 19
19. The head is shorter than wide across the compound eyes (0.85) and the compound eye is not quite three times as long as the cheek (2.9). *Ficus stupenda* Miq. (Indonesia: Sumatra, Kalimantan) . . . . . *W. masii* (Grandi)
– The head is as long as wide across the compound eyes and the compound eyes are a bit more than three times as long as the cheek (3.2). This form is not well differentiated against *W. masii.* Caught at light (Indonesia: Kalimantan) . . . . . *W. straeleni* Grandi
20. The males can be divided up into a number of morphological groups, as follows. See also table 2.
– The antennal funicle consists of only one segment (fig. 12). All tarsi are pentamerous . . . . . group of *W. sundaica*
– The antennal funicle consists of two segments. The fore tarsus is bimerous. ♀, couplet no. 3 . . . . . *W. williamsi* Wiebes
– The antennal funicle consists of three segments (fig. 11). 21
21. The pronotum has wide lateral expansions (fig. 10). . . . . group of *W. masii*
– The pronotum may have a frontal, but no distinct lateral expansions (as in fig. 14) . . . . . group of *W. jacobsoni*

The species group of *Waterstoniella masii*

The tridentate dorsal comb of the female fore tibia is characteristic; the male has three funicular segments, and the pronotum has large lateral expansions. The host figs are *Ficus crassiramea* Miq. and *F. stupenda* Miq., but the relations are more intricate than they may seem from this statement, as follows.

In 1921, Grandi named *W. masii* and *W. modiglianii.* Originally, they were described from a single female and three females, respectively, preserved dry, that were collected as early as 1891, on the island of Engano, off Sumatra. Later,

Table 2. Some characters of the males of *Waterstoniella*.

	width/length ratio of head	length eye/ length cheek	number of segments in antennal funicle
W. williamsi	1.1	1	2
W. masii	1.9	1.25	3
W. fiorii	1.9	3	3
W. cuspidis	1.9	5	3
W. jacobsoni	1.3	10*	3
W. javana	1.3	2	3
W. malayana	1.7	1.25	3
W. grandii	1.4	1	3
W. obvenata	1.3	10*	3
W. calcaria	1.25	0.85	3
W. sundaica	1.5	10*	1
W. sumatrana	1.6	1	1
W. borneana	1.7	2	1
W. brevigena	1.5	4	1

* the cheek is virtually non-existent.

Grandi (1924) received much better preserved, new material from Fort de Kock (Bukittinggi, Sumatra) and gave additional descriptions. In 1966, I identified a sample from *F. stupenda* with *W. masii*, and described the male (Wiebes, 1966a).

W. modiglianii is easily distinguished by the long apical tooth of the mandible. In the present paper, another species with a long, cuspidate mandible is described and compared with *W. modiglianii* (of which I could study a specimen from Grandi, 1924) – the host of the new species was identified by prof. Corner with *F. crassiramea*.

In the early sixties, I collected a sample from *F. crassiramea* var. *clementis* (Merr.) Corner (det. Corner), in the Philippines, which I now identify with *W. fiorii* (I studied three female specimens from Grandi, 1924) and I describe the male.

Prof. Corner collected a small sample of females from *F. crassiramea* var. *patellifera* (Warb.) Corner (det. Corner) on the Solomon island of Ysabel, which I described as *W. solomonensis:* it has three teeth in the dorso-apical comb of the female fore tibia, and only one row of sensilla on the antennal segments (the other species mentioned above, have two).

From *F. crassiramea* Grandi (1917) described *W. jacobsoni*, collected on Java. The female has two teeth in the dorso-apical comb of the fore tibia and the male is different from that of the *W. masii*-group. Several samples from the type-locality are recorded below.

Other species of fig of the subseries *Crassirameae*, to which the species mentio-

ned above belong, are *Ficus xylophylla* Wall. ex Miq. and *F. forstenii* Miq. The last-mentioned has a species of *Eupristina* for pollinator, viz., *E. aurivillii* Mayr. From *F. xylophylla*, Corner collected a sample in Malaya, described below as *W. grandii*.

A survey of the relations mentioned is given in table 1.

Waterstoniella masii (Grandi)

(figs. 10–11)

Blastophaga (Waterstoniella) masii Grandi, 1921, Ann. Mus. Stor. nat. Genova 49: 306 (♀, Engano [island off Sumatra]); Grandi, 1922, Boll. Lab. Zool. Portici 15: 213–215 (do.); Grandi, 1924, Boll. Lab. Zool. Portici 18: 11–12 (♀, Sumatra); Grandi, 1932, Mém. Mus. Roy. Hist. Nat. Belg. (hors série) [IV (5)]: 5 (♀, Borneo); Wiebes, 1966a, Tijdschr. Ent. 109: 165–168 (♀♂, Borneo, ex *Ficus stupenda* Miq.).

New material. 20 ♀, 30 ♀, 4 ♀, and series ♀ 7 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus stupenda* Miq. var. *minor* Corner (H R 10 35 W 30 = no. 315, P W 10 25 S 30 = no. 497, B S 7 45 N 5 = no. 531; det. E.J.H. Corner; and T H 20 30 S 10, det. Leighton), leg. M. Leighton, 1978; coll. RMNH nos. 3429, 3469, 3936, and 3473.

Waterstoniella fiorii Grandi

Waterstoniella fiorii Grandi, 1923, Ann. Mus. Stor. nat. Genova 51, 102–103 (♀, Sumatra); Grandi, 1924, Boll. Lab. Zool. Portici 18, 12–13 (do.).

New material. Series ♀♂, Philippines: Luzon, Atimonan, Quezon Nat. Pk., 350 m alt., ex *Ficus crassiramea* Miq. var. *clementis* (Merr.) Corner (J.V. Pancho no. 4227, det. E.J.H. Corner), leg. J.T. Wiebes, 23.xii.1964; coll. RMNH no. 765.

The male is much like that of *W. masii*, as described by Wiebes (1966a; 167, figs. 1–11). The head is almost two times as wide as long (1.9), and the eye is about three times as long as the cheek and one-quarter of the length of the head (approximately as long as the cheek in *W. masii*, and one-fifth of the length of the head).

The thorax has lateral pronotal expansions as in *W. masii*, and also the propodeal spiracular peritremata are as in that species. The tarsal segments have the ratio: I, 10 : 5 : 4 : 4 : 9; II, 10 : 5 : 6 : 6 : 14; III, 10 : 5 : 5 : 7 : 12.

The length of the head and thorax is ca. 1.1 mm.

Waterstoniella cuspidis spec. nov.

(figs. 1–4)

Material. Series ♀ 1 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus crassiramea* Miq. (A W 27 15 N 5 = no. 446, det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNNH no. 3907.

The female head (fig. 1) is much shorter than wide across the compound eyes (0.75), which are ca. five times as long as the cheek. There are two lateral ocelli. The antennal scape is a little over two times as long as wide; the appendage of the third segment (fig. 3) reaches up to the basal third of the fifth segment; the segments bear rather wide sensilla in two rows. The mandible (fig. 4) has a cuspidate apical tooth; the appendage bears six ventral lamellae, the proximal two of which are a bit produced.

The fore wing (5 : 2) is ca. 1.7 mm long; the submarginal, marginal, stigmal and postmarginal veins are approximately in ratio 9 : 2 : 2 : 4. The fore tibia bears a dorso-apical comb of three teeth (fig. 2); the tarsal segments are approximately in ratio 10 : 3 : 2 : 3 : 7. The tarsal ratio of the midleg is 14 : 6 : 5 : 5 : 8. The armature of the hind tibia consists of an indistinctly bicuspidate antiaxial, and a bifurcate axial tooth; the tarsal segments are approximately in ratio 10 : 4 : 3 : 3 : 5.

The hypopygium has a long spine, almost three times as long as wide at the base.

The total length (head, thorax and gaster) is ca. 1.8 mm; the ovipositor valves are almost three times as long as the gaster. The colour is yellow-brown.

The male is much like that of *W. fiorii*, described above. The eye is larger, *i.e.*, five times as long as the cheek, and one-third of the length of the head. The spiracular peritremata are situated at half length of the propodeum (*vs.* more frontad in the other species).

The length of the head and thorax is ca. 0.9 mm.

Note. The female much resembles *W. modiglianii* (Grandi), but it is distinct by the longer eyes (almost five *vs.* three times as long as the cheek) and the longer ovipositor valves (three *vs.* two times as long as the gaster). The male is not much different from that of *W. masii* and *W. fiorii*.

Waterstoniella jacobsoni (Grandi)

Blastophaga jacobsoni Grandi, 1917, Boll. Lab. Zool. Portici 12: 21–32 (♀ ♂, Java, ex *Ficus procera* Reinw. var. *crassiramea* King [=*F. crassiramea* Miq.]); Grandi, 1921, Ann. Mus. Stor. nat. Genova 49: 304–306 (type-species of *Waterstoniella*); Grandi, 1922, Boll. Lab. Zool. Portici 15: 212–213 (do.); Wiebes, 1966a, Tijdschr. Ent. 109: 167, figs. 8–11 (♂, Java, *F. crassiramea* Miq.).

New material. 10 ♀ 4 ♂, 11 ♀ 12 ♂ and 2 ♀ 2 ♂, Indonesia: Java, Bogor, ex *Ficus crassiramea* Miq. (det. E.J.H. Corner), leg. J. van der Vecht, 29.viii.1954, 5 and 11.iv.1955; coll. RMNH nos. 3, 323, 348; also at light: 1 ♀, coll. RMNH no. 118.

Waterstoniella malayana Wiebes

Waterstoniella malayana Wiebes, 1982, Proc. Kon. Ned. Akad. Wet. (C) 85: 400–403 (♀ ♂, Selangor, ex *Ficus consociata* Bl.).

New material. 4 ♀ and 3 ♂, and 4 ♀ 1 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus consociata* Bl. (H R 4 15 N 30 = no. 506 [? = no. 456], and S R 0 30 E 5 = no. 456, and O B 03 5 E 25 = no. 482; det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMHH nos. 3418, 3495, and 3894.

Note. The specimens from Kalimantan have two rather small ocelli, while those from Malaya were without.

Waterstoniella grandii spec. nov.

(fig. 6)

Material. Series ♀♂, Malaysia: Pahang, Fraser's Hill, ex. *Ficus xylophylla* Wall.[1] (det. E.J.H. Corner), leg. E.J.H. Corner, 15.ii.1978; coll. RMNH no. 3277 (type: ♀).

The female head (fig. 6) is distinctly shorter than wide across the compound eyes (0.9), which are ca. 3 times as long as the cheek. There are three ocelli. The antennal scape is 2.5 times as long as wide, antiaxially slightly surpassing the base of the pedicel, which has almost thirty axial spines; the appendage of the third segment is long and attenuate, reaching over the basal quarter of the fifth segment; the fifth to eleventh segments have two or three rows of oblong sensilla. The mandible has a long apical tooth and a small subapical, six ventral ridges, and one gland; the appendage bears eight ventral lamellae.

The fore wing (5 : 2) is 1 mm long, the submarginal, marginal, stigmal and postmarginal veins are approximately in ratio 17 : 3 : 4 : 5, i.e. the postmarginal is only little longer than the stigmal. The fore tibia bears a dorso-apical comb of two teeth; the tarsal segments are approximately in ratio 2 : 1 : 1 : 1 : 2. The tarsal ratio of the mid leg is 4 : 3 : 2 : 2 : 3. The armature of the hind tibia consists of a bicuspidate antiaxial and a simple, slender axial tooth; the tarsal segments are approximately in ratio 4 : 3 : 2 : 2 : 3.

The hypopygium has a long, acute spine, with a few long setae.

The total length (head, thorax and gaster) is ca. 2.1 mm; the ovipositor valves are almost $1\frac{1}{2}$ times as long as the gaster. The colour is yellowish, but the head is a bit darker.

The male head is 1.4 times as wide as long; the eye is as long as the cheek, and ca. one-quarter of the length of the head. The antennal funicle has three segments.

The pronotum has a short anterior expansion. The tarsal segments have the ratio: I, 4 : 2 : 2 : 2 : 7; II, 7 : 6 : 4 : 4 : 8; III, 8 : 5 : 5 : 3 : 9.

The length of the head and thorax is ca. 1.1 mm.

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[1]Dr. Leighton collected two small samples of wasps from this species of fig in E. Kalimantan (*viz.*, 13 ♀ 2 ♂, OB 10 2 SE 3 = no. 507, det. E.J.H. Corner; and 3 ♀ 4 ♂, HR 22 15 W 10 = as no. 507). The females resemble *W. borneana*, known as the pollinator of *F. binnendijkii* Miq., but the males are different.

Note. The female of the new species resembles that of *W. jacobsoni*, but it is distinct by the presence of three distinct ocelli (*vs.* two), the relatively short postmarginal vein of the fore wing, and the shorter ovipositor valvae (*vs.* both two times as long as the stigmal, and the gaster, respectively). Also the male is much like that of *W. jacobsoni*, but the eye is as long as the cheek.

Waterstoniella obvenata spec. nov.

Material. 3 ♀ 1 ♂, series ♀ ♂[2], series ♀ 2 ♂[2], and 3 ♀ 5 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus acamptophylla* Miq. (O B 9 10 E 10 = no. 223, O B 9 20 W 20 = no. 463[2], O B 10 10 W 10 = no. 500[2], and O B 9 25 E 1 = no. 508; det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNH nos. 3459 (type-lot; type: ♀), 3520[2], 3940[2] and 3527.

The female head is almost as long as wide across the compound eyes (0.9), which are $3\frac{1}{4}$ times as long as the cheek. There are two ocelli. The antennal scape is almost two times as long as wide; the appendage of the third segment is very long and acute, reaching the distal margin of the fifth segment; the segments have two (or indistinctly three) rows of rather wide sensilla. The mandible has a subapical tooth next to the apical one; the appendage bears ten ventral lamellae, some proximal of which are produced.

The fore wing (5 : 2) is 1.4 mm long; the submarginal, marginal, stigmal and postmarginal veins are approximately in ratio 26 : 10 : 10 : 13. The fore tibia has a dorso-apical comb consisting of two teeth; the tarsal segments are approximately in ratio 8 : 2 : 3 : 2 : 7. The tarsal ratio of the mid leg is 13 : 5 : 6 : 5 : 6. The armature of the hind tibia consists of a bicuspidate antiaxial and a more slender, simple axial tooth; the tarsal segments are approximately in ratio 16 : 8 : 7 : 7 : 9.

The hypopygium has a long spine.

The total length (head, thorax and gaster) is ca. 1.6 mm. The ovipositor valves are a bit longer than the gaster (1.15).

The male head is 1.3 times as wide as long; the eye is much longer than the cheek (which is almost non-existent) and one-quarter of the length of the head. The antennal funicle has three segments.

The pronotum is slightly expanded frontad. The tarsal segments have the ratio I, 3 : 1 : 1 : 1 : 3; II, 3 : 2 : 2 : 2 : 4; III, 3 : 2 : 2 : 2 : 4.

The length of the head and the thorax is ca. 0.9 mm.

Note. The female of this species resembles *W. grandii*, described above, but it does not show the three large ocelli – it has two smaller ocelli. The male is similar to that of *W. jacobsoni*.

[2]From the herbarium material, the identification of the fig species was not certain: it could also have been F. pellucidopunctata Griffith, but most probably it was *F. acamptophylla*. The wasps do suggest the same.

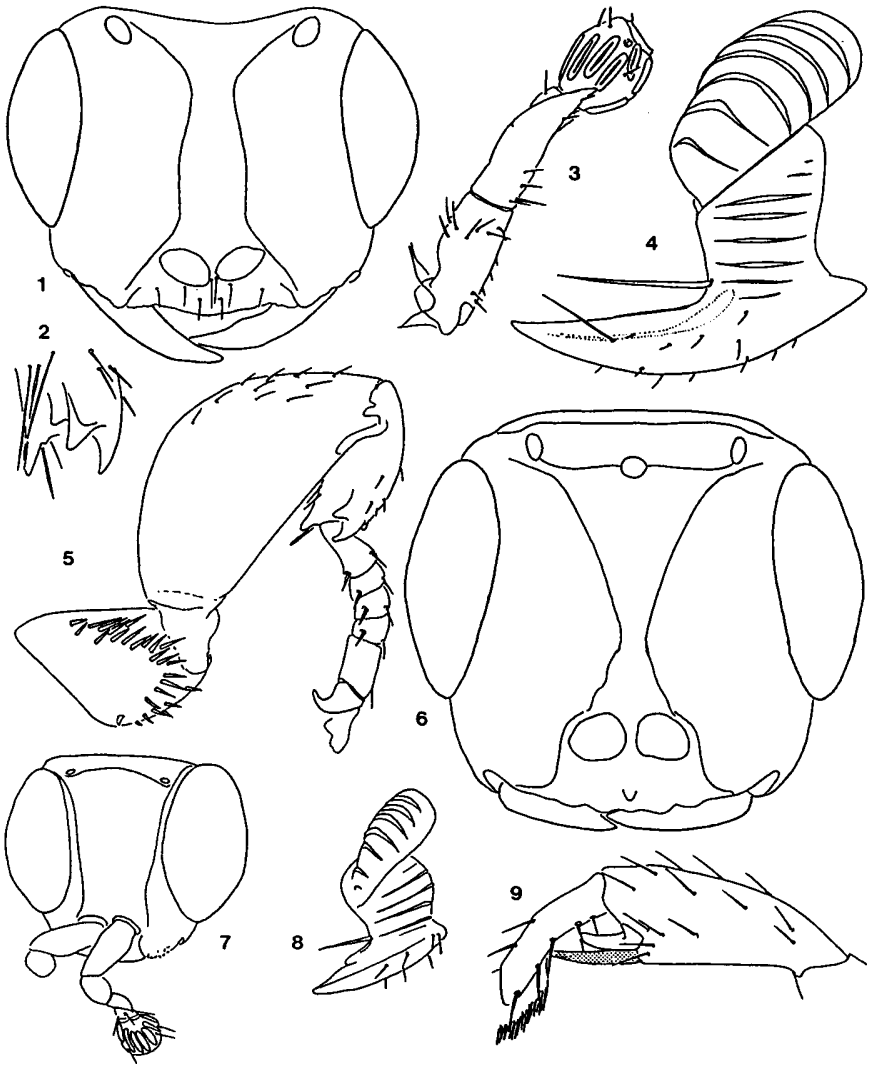

Fig. 1–4. *Waterstoniella cuspidis* spec. nov., female. 1, head, frontal aspect, × 105; 2, apical part of fore tibia, antiaxial aspect, × 215; 3, second to fifth antennal segments, antiaxial aspect, × 215; 4, mandible, ventral aspect, × 215.

Fig. 5&9. *Waterstoniella calcaria* spec. nov., female. 5, fore leg, antiaxial aspect, × 215; 9, hind tibia and first tarsal segment, antiaxial aspect, × 215.

Fig. 6. *Waterstoniella grandii* spec. nov., female head, frontal aspect, × 105.

Fig. 7. *Waterstoniella brevigena* spec. nov., female head and base of antenna, oblique frontal aspect, × 105.

Fig. 8. *Waterstoniella delicata* spec. nov., female mandible, ventral aspect, × 215.

Waterstoniella calcaria spec. nov.

(figs. 5 & 9)

Material. Series ♀ 2 ♂ and 7 ♀ 8 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus sumatrana* Miq. var. *microsyce* Corner (C H 26 00 E 1 = no. 495, and C B 2 39 = no. 265; det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNH nos. 3416 (type-lot; type: ♀) and 3432.

The female head is shorter than wide across the compound eyes (0.8), which are bulging; they are $4\frac{1}{2}$ times as long as the cheek. There are two very small ocelli. The antennal scape is over three times as long as wide; the appendage of the third segment reaches half-way the fifth; the fifth to eleventh segments bear one row of rather wide sensilla. The mandible has an acute apical tooth; the appendage bears six ventral lamellae, the proximal three of which are produced.

The fore wing (5 : 2) is ca. 1.2 mm long; the submarginal, marginal, stigmal and postmarginal veins are approximately in ratio 9 : 3 : 3 : 2. The fore coxa (fig. 5) bears stout antiaxial setae, such as are not found in the other species; the tibia has a dorso-apical comb of two teeth and a smaller spine on the outer margin; the tarsal segments are approximately in ratio 10 : 4 : 5 : 4 : 8. The tarsal ratio of the mid leg is 5 : 4 : 4 : 4 : 5. The armature of the hind tibia (fig. 9) is peculiar in the long axial tooth having the shape of a spur; the tarsal segments are approximately in ratio 11 : 5 : 5 : 4 : 6.

The hypopygium has a short, blunt spine.

The total length (head, thorax and gaster) is ca. 1.2 mm; the ovipositor valves are over two times as long as the gaster (2.2). The colour is yellowish.

The male is very small and squat. The head is $1\frac{1}{4}$ times as wide as long; the eye is shorter than the cheek (5 : 6), and one-sixth of the length of the head. The antennal funicle has three segments.

The pronotum is slightly expanded frontad. The fore tarsus is bimerous, but there is some indication of a dorsal subdivision in more segments (5 : 2 : 4); the mid and hind tarsal segments have the ratio II, 4 : 2 : 2 : 3 : 5; III, 4 : 2 : 1 : 1 : 2.

The length of the head and the thorax is ca. 0.8 mm.

Note. The female of this species resembles *W. sumatrana*, but it is at once distinguished by the large eyes (compare Wiebes, 1982, fig. 52), the fore coxal patch of setae and the axial spur of the hind tibia (compare Wiebes, 1982, fig. 55). The male is recognizable by the long cheek and the reduction in the fore tarsi.

Waterstoniella sundaica (Wiebes)

(figs. 12–14)

Blastophaga (Waterstoniella) sundaica Wiebes, 1966b, Ent. Ber. Amst. 26: 166–170 (♀ ♂, Sarawak, ex *Ficus sundaica* Bl.).

Blastophaga jacobsoni – Waterston, 1921, Bull. ent. Res. 12: 35 (♀, Sarawak).

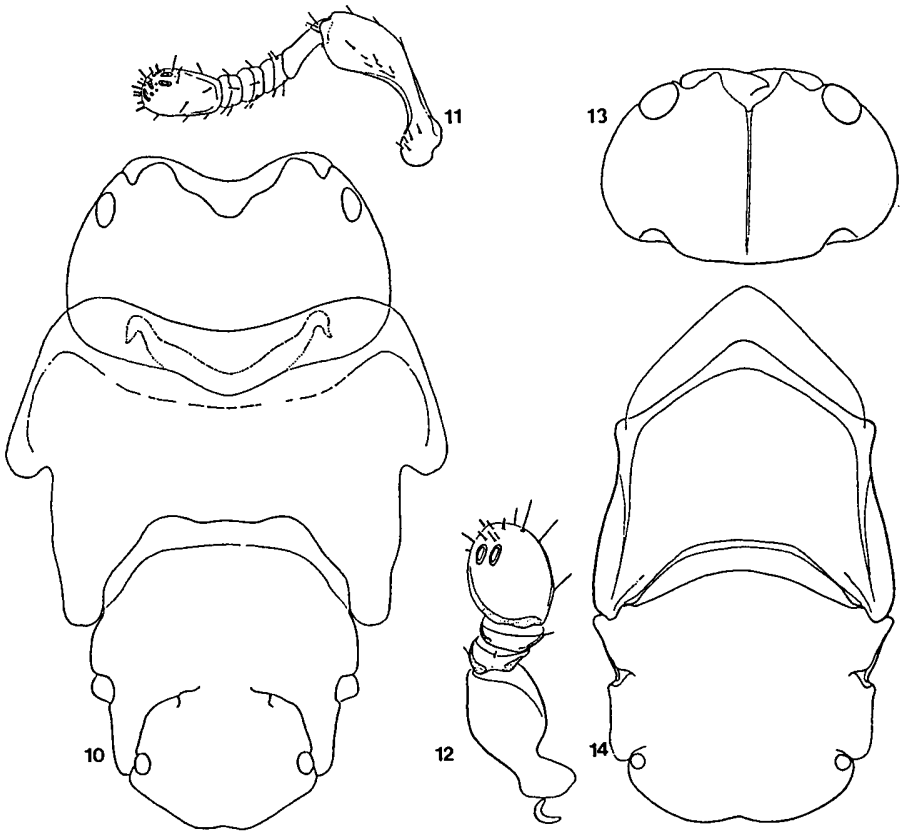

Fig. 10–11. *Waterstoniella masii* (Grandi), male. 10, head and thorax, dorsal aspect, × 90; 11, antenna, dorsal aspect, × 125. After Wiebes (1966a, figs. 6 and 5, respectively).
Fig. 12–14. *Waterstoniella sundaica* (Wiebes), male. 12, antenna, dorsal aspect, × 185; 13, head, and 14, thorax, both dorsal aspect, × 75. After Wiebes (1966b, figs. 11, 9 & 13).

New material. Series ♀ 1 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus sundaica* Bl. var. *beccariana* (King) Corner (A 11 30 N 30 = no. 456, det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNH no. 3486.

Note. The females collected by Dr. Leighton show two ocelli, while those of the type series have none.

Waterstoniella borneana Wiebes

Waterstoniella borneana Wiebes, 1982, Proc. Kon. Ned. Akad. Wet. (C) 85: 407–409 (♀ ♂, Sarawak, ex *Ficus binnendijkii* Miq.).

New material. Series ♀ 2 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus binnendijkii* Miq. (P R 6 20 E 5 = no. 461, det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNH no. 3501.

Waterstoniella delicata spec. nov.

(fig. 8)

Material. 2 ♀ and 4 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus delosyce* Corner var. *obtusa* Corner (T H 6 47 N 5 = no. 483 and C H 11 30 W 20 = no. 477; det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNH nos. 3930 and 4027 (type-lot; type: ♀).

The female head is somewhat shorter than wide across the compound eyes (0.85), which are almost five times as long as the cheek. There are no ocelli. The antennal scape is three times as long as wide; the pedicel has some five axial spines; the appendage of the third segment is long and attenuate, reaching over the basal third of the fifth segment; the fifth to eleventh segments have one row of long sensilla. The mandible (fig. 8) has a long apical tooth and a smaller subapical, four or five ventral ridges, and one gland; the appendage bears six ventral lamellae, the proximal two of which are somewhat produced.

The fore wing (16 : 7) is 1.2 mm long, the submarginal, marginal, stigmal and postmarginal veins are approximately in ratio 12 : 4 : 3 : ca. 3 (fading out indistinctly). The fore tibia bears a dorso-apical comb of two teeth; the tarsal segments are approximately in ratio 10 : 4 : 5 : 4 : 10. The tarsal ratio of the mid leg is 8 : 4 : 4 : 3 : 6. The armature of the hind tibia consists of a bicuspidate antiaxial and a more simple, slender axial tooth; the tarsal segments are approximately in ratio 10 : 8 : 5 : 5 : 8.

The hypopygium has a long acute spine, with a few long setae.

The total length (head, thorax and gaster) is ca. 1.3 mm; the ovipositor valves are subequal to the length of the gaster. The colour is yellowish.

The male is not known.

Note. This species resembles *W. solomonensis* Wiebes, but it has no ocelli (*vs.* two) and the ovipositor valves are ca. as long as the gaster (*vs.* two times as long).

Waterstoniella brevigena nov. spec.

(fig. 7)

Material. Series ♀♂ and 3 ♀ 4 ♂, Indonesia: E. Kalimantan, Kutai Nature Reserve, ex *Ficus pellucidopunctata* Griffith (A W 24 25 N 10 = no. 312 and E C 6 15 W 1 = no. 501; det. E.J.H. Corner), leg. M. Leighton, 1978; coll. RMNH nos. 3406 (type-lot; type: ♀) and 3915.

The female head (fig. 7) is distinctly shorter than wide across the compound eyes (0.8), which – because of their own length, but also because the cheeks are very short – are nine times as long as the cheek. There are two lateral ocelli. The antennal scape is 2.3 times as long as wide; the appendage of the third segment (fig. 7) is very short; the segments bear rather wide sensilla in one row, but those of the fifth to seventh are placed rather irregularly, at places forming almost two

rows. The mandible has an subapical tooth next to the apical; the appendage has six ventral lamellae, the first of which is produced.

The fore wing (15 : 7) is ca. 1.2 mm long, the submarginal, marginal, stigmal and postmarginal veins are approximately in ratio 10 : 3 : 4 : 1. The fore tibia bears a dorso-apical comb of two teeth; the tarsal segments are approximately in ratio 3 : 1 : 1 : 1 : 3. The tarsal ratio of the mid leg is 6 : 4 : 4 : 3 : 5. The armature of the hind consists of an indistinctly tricuspidate antiaxial and a bilamellate axial tooth; the tarsal segments are approximately in ratio 13 : 5 : 5 : 5 : 6.

The hypopygium has a very long and acute spine, which is $3\frac{1}{2}$ times as long as wide at the basis.

The total length (head, thorax and gaster) is ca. 1.2 mm; the ovipositor valves are 1.2 times as long as the gaster. The colour is yellowish.

The male is much like that of *W. sundaica*. The head is $1\frac{1}{2}$ times as wide as long, the eye is four times as long as the cheek, and one-third of the length of the head. The antennal funicle has one segment.

The thorax has a short pronotal expansion, which is not at all tapering in front. In general, the thorax resembles that of *W. borneana*, but the propodeum and the (meso-)metanotum and the propodeum are incompletely separate. The tarsal segments have the ratio: I, 7 : 3 : 3 : 3 : 8; II, 2 : 1 : 1 : 1 : 2; III, 8 : 4 : 3 : 3 : 8.

The length of the head and thorax is ca. 0.9 mm.

Note. In the characteristic antenna of the female, with a short appendage on the third segment, this species resembles *W. borneana*, but it has two ocelli (*vs.* none), the antennal segments have one row of sensilla (*vs.* more distinctly two) and the compound eyes are longer. The male resembles that of *W. sundaica,* but is distinct by the short pronotal expansion.

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