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DESCRIPTION, BIOLOGY, AND KARYOTYPE OF A NEW *PSILOCHALCIS* KIEFFER (HYMENOPTERA: CHALCIDIDAE) FROM INDIANMEAL MOTH PUPAE (LEPIDOPTERA: PYRALIDAE) ASSOCIATED WITH CULLED FIGS

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Abstract.—***Psilochalcis brevialata*** **Grissell and Johnson, new species**, is described and illustrated based on specimens from a laboratory culture reared on *Plodia interpunctella* (Hübner) pupae. This species, isolated from laboratory-reared *P. interpunctella* placed at a culled fig warehouse in central California, is the first *Psilochalcis* associated with stored product pyralids. In the laboratory, *P. brevialata* also sucessfully parasitized *Cadra figulilella* (Gregson), *C. cautella* (Walker), *Ephestia elutella* (Hübner) and *Amyelois transitella* (Walker). The karyotype of *P. brevialata* showed a haploid chromosome number (n) of 6, the highest n value known for the family Chalcididae. Female *P. brevialata* had relatively long reproductive lives of 39.3 days, producing an average of 3.3 progeny/day for a total of 128.7 progeny per female.

Key Words: Hymenoptera, Chalcididae, *Psilochalcis brevialata,* new species, Pyralidae, pupae

A review of the hymenopterous parasites of stored product insects (Gordh and Hartman 1991) included only two chalcidid species: *Antrocephalus aethiopicus* Masi and *A. mahensis* Masi, both parasitoids of *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae). No *Psilochalcis* species has previously been recovered from stored product pyralids, and few host records are known for the genus (Bouček 1992). Grissell and Schauff (1981) summarized the then known hosts, which consisted of two pyralid species in the Old World and a pyralid and gelechiid species in the New World. Narendran (1989) reported as a host a species of the family Oecophoridae from India. No biological observations have been made on any species, but in the few reared instances, adult wasps emerged from the pupal stage of its host moth.

Psilochalcis (as *Invreia*), originally considered an Old World genus, was first reported in the New World based upon three species described from Oklahoma and Texas (Grissell and Schauff 1981). A fourth species from Arizona and Hawaii was added later (Bouček 1984). Bouček (1992) reported that less than 20 species of *Psilochalcis* were known from the western hemisphere. Bouček and Halstead (1997) recently stated that at least 10 undescribed species occurred in the Nearctic Region.

As part of a project to integrate natural enemies into non-chemical control programs for postharvest dried fruits and nuts, a survey was made of the insects present at a culled fig warehouse in Fresno, California (Johnson et al. 2000). Because culled, substandard figs are judged unsuitable for human consumption, little or no attempt is made to control pests within the warehouse. Consequently, large pyralid populations develop in these figs, which in turn support various parasitoid populations. During the course of the survey, we discovered an undescribed species of *Psilochalcis* (Hymenoptera: Chalcididae) parasitizing pupae of the Indianmeal moth, *Plodia interpunctella* (Hübner) (Lepidoptera: Pyralidae). In this paper, we describe the new species *Psilochalcis brevialata* Grissell and Johnson and include observations on its culture, biology and karyotype.

Methods and Materials

Maintenance of laboratory culture.—We began a laboratory culture of *Psilochalcis* using material reared from traps baited with host pupae placed at the culled fig warehouse in November 1994 and June 1995 (Johnson et al. 2000). Host pupae were from a laboratory culture of Indianmeal moth reared in glass jars (4l) with about 350 g of wheat bran diet (Tebbets et al. 1978). Corrugated cardboard strips (2.5 cm × 2 m) were placed on the diet surface, coiled along the inner wall of the jar, to serve as pupation sites for Indianmeal moth larvae. Strips with 1–3 day old pupae were transferred to clean jars, along with a handful of diet containing mature larvae. About 1 g of honey was smeared along the inside wall of the jar before adding 50–100 adult *Psilochalcis*.

Psilochalcis rearing jars were kept in environmental chambers at 27°C, 60% RH, and a photoperiod of 14:10 (L:D) h. Moths from unparasitized hosts were removed as quickly as possible, but not before some were able to lay eggs. Because these eggs produced larvae capable of feeding on parasitized host pupae, 1 week after the addition of adult *Psilochalcis,* pupae were removed from the pupation strips and examined for evidence of parasitization (melanized spots). Parasitized pupae were placed in plastic Petri dishes (90 × 15 mm) lined with filter paper. A small amount of honey was smeared on the underside of the lid. Dishes were held under rearing conditions until emergence of adult *Psilochalcis.* These adults, along with any remaining in the jars, were used to continue the culture. Specimens from several generations of the laboratory colony were killed in 70% ETOH and sent to E. Grissell for taxonomic study.

Karyotype.—Parasitized hosts from the laboratory culture were sent to V. Gokhman for karyotype determination. Chromosome preparations were obtained from cerebral ganglia of prepupae according to the technique of Imai et al. (1988). Chromosomes of three males and three females of *P. brevialata* were studied. For making chromosome measurements, ten haploid metaphase plates were scanned directly from the preparations using an optic microscope fitted with a static TV camera connected to a personal computer equipped with the image analysis program ImageExpert® version 1.0. Scanned images were measured using Adobe Photoshop® version 3.0.5. Statistical analysis was performed with the help of STATISTICA® version 4.3.

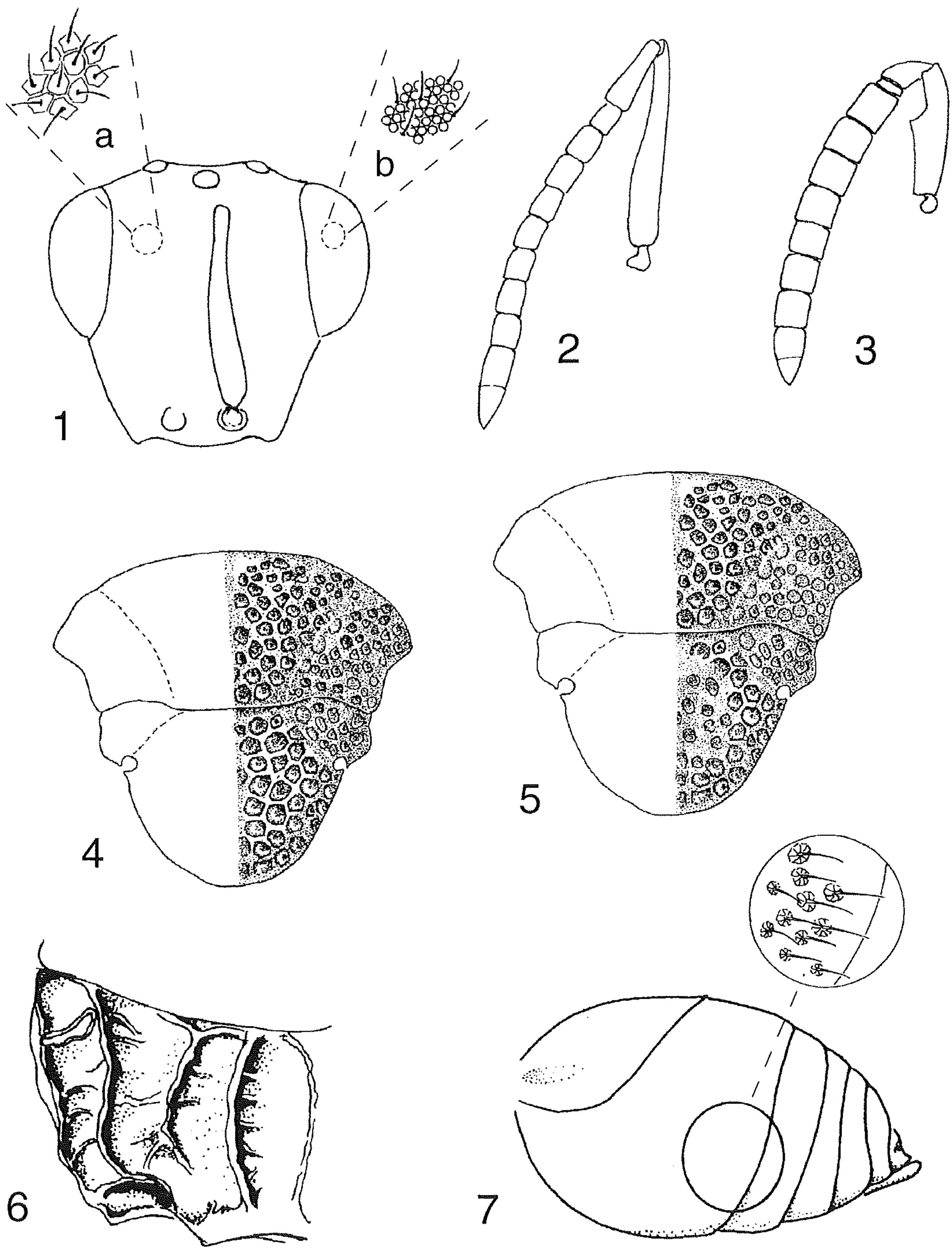
Life history.—We obtained adult *Psilochalcis* of known age by placing individual parasitized host pupae in glass culture tubes (12 × 75 mm) closed with foam plugs. Within 24 hours of emergence, adult parasitoids were removed from the culture tubes and sexed. Single pairs of male and female wasps were placed in plastic Petri dishes (90 × 15 mm) lined with filter paper. A small amount of honey was smeared on the underside of each lid. Only pairs that were observed *in copulo* were used in the study. A total of 15 pairs were used. Ten 1- to 4-day old Indianmeal moth pupae in cocoons were added to each dish. After 24 hrs, pupae were removed, placed in plastic sample cups (30 ml), and held at 27°C, 60% RH, and a photoperiod of 14:10 (L:D) h for emergence of either moths or *Psilochalcis.* Host pupae were provided each day to each *Psilochalcis* pair until the death of the female. A similar test with 10 virgin females also was done.

Potential host range.—Pupae from laboratory cultures of various postharvest Lepidoptera other than *P. interpunctella* were offered to recently emerged and mated *Psilochalcis* females held in plastic sample cups. After 24–72 hours, the pupae were removed and held at rearing conditions for emergence of either moths or *Psilochalcis.* A total of five pyralid species (Lepidoptera: Pyralidae) were tested: *Cadra figulilella* (Gregson), *C. cautella* (Walker), *Ephestia elutella* (Hübner), *Amyelois transitella* (Walker) and *Galleria mellonella* (Linnaeus). We also tested pupae of the codling moth, *Cydia pomonella* (Linnaeus) (Lepidoptera: Tortricidae).

Results and Discussion

Psilochalcis brevialata Grissell and Johnson, new species
(Figs. 1–7)

Description.—Female length 3.0 to 4.0 mm (holotype 3.5 mm). Ratio head : mesosoma : metasoma : forewing ca. 1.5:5:5:6 (holotype 7:23:25:29). Black except the following yellow to dark reddish brown: tegula, tarsi, tibiae (except sometimes pro- and mesotibiae basally brown to black), metafemur at apex and base, metatrochanter, scape and flagellum (basal half of scape and apex of pedicel may be yellow). *Head:* Face (Fig. 1) wider than high (holotype 5:4), eye (Fig. lb) with sparse erect setae ca. 2 to 3 ommatidia in length, 1 to 1.5× own length apart; eye height less than least interocular distance (at vertex) (holotype 5:6), ratio lateral ocellus : ocellocular length : postocellar length ca. 1:1:4 (holotype 7:5:20), malar distance shorter than intermalar distance (holotype 7:8); upper face with contiguous punctures each with recurved silvery seta (Fig. 1 a); lower face laterad of scrobes rugose and covered with appressed dense silvery pubescence; scrobe nearly reaching venter of median ocellus, separated from it dorsally by about one ocellus diameter (an area covered with effaced sculpture); flagellum (Fig. 2) filiform, scape widest in basal ⅓, pedicel 2 to 3× longer than any funicular segment, slightly shorter than clava, which appears to be one-segmented (ratio in holotype beginning with scape 55:18:7:8:9:9:9:9:9:9:21); scape ca. 1.3× as long as eye height; pedicel 3× longer than greatest width (apical). *Mesosoma:* Ratio pronotum : mesoscutum : scutellum : propodeum ca. 3:4:4:3 (holotype same); pronotum, scutum, and scutellum with evenly spaced, nearly contiguous setigerous punctures except punctures on median area of scutellum vary from nearly contiguous (as for male, Fig. 4) to 1 to 2 diameters apart (Fig. 5), seta length 1 to 2× puncture diameters; interspaces reticulate-aciculate; midlobe of mesoscutum with punctures ca. ½ own diameter apart (especially posteriorly); scutellum medially with punctures less than own diameter apart (as in Fig. 5); mesepisternum with forecoxal depression not prolonged into flange ventrally; propodeum (Fig. 6) with complete well-developed submedian carina, prespiracular sulcus carinate laterally, an irregular diagonal carina joined from anterior of sublateral carina to inner posterior carina of prespiracular sulcus, with many transverse carinae between main longitudinal carinae; midfemur distally swollen, rounded ventrally, 3× wider distally than proximally; forewing 2–3× as long as wide (holotype 8:3), hyaline, ratio submarginal: marginal: stigmal veins ca. 9:1.5:1 (holotype 27:5:3), barely reaching apex of tergum 3 when folded flat. *Metasoma:* Elliptical in side view; tergum I reaching ca. 0.4× length of metasoma, epipygidium and ovipositor barely visible from above; tergum I anterolaterally with longitudinal elliptical depression which is mostly bare except for a dorsal line of several long overlapping setae with bases much closer together than length of seta, area ventrad of depression with numerous, short setae, tergum laterally polished, dorsally finely punctate to reticulate except posterior ⅕ of margin smooth and polished;



Figs. 1–7. *Psilochalcis brevialata.* 1, Face, female, insets show sculpture on upper frons (a) and eye setation (b). 2–3, Antenna (lateral view). 2, Female. 3, Male. 4–5, Mesonotum (dorsal view, setae not shown). 4, Male. 5, Female. 6. Propodeum (dorsal view), female. 7, Metasoma (lateral view), female, inset shows sculpture.

tergum II laterally covered with appressed silver setae each in minute, shallow depression, surrounded by small depressions ("petallike" arrangement, Fig. 7), entirely finely aciculate except semicircular dorsomedian area smooth; tergum III–VI with posterior margins rimmed with fine reticulation and 1 or 2 rows of silver setae.

Male length 2.3 to 3.5 mm. Color as for female except some orange areas on scape, tegula, and femora replaced with black. Scape (Fig. 3) subapically incised, with upward projecting denticle on outer margin; antennal ratio beginning with scape 32:10: 2:10:9:9:9:9:9:9:18 (clava counted as one); scape subequal to eye height, pedicel ca. 1.5× longer than wide; funiculars evenly covered with short appressed silver setae arranged in 4 or 5 rows; sculpture and setae of mesosoma and metasoma same as for female except median area varies less, with punctures less than own diameter apart (Fig. 4).

Type material.—Holotype ♀, USA, California, Fresno County, Horticulture Crops Research Lab, 10-I-2000, J. Johnson, reared from culture of *Plodia interpunctella,* deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC. Paratype data same as holotype except as follows: 15 ♀ 29-XI-1999; 14 ♀, 8 ♂ 10-I-2000; 10 ♀ 12-IV-2000; 4 ♀, 7 ♂ XI-1999; 5 ♀, 5 ♂ V-1999, Johnson/Gill, from culled fig warehouse. Paratypes are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC, the California Department of Food and Agriculture, Sacramento, the Canadian National Collection, Ottawa, Canada, and The Natural History Museum, London, U.K.

Etymology.—From *brevis* (short) and *alata* (wing), in reference to the shortened wing.

Variation.—Most variation in females is found in the coloration of the tegula, scape (basally), and pro- and mesolegs. These areas vary from dark red brown to bright orange yellow. The degree of sculpture on the median area of the scutellum also varies as described above. The males are fairly consistent in coloration and sculpture.

Host.—Originally reared from laboratory-reared *Plodia interpunctella* pupae. Natural hosts at the culled fig warehouse are believed to be *P. interpunctella* and *Cadra figulilella.*

Discussion.—Representatives of all described Nearctic species (including types) have been examined as a basis for recognizing *P. brevialata.* The species cannot be confused with *P. hespenheidei* Bouček, which forms its own distinct species group (species *sola*) as discussed by Bouček (1984). In the key to Nearctic species of *Psilochalcis* (as *Invreia*) by Grissell and Schauff (1981), females of *P. brevialata* would run to *P. usta* (Grissell and Schauff) and males to *P. deceptor* (Grissell and Schauff). The difficulty of defining *Psilochalcis brevialata* is that it has several unique character states as well a unique combination of character states that overlap the other Nearctic *Psilochalcis* species. For this reason we first discuss the defining characters of *P. brevialata* and then compare characters with the three species with which it might be confused.

The unique characters that distinguish *P. brevialata* from *P. usta, P.* deceptor, and *P. threa* (all Grissell and Schauff, 1981) are as follows. In *P. brevialata* the eye has erect setae that are 2 to 3 ommatidia diameters in length and are separated at the base by 1 to 1.5 times their own length. In *P. deceptor, P. threa,* and *P. usta* the eyes have setae scarcely 1 ommatidium in length and are separated by 2 to 3 times their own length. In *P. brevialata* the upper face has contiguous pits separated by carinate walls. *Psilochalcis deceptor* and *P. usta* have punctures with flat spaces between them which may be 0.5 to 1 times the width of a puncture; *P. threa* has area covered with rugulose sculpture. Similar sculpturing is also found on the mesoscutum and scutellum as well, though it is more defined in these areas and the interspaces tend to be

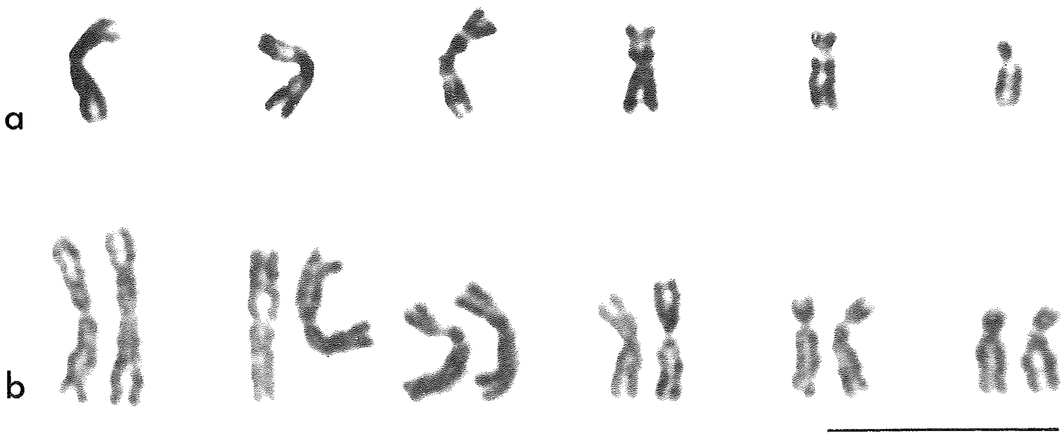


Fig. 8. Male (a) and female (b) karyotype of *Psilochalcis brevialata.* (scale bar indicates 10 μm).

slightly wider than on the face. In *P. deceptor* these areas are covered with evenly spaced punctures with polished flat spaces between them; *P. threa* is similar to *P. deceptor* but has reticulate spaces between punctures; *P. usta* has irregularly placed punctures with polished areas between them and the median area of the scutellum is highly polished without punctures. In females of *P. brevialata* the wings when folded flat over the metasoma (i.e., the normal condition) barely reach the apex of tergum 3. In *P. deceptor, P. threa,* and *P. usta* the wings reach or exceed the apex of the metasoma.

Additional diagnostic characters that help to distinguish *P. brevialata* from the other known species are as follows: in both sexes, *P. brevialata* has tergum 1 sculptured dorsally and polished laterally as in *P. usta.* In *P. deceptor* tergum 1 is polished entirely; *P. threa* is sculptured entirely. In *P. brevialata* the propodeum has well defined submedian, sublateral, and postspiracular carinae, with distinct glossy pits formed by transverse carinae as in *P. deceptor* and *P. usta.* In *P. threa* there are no transverse carinae and the entire propodeum is covered with granulate sculpture. Females of *P. brevialata* have the pedicel 3× longer than wide as in *threa* (5× in *P. deceptor,* 4× in *P. usta*). In males of *P. brevialata* the scape has a weakly developed denticle projecting slightly upward as in *P. deceptor.* In *P. threa* and *P. usta* it is well developed but points outward.

There is no indication that distributions of Old and New World species of *Psilochalcis* overlap. Although we have not examined every Old World species in the genus, we have checked Old World keys and discussions of taxa, and have found no reference to species of *Psilochalcis* (or its present synonyms) with shortened wings as found in *P. brevialata.* Included in our examination were the key to species known up to 1960 (Nikol'skaya 1960) and subsequent descriptions and transfers of species by Steffan (1962, 1976), Habu (1970), and Narendran (1989).

Karyotype (Figs. 8–9).—The haploid chromosome number (n) in this species is six, its karyotype containing four metacentric (M) and two submetacentric (SM) chromosomes (Fig. 8a). The arm number (NF^n) therefore equals 12. Similarly, for the diploid karyotype 2n = 12 (8M + 4SM) and NF = 24 (Fig. 8b).

In the karyotype of *P. brevialata* two long metacentrics are followed by a smaller chromosome of the same type, sometimes appearing as submetacentric due to a large segment of pericentromeric heterochromatin. Other chromosomes are obviously

Table 1. Relative length and centromeric index of chromosomes in *Psilochalcis brevialata*.

Chromosome	Relative Length	Centromeric Index
1	21.39 ± 0.88	47.22 ± 2.18
2	20.64 ± 0.86	44.79 ± 3.37
3	18.56 ± 1.27	42.48 ± 3.25
4	15.18 ± 0.73	46.47 ± 2.10
5	12.82 ± 1.05	28.49 ± 3.17
6	11.41 ± 0.45	26.38 ± 2.56

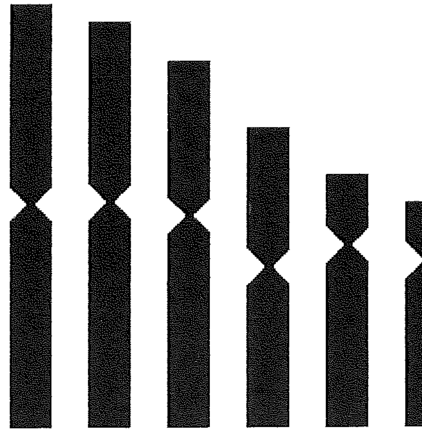


Fig. 9. Haploid ideogram of *Psilochalcis brevialata*.

shorter than the preceding ones. They are represented by a medium-sized metacentric and two small submetacentric (sometimes close to subtelocentric) chromosomes. Relative lengths and centromeric indices of the chromosomes are given in Table 1, and the haploid ideogram is shown in Fig. 9.

Karyotypes of four members of the family Chalcididae are known (Gokhman & Quicke 1995), but none of them has the haploid chromosome number of 6 found in *P. brevialata* (Table 2). However, two smaller submetacentrics in this species have very short arms, which may indicate that its n value was probably derived from the most usual number in the family, n = 5, by chromosomal fission.

Description of original habitat.—The culled fig warehouse was located in Fresno, California, in an area of light industry and residences. The facility consisted of an enclosed, unheated warehouse and a covered, open-sided, raised dock. Figs were stored in wooden bins in the warehouse or on the dock until they could be dumped onto a large pile in the center of the dock. Culled figs were brought in from throughout the fig-producing region of central California beginning in August and continuing through October. Sale and distribution of the figs as cattle feed began soon after receipt and continued throughout the year. During summer months, water was often added to the fig mass in order to maintain a suitable moisture content. No insect controls were used, other than occasional insecticide applications along the perimeter of the warehouse for ant control. Common Lepidoptera found at the warehouse include several pyralids, particularly Indianmeal moth, raisin moth (*C. figulilella*), and navel orangeworm (*Amyelois transitella*). Although all three of these pyralids were brought into the warehouse in new figs, only Indianmeal moth actually reproduced within the warehouse environment. Other pyralid parasitoids commonly found at the warehouse included *Habrobracon hebetor* (Say) (Hymenoptera: Braconidae) and species of *Goniozus* Förster (Hymenoptera:

Table 2. Chromosome numbers of Chalcididae.

Species	n	2n	References
Brachymeria intermedia (Nees)	3	6	Hung 1986
B. lasus (Walker)	5	10	Hung 1986
B. ovata (Say)	5	10	Hung 1986
Dirhinus himalayanus Westwood	5	10	Amalin et al. 1988
Psilochalcis brevialata Grissell and Johnson	6	12	present paper

Bethylidae), both external larval parasites, *Venturia canescens* (Gravenhorst) (Hymenoptera: Ichneumonidae) an internal larval parasite, and *Mesostenus gracilis* (Cresson) (Hymenoptera: Ichneumonidae), an external prepupal and pupal parasite.

Behavioral observations.—Large numbers of *Psilochalcis* adults were recovered from yellow sticky traps hung about 1 m off the ground at the culled fig warehouse in late summer and early fall (Johnson et al. 2000). Adult *Psilochalcis* were also seen flying at the culled fig warehouse in warm weather. Although they were capable of flight, *Psilochalcis* reared in the laboratory did not readily do so. Adults flew most often when warmed in direct sunlight. When disturbed, adults would often drop to the substrate, legs tucked in close to the body, and remain motionless.

Adult female *Psilochalcis* used their antennae to examine empty host cocoons and host pupae. Females used their mandibles to tear through cocoons to reach host pupae, and were rarely seen to sting their hosts through cocoons. Females showed no obvious preference for any location on the host, and seemed to sting whichever portion of the host was accessible. Dark, sclerotized spots on host pupae were evident within 24 h of stinging. We found evidence of as many as 20 stings on an individual host.

The ovipositional behavior of 40 females was observed. Females normally examined hosts for several seconds or even minutes before beginning to sting. A female in the process of stinging a host could be identified by a characteristic, vigorous twisting of the head. This head twist was also often noticed as the female withdrew her ovipositor. The length of time for a female to sting a host varied considerably, from 3–32 minutes, averaging about 13 minutes. Females appeared to host feed at the exudates from recent stings. Females were likely to sting the same host several times in succession, even when other host pupae were available. Single parasite eggs were normally found in dissected hosts, even those that had been stung several times. Several eggs (2–5) were found in single hosts exposed to one female in less than 1% of those dissected.

In spite of evidence of single hosts receiving multiple stings, no more than one wasp was seen to emerge from a single host. Developing parasites did not entirely consume their host; about 50–70% of the host's body mass remained after parasite emergence. Adult *Psilochalcis* normally emerged from the anterior half of the host, but the exact location varied considerably.

Host preference.—The laboratory culture of *Psilochalcis brevialata* was established from laboratory-reared Indianmeal moth pupae that had been placed at the culled fig warehouse and parasitized. Shortly after establishment of the culture on laboratory-reared Indianmeal moth, *P. brevialata* females successfully parasitized pupae from laboratory cultures of *Cadra figulilella, C. cautella, Ephestia elutella,* and *Amyelois transitella,* all pyralids. Females did not successfully parasitize pupae of laboratory-reared *Galleria mellonella* or *Cydia pomonella.* After *P. brevialata* had been in culture on Indianmeal moth for about one year, females still readily parasitized *C. figulilella* and *E. elutella,* but rejected *A. transitella.*

During weekly sampling over a two-year period, 4,824 *P. brevialata* were recovered from yellow, sticky flight traps at the culled fig warehouse (Johnson et al. 2000). Large numbers of postharvest pyralids were also recovered from pheromone traps at the warehouse. Indianmeal moth was the most prevalent of these, and commonly infested new figs as well as reproduced within the warehouse environment. New figs also were heavily infested with *C. figulilella,* a common field pest of drying fruits such as raisins and figs. Although *P. brevialata* was never reared from field-collected hosts, we believe that the recovery of *P. brevialata* from laboratory-reared Indianmeal moth, and the ease with which it is reared on Indianmeal moth, *Cadra,* and *Ephestia* species indicate that these are its natural hosts, at least within the culled fig warehouse.

Table 3. Life history parameters for 15 mated pairs and 10 unmated females of *Psilochalcis brevialata.*

Parameter	Mean ± SE	Max	Min
	Mated Pairs		
Female lifespan (days)	43.3 ± 3.38	67	20
Male lifespan (days)	35.4 ± 3.19	64	19
Female reproductive lifespan (days)	39.3 ± 2.39	53	23
Total progeny	128.7 ± 11.70	201	32
Female progeny	69.0 ± 6.00	109	25
Male progeny	59.7 ± 7.30	109	7
Sex ratio (female/male)	1.4 ± 0.20	3.57	0.53
Progeny development period (days)	24.5 ± 0.31	26	22
Female development period (days)	25.8 ± 0.42	29	24
Male development period (days)	24.3 ± 0.54	29	21
	Unmated Females		
Female lifespan (days)	37.3 ± 6.77	84	13
Female reproductive lifespan (days)	26.4 ± 4.76	40	5
Progeny (all male)	39.2 ± 7.02	64	6

It is uncertain how *P. brevialata* became established at the culled fig warehouse. Most likely, it was brought in with parasitized hosts in new figs. As such, it could have originally been from any of the orchards contributing figs to the warehouse, in either Indianmeal moth, *C. figulilella,* or *A. transitella* pupae. An alternate explanation is that *P. brevialata* was present in existing stored product pyralid populations. Several other food-processing plants and residences, both known sources for Indianmeal moths, are in the same area as the culled fig warehouse.

Life history.—Results of the life history studies are summarized in Table 3. On average, mated females lived nearly a week longer (43.3 days) than unmated females (37.3 days), although the longest lived female in the study (84 days) was unmated. Males lived about 2 days less (35.4 days) than unmated females. The reproductive lifespan for mated females (39.3 days) was nearly 2 weeks longer than for unmated females (26.4 days). Mated females produced an average of 128.7 progeny, more than 3 times the number of progeny produced by unmated females (39.2). The sex ratio for progeny from mated females was slightly skewed (1.4) towards females. Unmated females produced only male progeny. Overall, mean development time at 27°C for progeny of mated females averaged 24.5 days, with females (25.8 days) taking 1–2 days longer to develop than males (24.3 days). Developmental period was not measured for progeny of unmated females.

The average number of progeny produced per day for mated females is shown in Fig. 10. Very few host pupae were successfully parasitized the first day after adult emergence, but the number rose sharply to a peak 4–11 days after emergence. After about 11 days, the number of progeny produced each day slowly declined, with females producing no progeny the last 2–4 days of their lives. Females were never able to parasitize all 10 available hosts in a single day. Although the rate of parasitization per day seems low, the relatively long reproductive life of the females allows production of more than 120 offspring per female.

The highest number of *P. brevialata* was recovered from flight traps at the culled fig warehouse during the warm summer months, when other pyralid parasitoids such as *H. hebetor, V. canescens, M. gracilis,* or *Goniozus* spp. were far less active (Johnson et al. 2000). Other laboratory observations indicate that *P. brevialata* is relatively heat tolerant. *Psilochalcis brevialata* may there-

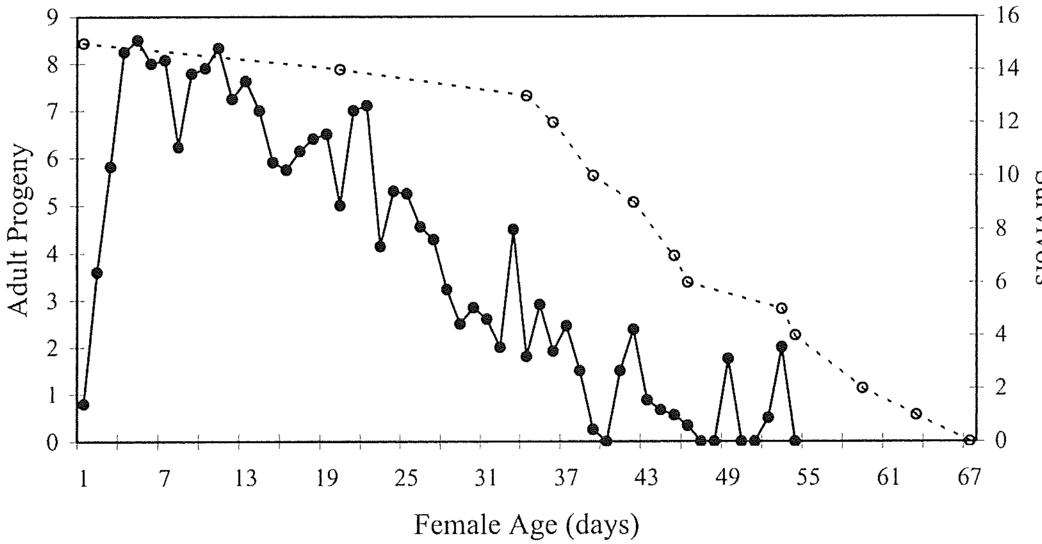


Fig. 10. Age specific fecundity (average adult progeny production per day of female life) of *Psilochalcis brevialata*.

fore prove to be a useful component of a biologically based control program for post-harvest dried fruits and nuts.

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