# Life Histories of *Ramosiana insignis* (Blanchard) and *Vulsirea violacea* (F.) (Hemiptera-Heteroptera: Pentatomidae), with Descriptions of Immature Stages

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# LIFE HISTORIES OF *RAMOSIANA INSIGNIS* (BLANCHARD) AND *VULSIREA VIOLACEA* (F.) (HEMIPTERA-HETEROPTERA: PENTATOMIDAE), WITH DESCRIPTIONS OF IMMATURE STAGES

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*Abstract*.—The life cycles of two pentatomid species, *Ramosiana insignis* and *Vulsirea violacea*, are reported for first time. We include descriptions and illustrations of all instars, as well as the host plant and behavior. Females of these two species care for their eggs and first-instar nymphs, and both species have the same host, *Schoepfia schreberi*, although *R. insignis* feeds on flower buds, fruits, and vegetative structures, whereas *V. violacea* feeds only on fruit. Adults are present at the same time on the plant, and even though their life cycles are separated in time, it seems that there is competition between them. Parasitoids and predators are also reported.

*Key Words:* maternal care, life cycle, *Schoepfia schreberi*

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In Heteroptera, parental care of eggs and nymphs occurs in members of the Pentatomidae, Scutelleridae, Cydnidae, Coreidae, Reduviidae, Tingidae, Aradidae, and Belostomatidae (Tallamy and Schaefer 1997). Maternal care may have evolved as a behavior to enhance offspring survival when exceptional environmental challenges occur (Wilson 1979). In a variety of phytophagous insects, it has been demonstrated that orphaned eggs and younger nymphs consistently suffer severe parasitism and predation and attendance by the mother greatly improve their survival (Tallamy and Denno 1981, Kudo et al. 1995, Kudo 2002, Santos et al. 2005, Kolliker and Vancassel 2007).

Female pentatomids and scutellerids use their broad bodies to physically shield their eggs and young from predators and especially parasitoids as in the case of several species of *Elasmucha* (Kudo and Nakahira 1993, Mappes and Kaitala 1995, Mappes et al. 1997, Kudo 2002); in *Antiteuchus* (Eberhard 1975); and several species of *Pachycoris* (Cervantes 2002, Santos et al. 2005, Williams et al. 2005).

Brooding females apparently do not feed and therefore may be subjected to costs associated with guarding offspring, including shortened lifespan due to starvation, and increased vulner-

* Accepted by Michael W. Gates

ability to natural enemies (Cervantes 2002).

Here we study the maternal behavior of two pentatomid species *Ramosiana insignis* (Blanchard) and *Vulsirea violacea* (Fabricius), including their life histories, and relationship with their host plant, predators, and parasitoids. Although adults of both species have been described previously, here we redescribe them and describe for first time all immature stages.

Both species are included in Section 2 of the tribe Pentatomini, which according with Rolston and McDonald (1980) and Rolston et al. (1980), have a median tubercle or spine at the base of the abdominal venter, but do not have the metasternum produced ventrad in apposition to the apex of that tubercle or spine. The information presented here on the morphology of the nymphs and the biology of these species provides evidence indicating these two genera could indeed be related.

## Materials and Methods

Specimens were collected in three different localities in the state of Veracruz, Mexico, from September 2006 to March 2008. The first site, in Tejeria (TJ), located 19°21′N and 96°54′W at 924 m, the second one in Monte Blanco (MB) located at 19°22′N and 96°55′W at 977 m, belonging to the municipality of Teocelo; the third one, a conservation area named "Osto"(OS), located at 19°18′N, and 96°50′W at 838 m near the municipality of Tlaltetela.

In Tejeria and Monte Blanco, the predominant vegetation is fragmented oak forest, associated with coffee plantations, secondary vegetation, and orchard trees growing in back yards. In Osto, the most abundant type of vegetation is low deciduous forest and fragmented oak forest.

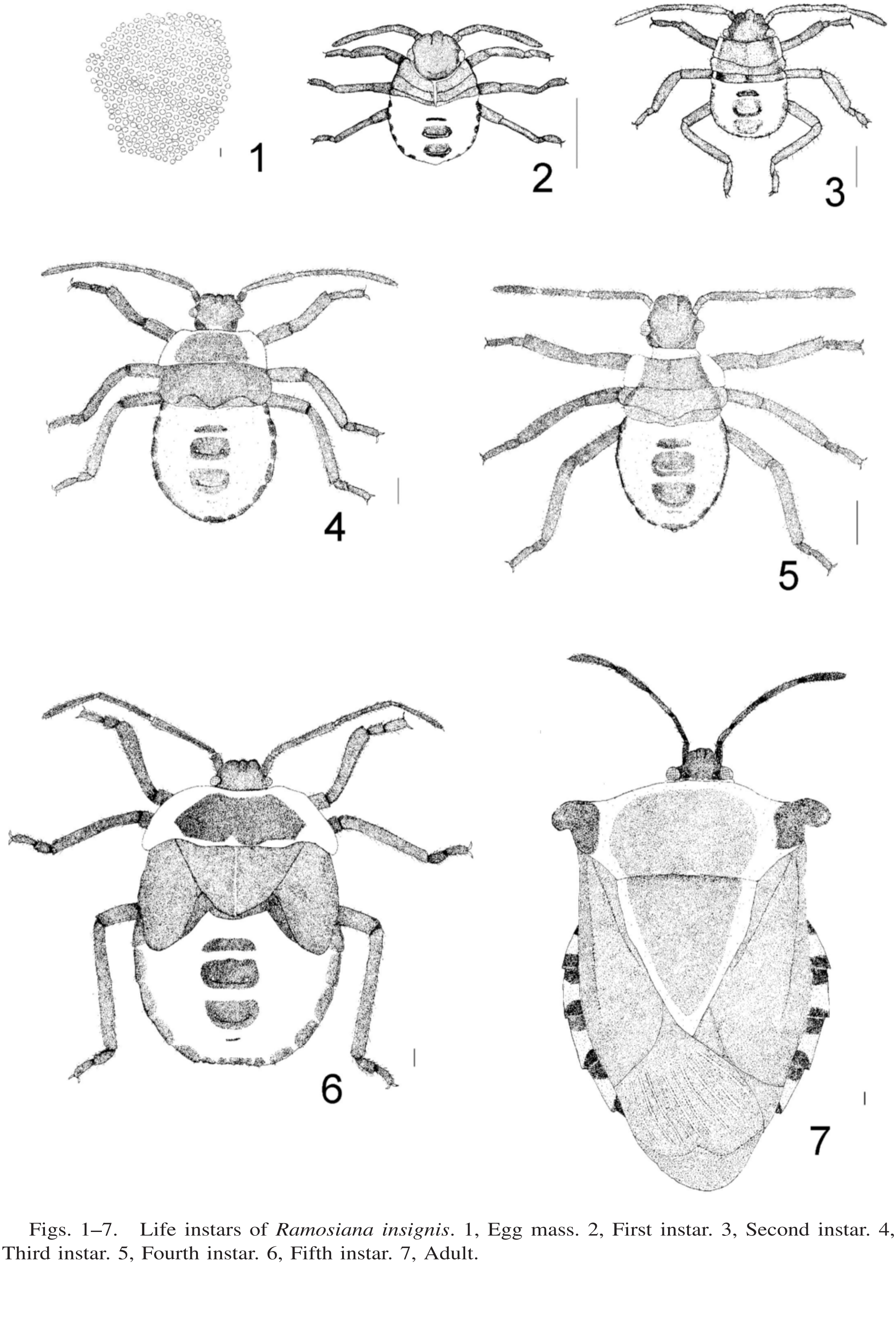
The study took place on *Schoepfia schreberi* J. F. Gmel. (Olacaceae) trees, 3 to 5 m high. Observations began when the breeding season was begining, just when females initiate aggregations and commence to oviposit; annotations were made twice a week during high activity (September to April) and once a week on low activity (May to August). Only trees with floral buds were selected.

A total of 49 egg masses of *R. insignis* were chosen at random, nine in MB, 27 in TJ, and 13 in OS; in 32 trees, seven in MB, 14 in TJ, and 11 in OS. For *V. violaceae*, seven egg masses, three in TJ, and four in OS, were observed on seven trees. Warding females were marked on the thorax with non-toxic acrylic paint (Politec, Rodin S.A. de C.V. Mexico).

The life cycle was studied by quantifying the number of eggs, number of eggs parasitized, and number of eggs hatched and not hatched. These procedures were done using a digital camera Canon EOS Digital Rebel XTi (Canon Inc.). Each egg mass and sometimes the females were collected.

The life cycle was studied through field observations and by randomly collecting specimens of each instar for description and illustration.

The host *Schoepfia schreberi* is a shrub that grows from low deciduous forest to dry oak forest. It is distributed from Venezuela, throughout Central America and Mexico, to Florida, and on in some Caribbean islands. It flowers from September to March, produces berries of 5–12 mm, green when immature and turning red when ripe (Sanchez 1996). This species is considered a hemiparasite, getting nutrients through the roots of other trees. All insect specimens are deposited in the Entomological Collection of Instituto de Ecologia, A.C. (IEXA). Measurements are given in mm ± SD.




Figs. 1–7. Life instars of *Ramosiana insignis*. 1, Egg mass. 2, First instar. 3, Second instar. 4, Third instar. 5, Fourth instar. 6, Fifth instar. 7, Adult.

## Results

### *Ramosiana insignis* (Blanchard) (Figs. 1–7)

Egg (Fig. 1).—Pyriform, whitish when laid, turning yellow and reddish; chorion without an apparent reticulation pattern; operculum surrounded by abount 20 mycropilar processes. Egg: length 1.39 ± 0.07, width 0.96 ± 0.04; egg mass: length 18.45 ± 0.76, width 17.1 ± 1.13.

First instar (Fig. 2).—Slightly pyriform, with maximum width through abdominal segment III. Head, pro-, meso-, and metathorax, connexival and scent gland plates, antenna, rostrum and legs dark brown. Eyes red, joints between antennal segments pale yellow. Abdomen yellowish orange. Head declivent, tylus longer than jugum, antennal segment I the smallest, II and III subequal in size, segment IV slightly fusiform and the largest. Rostrum slightly surpassing metacoxae. Scent gland plates present on segments III–IV, IV–V, and V–VI; first one very thin and elongated; and the other two cuadrangular in shape.

*Measurements* (n = 10): Body length 1.71 ± 0.13; head length 0.66 ± 0.1; width across eyes 0.76 ± 0.02; interocular distance 0.55 ± 0.03; postocular distance 0; antennal segments: I 0.09 ± 0.02, II 0.29 ± 0.02, III 0.29 ± 0.02, IV 0.52 ± 0.08; rostral segments: I 0.23 ± 0.02, II 0.25 ± 0.03, III 0.31 ± 0.05, IV 0.29 ± 0.05; pronotum: length 0.18 ± 0.03, width across anterior margin 0.78 ± 0.05, width across humeral angles 0.97 ± 0.05; length of hind leg: femur 0.57 ± 0.03, tibia 0.57 ± 0.18, tarsi: I 0.12 ± 0.02, II 0.30 ± 0.03.

Second instar (Fig. 3).—Slightly pyriform; very similar to the first instar, although the entire body covered by numerous setae. Colors similar to the first instar, although the lateral margins of pronotum paler and in some specimens translucid; small plate on abdominal segments VI–VII, resembling a scent gland plate but without openings. Abdomen bright orange. Lateral margins of pro-, meso-, and metanotum expanded. Rostrum reaching middle of abdomen. Ventral segments VI to IX with rectangular maculae located at each side of middle line. Tibiae of all legs slightly sulcate.

*Measurements* (n = 10): Body length 3.02 ± 0.12; head length 0.88 ± 0.08; width across eyes 1.11 ± 0.02; interocular distance 0.75 ± 0.03; postocular distance 0.18 ± 0.29; antennal segments: I 0.25 ± 0, II 0.82 ± 0.03, III 0.78 ± 0.02, IV 0.94 ± 0.08; rostral segments: I 0.48 ± 0.03, II 0.6 ± 0.02, III 0.71 ± 0.04, IV 0.62 ± 0.02; pronotum: length 0.44 ± 0.03, width across anterior margin 1.24 ± 0.03, width across humeral angles 1.52 ± 0.04; length of hind leg: femur 1.21 ± 0.07, tibia 1.31 ± 0.08, tarsi: I 0.29 ± 0.02, II 0.48 ± 0.03.

Third instar (Fig. 4).—Body very elongated, with maximum width through abdominal segment III. Very similar to second instar, although the body more convex. Coloration similar to second instar, but with lateral margins of pronotum whitish. Head in almost all specimens separated from the thorax by a small neck. Scutellum and mesothoracic wing pads slightly developed, but only covering part of metanotum. Rostrum reaching abdominal segment IV; spiracles and trichobotria black and very apparent.

*Measurements* (n = 10): Body length 5.44 ± 0.19; head length 1.24 ± 0.07; width across eyes 1.52 ± 0.04; interocular distance 1 ± 0.02; postocular distance 0.51 ± 0.06; antennal segments: I 0.3 ± 0.02, II 1.24 ± 0.06, III 1.19 ± 0.07, IV 1.50 ± 0.07; rostral segments: I 0.65 ± 0.05, II 0.86 ± 0.03, III 0.94 ± 0.08, IV 0.87 ± 0.1;

pronotum: length 0.79 ± 0.04, width across anterior margin 1.68 ± 0.05, width across humeral angles 2.38 ± 0.09; length of hind leg: femur 1.82 ± 0.17, tibia 2.16 ± 0.19, tarsi: I 0.36 ± 0.06, II 0.66 ± 0.03.

Fourth instar (Fig. 5).—Similar to the third instar, but lateral margins of pronotum and mesonotum more expanded; pronotal lateral margins with broad white band, and anterior margin with a narrow white band. Abdominal ventral segments III to VII with dark brown median macules, the first two rounded and the remainder quadrangular. Thin dark brown bands at each side of middle line between the joints of ventral segments I–II, II–III, and III–IV. Rostrum reaching base of abdominal segment III. Mesothoracic wing pads just covering metanotum.

*Measurements* (n = 10): Body length 10.97 ± 0.36; head length 1.64 ± 0.18; width across eyes 2.23 ± 0.05; interocular distance 1.4 ± 0.05; postocular distance 0.33 ± 0.17; antennal segments: I 0.5 ± 0, II 1.92 ± 0.1, III 1.72 ± 0.09, IV 1.85 ± 0.15; rostral segments: I 0.95 ± 0.05, II 1.24 ± 0.08, III 1.31 ± 0.07, IV 1.18 ± 0.06; pronotum: length 1.32 ± 0.09, width across anterior margin 2.69 ± 0.17, width across humeral angles 4.61 ± 0.22; scutellum: length 1.62 ± 0.09, width 3.49 ± 0.09; length of hind leg: femur 3.19 ± 0.17, tibia 3.67 ± 0.25, tarsi: I 0.61 ± 0.06, II 0.99 ± 0.03.

Fifth instar (Fig. 6).—Similar to the fourth instar. Head slightly covered by tanterior margins of pronotum. Pronotum with lateral margins more expanded, and frontal and humeral angles larger. Disc of pronotum with a dark brown trapezoidal macula having a small central incision at base; all margins of pronotum whitish, lateral ones broad and front and posterior margins slender. Meso-, and metathoracic wing pads reaching base of abdominal segment IV. Rostrum reaching base of sternite II.

*Measurements* (n = 10): Body length 14.52 ± 1.27; head length 1.63 ± 0.22; width across eyes 3.11 ± 0.13; interocular distance 1.98 ± 0.1; interocelar distance 1.28 ± 0.03; postocular distance 0.22 ± 0.16; antennal segments: I 0.88 ± 0.18, II 3.19 ± 0.17, III 2.55 ± 0.17, IV 2.54 ± 0.27; rostral segments: I 1.33 ± 0.07, II 1.75 ± 0.13, III 1.87 ± 0.11, IV 1.55 ± 0.08; pronotum: length 2.45 ± 0.41, width across anterior margin 3.7 ± 0.29, width across humeral angles 8.61 ± 0.49; scutellum: length 3.62 ± 0.25, width 3.63 ± 0.25; length of hind leg: femur 5.72 ± 0.48, tibia 6.06 ± 0.37, tarsi: I 1.25 ± 0.11, II 1.29 ± 0.15.

Adult (Fig. 7).—Head, antenna, rostrum, humeral angles, distal third of femora, tibiae, tarsi, maculae of connexivum, maculae of pro-, meso-, and metapleura, spiracles, and maculae situated mesially on abdominal sternites III to V black. Scutellum with lateral margins creamy yellow and disc metallic green, these areas of scutellum extend to the pronotum, the creamy margins extend toward the head and join on the anterior margin of pronotum. Corium metallic green; coxae, basal 2/3 of femora, venter, and rest of conexivum orange.

Distal end of first antennal segment clearly exceeding apex of head; distal end of first rostral segment clearly surpassing bucculae; rostrum extending toward the base of abdominal spine; scutellar width at base about 2/3 length.

Female. *Measurements* (n = 10): Body length 23.93 ± 0.98; head length 2.82 ± 0.15; width across eyes 3.53 ± 0.11; interocular distance 2.1 ± 0.19; interocelar distance 1.51 ± 0.14; postocular distance 0; antennal segments: I 0.46 ± 0.05, II 1.36 ± 0.05, III 2.7 ± 0.22, IV 3.24 ± 0.21, V 3.07 ± 0.14; rostral segments: I 1.71 ± 0.07, II 2.12

± 0.28, III 2.39 ± 0.27, IV 1.82 ± 0.06; pronotum: length 6.29 ± 0.28, width across anterior margin 3.91 ± 0.18, width across humeral angles 15.72 ± 0.74; scutellum: length 9.18 ± 1.14, width 8.07 ± 0.61; length of hind leg: femur 8.23 ± 0.54, tibia 8.07 ± 0.52, tarsi: I 1.29 ± 0.07, II 0.67 ± 0.09, III 0.91 ± 0.03.

Male. *Measurements* (n = 10): Body length 21.84 ± 1.06; head length 2.61 ± 0.09; width across eyes 3.39 ± 0.14; interocular distance 2.04 ± 0.1; interocelar distance 1.43 ± 0.08; postocular distance 0; antennal segments: I 0.96 ± 0.07, II 1.32 ± 0.1, III 2.86 ± 0.41, IV 3.39 ± 0.27, V 2.97 ± 0.27; rostral segments: I 1.56 ± 0.11, II 2.27 ± 0.13, III 2.34 ± 0.15, IV 1.76 ± 0.11; pronotum: length 5.95 ± 0.27, width across anterior margin 3.67 ± 0.18, width across humeral angles 14.09 ± 0.54; scutellum: length 8.67 ± 0.25, width 7.31 ± 0.23; length of hind leg: femur 7.61 ± 0.26, tibia 7.52 ± 0.46, tarsi: I 1.3 ± 0.05, II 0.52 ± 0.09, III 0.91 ± 0.14.

Distribution.—This species has been collected in Mexico in several states: Chiapas, Guerrero, Mexico, Michoacan, Morelos, Nuevo Leon, Oaxaca, Puebla, San Luis Potosi, Tamaulipas, and Veracruz. It has also been reported from Costa Rica using the same host plant (Nielsen et al. 2004).

### *Vulsirea violacea* (Fabricius)
(Figs. 8–14)

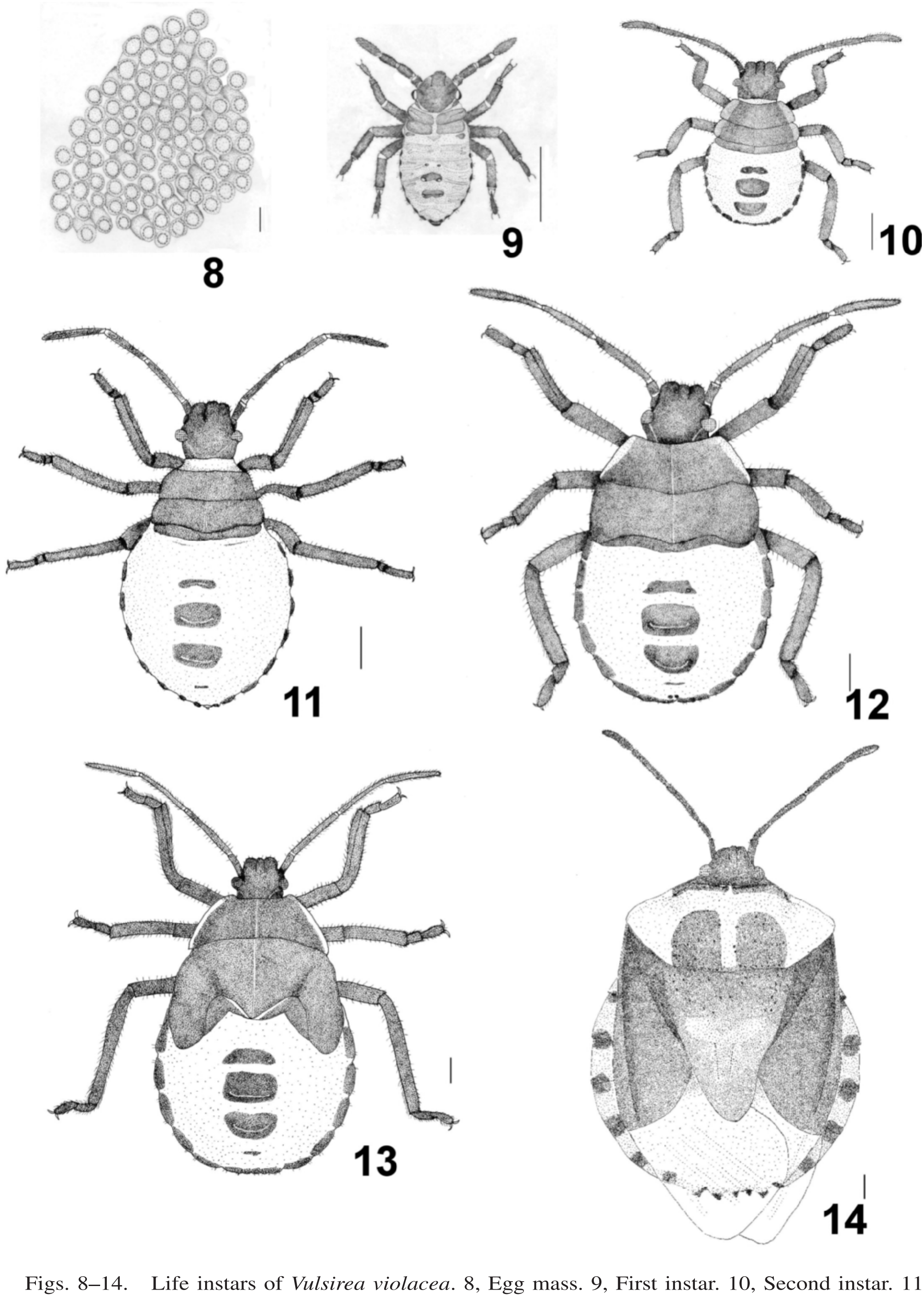
Egg (Fig. 1).—Pyriform, whitish when first laid, turning yellow and reddish. Operculum with 14 to 20 mycropilar processes. Egg: length 1.33 ± 0.13, width 0.88 ± 0.08; egg mass with around 85 eggs.

First instar (Fig. 2).—Slightly pyriform, with maximum width through abdominal segment III. Head, pro-, and mesothorax, and connexival and scent gland plates, antenna, rostrum and legs dark brown to black; metathorax pale gray only on the middle area and the margins. Eyes red, joints between antennal segments pale yellow. Abdomen yellowish orange. Rostrum reaching metacoxae. Scent gland plates present on segments III–IV, IV–V, and V–VI; the first one just as two small macules; and the other two elongated and constrained by the middle.

*Measurements* (n = 10): Body length 2.08 ± 0.13; head length 0.62 ± 0.06; width across eyes 0.68 ± 0.02; interocular distance 0.52 ± 0.02; postocular distance 0; antennal segments: I 0.09 ± 0.01, II 0.24 ± 0.03, III 0.27 ± 0.03, IV 0.44 ± 0.04; rostral segments: I 0.15 ± 0.02, II 0.17 ± 0.03, III 0.2 ± 0.02, IV 0.31 ± 0.03; pronotum: length 0.4 ± 0.03, width across anterior margin 0.74 ± 0.04, width across humeral angles 0.88± 0.05; length of hind leg: femur 0.36 ± 0.07, tibia 0.41 ± 0.06, tarsi: I 0.11 ± 0.03, II 0.31 ± 0.02.

Second instar (Fig. 10).—Pyriform, with body very convex. Head, antenna, rostrum, thorax, legs, scent gland plates of segments III–IV, IV–V, V–VI, and VI–VII and connexival plates dark brown to black. Joints of antennal segments, eyes, and moulting sutures reddish, joints between leg segments pale yellow. Rostrum reaching abdominal sternite IV. Abdominal venter with quadrangular middle line plates on sternites III to VII, first three sternites with small long and thin, pale brown plates.

*Measurements* (n = 9): Body length 4.38 ± 0.14; head length 0.92 ± 0.12; width across eyes 1.37 ± 0.05; interocular distance 0.92 ± 0.06; postocular distance 0; antennal segments: I 0.32 ± 0.03, II 1.07 ± 0.04, III 1.03 ± 0.04, IV 1.27 ± 0.08; rostral segments: I 0.64 ± 0.05, II 0.94 ± 0.09, III 0.96 ± 0.04, IV 0.94 ± 0.03; pronotum: length 0.66 ± 0.04, width across anterior margin 1.41 ± 0.07, width across humeral




Figs. 8–14. Life instars of *Vulsirea violacea*. 8, Egg mass. 9, First instar. 10, Second instar. 11, Third instar. 12, Fourth instar. 13, Fifth instar. 14, Adult.

Fig. 15. Adults of *Ramosiana insignis* and *Vulsirea violacea* on their host plant *Schoepfia schreberi.*

angles 2.09 ± 0.1; length of hind leg: femur 1.59 ± 0.11, tibia 1.73 ± 0.12, tarsi: I 0.37 ± 0.02, II 0.61 ± 0.03.

Third instar (Fig. 11).—Very similar to the second instar, although the rostrum only reaches in almost all specimens sternite III.

*Measurements* (n = 4): Body length 6.28 ± 0.86; head length 1.22 ± 0.11; width across eyes 1.49 ± 0.02; interocular distance 0.99 ± 0.03; postocular distance 2.24 ± 0.16; antennal segments: I 0.35 ± 0, II 1.18 ± 0.05, III 1.1 ± 0.04, IV 1.39 ± 0.06; rostral segments: I 0.69 ± 0.02, II 0.92 ± 0.05, III 1.05 ± 0.06, IV 1.06 ± 0.08; pronotum: length 0.7 ± 0.04, width across anterior margin 1.58 ± 0.03, width across humeral angles 2.18 ± 0.06; length of hind leg: femur 1.79 ± 0.16, tibia 1.92 ± 0.03, tarsi: I 0.35 ± 0, II 0.64 ± 0.02.

Fourth instar (Fig. 12).—Similar to the third instar. The lateral margins of pronotum slightly expanded and paler than the rest. Abdominal sternites III to VII with middle dark brown plates, the first two rounded and the remainder quadrangular. Rostrum reaching base of sternite III. Mesothoracic wing pads slightly developed, covering just part of the metathorax.

*Measurements* (n = 5): Body length 7.68 ± 0.54; head length 1.38 ± 0.04; width across eyes 1.91 ± 0.1; interocular distance 1.25 ± 0.07; postocular distance 0.18 ± 0.13; antennal segments: I 0.51 ± 0.02, II 1.67 ± 0.1, III 1.5 ± 0.07, IV 1.76 ± 0.11; rostral segments: I 0.9 ± 0.07, II 1.16 ± 0.05, III 1.18 ± 0.04, IV 1.18 ± 0.11; pronotum: length 1.14 ± 0.09, width across anterior margin 2.1 ± 0.12, width across humeral angles 3.54 ±

Fig. 16. *Ramosiana insignis* female guarding egg mass. Reddish eggs are normally developed, whereas blackish eggs are parasitized.

0.28; length of hind leg: femur 2.89 ± 0.29, tibia 2.85 ± 0.35, tarsi: I 0.62 ± 0.08, II 0.82 ± 0.4.

Fifth instar (Fig. 13).—Similar to the fourth instar, but the meso- and metathoracic wing pads almost reaching base of abdominal segment III; scutellum reaching middle part of segment I. Rostrum reaches base of segment II.

*Measurements* (n = 3): Body length 7.95 ± 0.69; head length 1.63 ± 0.06; width across eyes 2.6 ± 0; interocular distance 1.63 ± 0.06; postocular distance 0.27 ± 0.21; antennal segments: I 0.77 ± 0.06, II 2.5 ± 0.1, III 2.3 ± 0, IV 2.3 ± 0; rostral segments: I 1.23 ± 0, II 1.5 ± 0.1, III 1.8 ± 0, IV 1.5 ± 0; pronotum: length 1.73 ± 0.12, width across anterior margin 3 ± 0, width across humeral angles 6.27 ± 0.4; scutellum: length 2.67 ± 0.06, width 5.1 ± 0.17; length of hind leg: femur 4.47 ± 0.29, tibia 4.9 ± 0.26, tarsi: I 0.9 ± 0, II 1.2 ± 0.

Adult (Fig. 14).—Head, antenna, rostrum, two maculae on front half of pronotum, two maculae on posterior half of pronotum, most of scutellum, corium, legs, maculae between each abdominal segment on connexivum, and spiracles black. Head, maculae of pronotum, scutellum, and corium usually with metallic green shines. Pronotum sometimes all black with metallic-green sheen, although it can have a mesial T-shape orange area or this area can become larger, extending toward the humeral angles and turning creamy yellow. Scutellum sometimes all black or with one orange macula situated posteriorly on each lateral margin. Remainder of connexivum and most of

Fig. 17. *Vulsirea violacea* female guarding egg mass and first-instar nymphs.

the venter orange, except anterior half of prosternum, maculae of meso- and metapleura, and a macula situated mesially on last abdominal sternite which are black. Distal end of first antennal segment clearly exceeding apex of head; first rostral segment lying entirely between bucculae; rostrum reaching median abdominal spine; median spine at base of abdominal venter not projecting as far as procoxae; scutellar width and length subequal.

Female. *Measurements* (n = 6): Body length 15.71 ± 0.63; head length 1.92 ± 0.21; width across eyes 2.76 ± 0.07; interocular distance 1.67 ± 0.08; interocelar distance 1.3 ± 0; postocular distance 0.01 ± 0.04; antennal segments: I 0.82 ± 0.1, II 0.92 ± 0.08, III 1.92 ± 0.12, IV 2.55 ± 0.22, V 2.37 ± 0.05; rostral segments: I 1.13 ± 0.05, II 1.62 ± 0.13, III 1.67 ± 0.05, IV 1.47 ± 0.05; pronotum: length 3.8 ± 0.19, width across anterior margin 2.98 ± 0.12, width across humeral angles 9.18 ± 0.29; scutellum: length 6.03 ± 0.16, width 5.67 ± 0.14; length of hind leg: femur 5.83 ± 0.22, tibia 5.5 ± 0.11, tarsi: I 0.88 ± 0.1, II 0.32 ± 0.04, III 0.78 ± 0.04.

Male. *Measurements* (n = 7): Body length 13.85 ± 0.71; head length 1.86 ± 0.18; width across eyes 2.56 ± 0.11; interocular distance 1.5 ± 0.07; interocelar distance 1.09 ± 0.06; postocular distance 0; antennal segments: I 0.74 ± 0.05, II 0.78 ± 0.07, III 1.76 ± 0.08, IV 2.24 ± 0.08, V 2.18 ± 0.13; rostral segments: I 1.06 ± 0.05, II 1.44 ± 0.11, III 1.71 ± 0.13, IV 1.39 ± 0.04; pronotum: length 3.4 ± 0.24, width across anterior margin 2.79 ± 0.2, width across humeral angles 8.08 ± 0.54; scutellum: length 5.33 ± 0.35, width 5.11 ± 0.44; length of hind leg: femur 5.07 ± 0.16, tibia 4.86 ±

Fig. 18. Fifth-instar nymph of *Euthyrhynchus floridanus* (Hemiptera: Asopinae) feeding on second-instar nymphs of *Ramosiana insignis*.

0.18, tarsi: I 0.81 ± 0.07, II 0.31 ± 0.04, III 0.77 ± 0.08.

Distribution.—MEXICO: Campeche, Oaxaca, Queretaro, Veracruz. COSTA RICA. USA: Texas

Biology.—Nymphs and adults of *Ramosiana insignis* and *Vulsirea violacea* were associated with floral buds, green and ripe fruits, new shoots, and other vegetative structures of their host plant *Schoepfia schreberi* (Fig. 15).

Ovipositing females of *R. insignis* were only found on trees with floral buds, from the second week in September to early November each year. Ovipositing females of *V. violacea* were found only on trees with fruits from December to January.

Females of *R. insignis* deposited egg masses of 330.67 ± 93.5 (n = 49) eggs. Oviposition took place exclusively on the under-side of a leaf of *S. schreberi* at a height of 2.31 ± 0.80 m; and females of *V. violacea* deposited on average 162 ± 42.6 (n = 7) eggs per egg mass, on the upper side of a leaf at a height of 2.45 ± 0.82 m. Both species arrange the eggs in a regular and uniform mass of rhomboid shape.

Maternal care was observed in both species from oviposition to the first nymphal instar. In both species, care of the young was limited to the protection of the egg mass and the first-instar nymphs. Females covered the egg mass with their bodies. Usually they sat without movement over the egg mass, moving only the antennae; but when they were disturbed by the presence of parasitoids, ants or by our observations, they moved their bodies up and down or side to side, and they usually passed their posterior legs over the egg mass; they also expelled a blend of chemicals

Fig. 19. The spider *Phidippus bidentatus* feeding on a fourth-instar nymph of *Ramosiana insignis*.

known to act as a repellent. When females left the masses unattended, sometimes ants preyed on the eggs. Females usually sat looking towards the leaf base (Fig. 16) and only *R. insignis* changed its position, moving vertically when the nymphs started to hatch, leaving the nymphs exposed. *Vulsirea violacea* stayed on the same position until they moulted to the second instar, and the nymphs continue to be protected by its body (Fig. 17). Reproduction in *R. insignis* took place from September to December; whereas *V. violacea* reproduced from December to March.

Eggs were yellow when laid; five days later just before hatching they turned pinkish. On some occasions the mother died while looking after their young or soon after the nymphs dispersed, even when she had been observed feeding. We suggest that these species oviposit only once and are univoltine. Hatching occurred late in October or November for *R. insignis*, and during early January for *V. violacea*. There were around 187.8 $\pm$ 86.9 nymphs of *R. insignis* and 102 $\pm$ 26.8 nymphs of *V. violacea* per egg mass, so 56.8% and 62.9% of the eggs survived to the first nymphal stage for both species, respectively.

The nymphs of *R. insignis* dispersed away from the egg mass during the first or second instar in November and December, usually migrating in an aggregated formation toward the floral buds or to the new shoots on the same host plant. Practically all instars and adults fed on these resources until they were depleted, and third- to fifth-instar nymphs and adults moved to another tree looking for fresh food.

All instars of *V. violacea* fed exclusively on the immature and ripe fruits, forming aggregations, and dispersed only when the resource diminished. Nymphs dispersed in January or February.

Nymphs of both species could be found simultaneously on the same plant, but they could be differentiated because the nymphs of *R. insignis* have a paler coloration than those of *V. violacea*, whose coloration is more intense, turning reddish with development.

The length of the life cycles for each species differs in several ways. Nymphs of *R. insignis* hatched mainly in October and the middle of November, dispersing during November and December. From January to mid March (fruiting season of *S. schreberi*), the third- to fifth-instar nymphs walked on the ground, moving from plant to plant, and feeding on the fruits on the tree. Nymphs always left the egg mass collectively. It was possible to observe individuals from different egg masses and from distinct instars present in the same plant. Feeding habits varied according to the nymphal instar; during the first instar the nymphs fed on fruits, usually finished with all the ripe fruits present in one plant, before moving to another one; during the last instars, the nymphs reduced their fruit consumption, although they fed on the very low number of fruits that were ripe during that period. They reached the adult stage by the end of February or beginning of March.

Nymphs of *V. violacea* emerged in January and reached the adult stage in March, and always fed on ripe fruits.

After the fruiting season of *S. schreberi* at the end of March, adults of both species aggregated in specific trees and stayed almost without movement until the end of June, when the rainy season started. The life cycle of *R. insignis* was about three months longer than that of *V. violacea*.

A few adults of *R. insignis* were observed feeding on the seeds of unripe fruits of *Ximenia americana* L., another member of the Olacaceae. This species fruits between the end of April and May. We consider that adults of *R. insignis* fed on this species to complete their nutritional requirements after the fruits of *S. schreberi* have gone. This phenomenon occurred only in Osto where *X. americana* was present. We did not find bugs on other plant species in the study sites, although they probably moved to other plants when the aggregation of adults disappeared between July and August. Some adults of *R. insignis* were found on *Erythrina americana* Miller (Fabaceae) trees. Perhaps these trees were used as a temporary host, as a source of water and/or nutrients, or as a resting site, but not for reproduction.

Parasitoids.—Parasitoids were found attacking only *R. insignis* (Fig. 14). Two species of egg parasitoids were found, *Telenomus* sp. (Hymenoptera: Scelionidae), and an unidentified species. Parasitized eggs turn black; the number of parasitized eggs per mass was 75.8 $\pm$ 81.5 (i.e., 23%) (n = 49).

Nymphs were parasitized by two species of Tachinidae; *Trichopoda pennipes* F. and an unidentified species.

Predators.—We found *Euthyrhynchus floridanus* (L.) (Hemiptera: Pentatomidae: Asopinae) feeding on first- and second-instar nymphs of *R. insignis* when the mother was absent (Fig. 18).

Other predators included the spider *Phidippus bidentatus* F.P. Cambridge (Salticidae), which was found preying upon solitary nymphs of fourth and fifth instars of *R. insignis* (Fig. 19). Second and third instars were attacked by two other species of Salticidae when they were dispersing.

## Discussion

The information present here represents the first report about the biology and the descriptions of the immature stages of these two species. Although it is very difficult to differentiate between these species in the early stages, later instars can be distinguished mainly by size and color. The nymphs of *R. insignis* are larger and in general the nymphs of *V. violacea* have a more yellowish-orange coloration; fourth- and fifth-instar nymphs of *R. insignis* have a pronotum with the lateral, frontal and posterior margins whitish and the disc dark brown.

The nymphs of *R. insignis* and *V. violacea* can be separated from other species of Pentatomini mainly by their coloration. Following the key presented by Brailovsky et al. (1992) for the fifth-instar nymphs of Pentatomini present in Los Tuxtlas, Veracruz, they key to couplet 12B which includes species that have a unicolorous abdomen, with just the connexival and medial plates dark brown.

The fact that both species have very similar nymphs, that both have an aposematic coloration, and that both species exhibit maternal behavior could be evidence that indeed these two genera are related.

These two species differ in the plant structures they use as food resources. Even though they can be present on the same plant, *R. insignis* appears first during the reproductive season of its host plant, and feeds on all vegetative and reproductive structures; whereas *V. violacea* only uses the inmmature and ripe fruit later in the season, reflecting a slightly shifted life cycle.

Both species oviposited large egg masses, which are proportional to their body sizes, as previously reported for other pentatomids and scutellerids (Eberhard 1975, Cervantes 2002). Egg masses are usually arranged in a rhomboid shape giving the eggs in the center of the mass better protection against parasitoids (Eberhard 1975, Cervantes 2002).

Another difference in oviposition behavior of these two species is that females of *R. insignis* oviposite on the underside of the leaf, whereas *V. violacea* places them on the upperside. We did not observe any behavior, leaf characteristics or environmental facts that would explain this difference. *Ramosiana insignis*, as with many other pentatomids, adopts a similar strategy of oviposition, ovipositing on the underside of the leaves of their hosts; however, we are still examining the strategies for *V. violaceae*, which was found in low densities during this study, and will be consider for further studies.

In both species, maternal care is restrained to the egg mass and first-instar nymphs, and their behavior seems to be directed to deter parasitoids and predators. We did not observe any parasitoids attacking *V. violacea* eggs, suggesting that parasitoids were absent or they were not able to detect the egg masses.

If maternal care is viewed in terms of reproduction, this phenomenon is for many insects the best way to increase their fitness. And although it has very high costs for univoltine species, this is probably the only chance to increase their reproductive success.

Also, as with most pentatomids, first-instar nymphs do not feed. Soon after they moulted to the second instar they began to disperse. They were observed moving in an aggregated way perhaps in an attempt to avoid predation; isolated nymphs were often found to be attacked by spiders or other bugs.

If we consider parasitism, *R. insignis* laid eggs just before *S. schreberi* flowered, when parasitoids were present, probably attracted by some chemicals produced by the plant or the bugs. During this time, the environment is simple because there are not yet many floral visitors or predators. *Ramosiana insignis* usually laid around 330 eggs in a compact mass, and when it sat over the mass, it left exposed only a small number of eggs at the edges of the mass, so there were many eggs in the center of the mass that were not exposed to parasitoids. Nymphs developed slowly, especially during the second and third instar because food resources were not abundant.

In contrast, *V. violacea* oviposited slightly later, when flowering was at its peak and when the fruiting season had started. During this time, there were many more flower visitors and predators, but it seems that there were no parasitoids present, or they were not able to locate *V. violacea* eggs. The nymphs of this species have extremely large numbers of fruits to feed on, and they usually develop very fast from egg to the adult stage (approximately 28 days). Females usually deposited egg masses proportionally smaller than *R. insignis*.

Parasitized eggs turn black. The number of parasitized egg per mass for *R. insignis* was 75.8 $\pm$ 81.5 with a percentage of 23% (n $=$ 49). This behavior is similar to the one described for *Pachycoris klugii* (Scutelleridae) (Cervantes 2002), but more studies are needed to determine if the eggs of *V. violacea* can really escape from parasitoids.

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