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# Food Plants and Life Histories of Sawflies of the Family Argidae (Hymenoptera) in Costa Rica, with Descriptions of Two New Species

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*Abstract.*—Food plants and biological information are given for 12 species of the family Argidae in Costa Rica: *Atomacera raza* Smith on *Malvaviscus* sp. (Malvaceae); *Eriglenum crudum* Konow on *Machaerium acuminatum* (Fabaceae); *Sericoceros gibbus* (Klug) on *Coccoloba guanacastensis* (Polygonaceae); *Sericoceros mexicanus* (Kirby) on *Coccoloba venosa* and *C. uvifera* (Polygonaceae); *Sericoceros vumirus* Smith on *Lonchocarpus minimiflorus* (Fabaceae); ***Themos mayi* Smith, n. sp.**, on *Meliosma idiopoda* (Sabiaceae); *Ptilia versicolor* (Klug) and *Trochophora lobata* (Erichson) on *Rourea glabra* (Connaraceae); ***Didymia jonesi* Smith, n. sp.**, on *Connarus* sp. (Connaraceae); *Sphacophilus janzeni* Smith on *Hymenaea courbaril* (Fabaceae); *Sphacophilus edus* Smith on *Heteropterys laurifolia* (Malpighiaceae); and *Durgoa mattogrossensis* Malaise on *Bauhinia ungulata* (Fabaceae). The male of *Durgoa mattogrossensis* is described for the first time. All species were reared in the Area de Conservación Guanacaste, Guanacaste Province, Costa Rica.

Little is known of the larval food plants and habits of most Neotropical sawflies. During the course of a Lepidoptera caterpillar inventory, the second author reared and collected information on the larvae of a number of species of sawflies from the Area de Conservación Guanacaste (ACG), which lies primarily in Guanacaste Province in northwestern Costa Rica. Details of the rearing records may be found on the website http://janzen.sas.upenn.edu and in Janzen (2000, 2001) and Burns and Janzen (2001). These rearings and notes are significant additions to our knowledge of Neotropical sawflies. Food plants of some species were recorded by Smith (1992, 1995), but life history notes were not included and several additional species have been reared since, including two new species described herein. We comment on 12 tropical species of the family Argidae.

Argidae, Pergidae, and Tenthredinidae are the three dominant families of Symphyta in the Neotropics. The Neotropical argid fauna was treated by Smith (1992) who recorded 5 subfamilies, 32 genera, and 356 species. In Costa Rica, 5 subfamilies (including the addition of Dieloceriinae in this paper), 16 genera, and 40 species are known (Smith 1995). Argidae are recognized by the three-segmented antenna: scape, pedicel, and long, single-segmented flagellum. The flagellum is bifurcate in some males. At least 22 species in 13 genera of Symphyta have been reared in the ACG.

Two species of Argidae for which the food plants are known, *Scobina consobrina* (Norton) and *S. guatemalensis* (Dalla Torre), have been taken in Malaise traps in ACG but not reared. Both were reared previously from *Sida* sp. (Malvaceae), the former in Nicaragua and the latter in Veracruz, Mexico (Smith 1992).

Acronyms used are: INBio = Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica; USNM = National Museum of Natural History, Smithsonian Institution, Washington, DC, U.S.A. Voucher numbers associated with each reared adult are expressed as, for example, "99-SRNP-4547," and the voucher record may be obtained from the website at http://janzen.sas.upenn.edu.

## ATOMACERINAE

### *Atomacera* Say

Species of *Atomacera* are small, usually 5–6 mm in length, and are completely black or black with part of the thorax red. The male flagellum is simple, the tarsal claw has a single tooth and a large acute basal lobe, the forewing has an intercostal crossvein and the radial cell is open at its apex, and the hind wing lacks the anal cell. The genus occurs from southeastern Canada south to northern Argentina. Smith (1992) recorded 32 species from Mexico southwards. Nine species have been recorded from Central America and four of these from Costa Rica. The host for *A. pubicornis* (F.) from northern South America is recorded as *Ipomoea* sp. (Convolvulaceae) (Smith 1992).

### *Atomacera raza* Smith

*Atomacera raza* is black with the pronotum, tegula, and mesonotum except scutellum red. It was described from Mexico and Costa Rica (Smith 1992). The single specimen reared from ACG is closest to this species, though there are slight differences in the lancet structure. From this specimen, it is difficult to determine whether it is *A. raza* or a new species. It is referred to *A. raza* for the present.

*Distribution.*—Costa Rica; Mexico (Veracruz).

*Food plant and biology.*—A single female (99-SRNP-4547) was reared on *Malvaviscus* sp. DHJ14038 (Malvaceae) foliage from shrubs on the rainforest margin in Sector San Cristobal, eastern ACG. The strong silk cocoon is dirty white, a blocky cylinder in shape, and glued to leaf litter. Ten days elapsed between cocoon spinning and eclosion.

## ERIGLENINAE

### *Eriglenum* Konow

Species of this genus are moderate sized, about 8–10 mm in length. Each mandible is three-toothed, the maxillary palpus and labial palpus are 6- and 4-segmented, respectively, the tarsal claws are simple, and the wings are usually black with the radial cell of the forewing closed and the intercostal crossvein present, and the hind wing with the anal cell present.

The genus includes four species (Smith 1992) and occurs from Mexico south to Paraguay and northern Argentina. Two species are known in Costa Rica. The food plant for *E. humeratum* Konow, a South American species known from Venezuela and Brazil to Paraguay and northern Argentina, is *Machaerium* sp. (Fabaceae) (Smith 1992).

### *Eriglenum crudum* Konow
(Fig. 1)

This species is recognized by the uniformly black wings and black clypeus, scape, pedicel, tegula, and legs (see Smith 1992).

*Distribution.*—Brazil (Amazonas, D.F.); Costa Rica (Guanacaste); Honduras; Mexico (Chiapas).

*Food plant and biology.*—The larvae of *Eriglenum crudum* feed on newly expanding and young fully expanded leaf blades of *Machaerium acuminatum* Kunth (Fabaceae) (82-SRNP-738, 85-SRNP-404, 86-SRNP-465, 86-SRNP-465.1), a dry forest shrubby vine. While this plant is nearly evergreen, the larvae have been found feeding only during the first month of leaf life and occur at extremely low density. The food plant also occurs at low density. A group of 6–10 eggs are inserted into the margin

of the blade of the leaf, and the larvae feed side-by-side. Larvae of all instars are greenish and yellowish gray with black spots of various sizes (Fig. 1; see 85-SRNP-404 at http://janzen.sas.upenn.edu). From a distance, the feeding larva, hanging loosely and conspicuously on the edge of the leaf blade, resembles damaged leaf tissue. Larval development takes about 8 days. Six days elapse from cessation of feeding and cocoon spinning to eclosion of the adult.

### *Sericoceros* Konow

*Sericoceros* are medium to large (mostly 8–11 mm in length), plump sawflies, with a very small head, smaller in width than the thorax. Smith (1992) recorded 20 species from the West Indies and Mexico south to northern Argentina. Four species occur in Central America, and three of these in Costa Rica. Hosts for other species are *Coccoloba* spp. (Polygonaceae) for *S. albicollis* (Klug) from northern South America and *S. krugii* (Cresson) from the West Indies (see Martorell 1941 for biology), and *Triplaris caracasana* Cham. (Polygonaceae) for *S. villetanae* Smith from Paraguay (Smith and Benítez Díaz 2001). All three Costa Rican species have been reared in the ACG.

### *Sericoceros gibbus* (Klug)
(Figs. 2, 3)

This species has the head, abdomen, and hind legs black; thorax orange; fore- and midcoxae and forefemur orange; palpi orange; wings black but slightly more hyaline at apices; and the hind wing with the anal cell present.

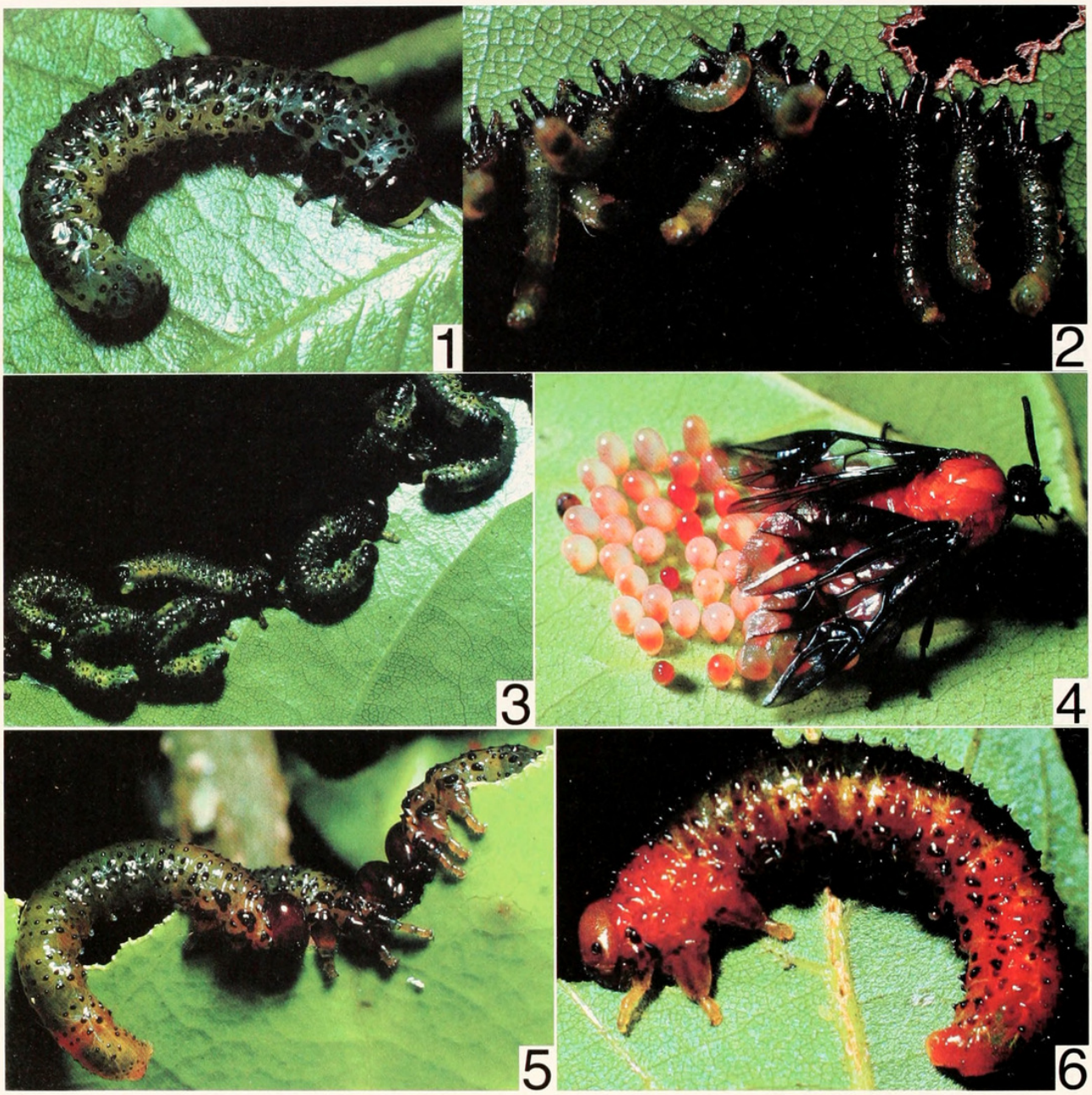
*Distribution.*—Bolivia, Brazil (Amapá, Amazonas, Ceará, Matto Grosso, Pará); Colombia, Costa Rica (Guanacaste), Guatemala, Guyana, Honduras, Mexico (Chiapas, Veracruz), Panama, Peru, Surinam, Venezuela (Smith 1992).

*Food plant and biology.*—This species has been recorded from *Coccoloba manzinellensis* Beurl. and *C. caracasana* Meisn. (Polygonaceae) in Panama (Kimsey and Smith 1985). A specimen from Panama is associated with a leaf with 20 oval eggs attached perpendicular to the surface (Smith 1992).

In the ACG dry forest, *Sericoceros gibbus* larvae are found occasionally feeding on new to very old mature leaves of *Coccoloba guanacastensis* W.C. Burger (Polygonaceae) during the rainy season. The food plant is a low density large tree, and all *S. gibbus* have been encountered on saplings less than 2 m tall. A single wasp lays groups of 20–30 orange to red eggs spaced regularly on the upper side of the leaf in a patch about 1 cm in diameter. She then remains with the eggs, as does the female of *Sericoceros mexicanus* (similar to Fig. 4; see below), until the larvae hatch. The larvae are gray green with small black platelike dots and feed side-by-side on the leaf margin (Figs. 2, 3; see 84-SRNP-1472 and 83-SRNP-1247 at http://janzen.sas.upenn.edu) through all instars. The tough silk cocoon is a brown, ovoid cylinder with rounded ends glued to leaf litter. About eight days elapse from cessation of feeding and cocoon spinning until eclosion of the adult, with the males eclosing one day before the females. While the food plant is evergreen in ACG dry forest, there is no hint of generations of this wasp during the dry season. A larva that spun its cocoon in the first few days of the dry season became dormant until two weeks after the rainy season began six months later (see 84-SRNP-2103 at http://janzen.sas.upenn.edu). Considered along with the observation that rainy season *S. gibbus* eclose within two weeks of spinning, this species probably has multiple generations during the rainy season and passes the dry season as a dormant prepupa in its cocoon.

### *Serococeros mexicanus* (Kirby)
(Figs. 4, 5)

This species has the head black; thorax and abdomen orange; legs with coxae, trochanters, and femora orange with the tib-



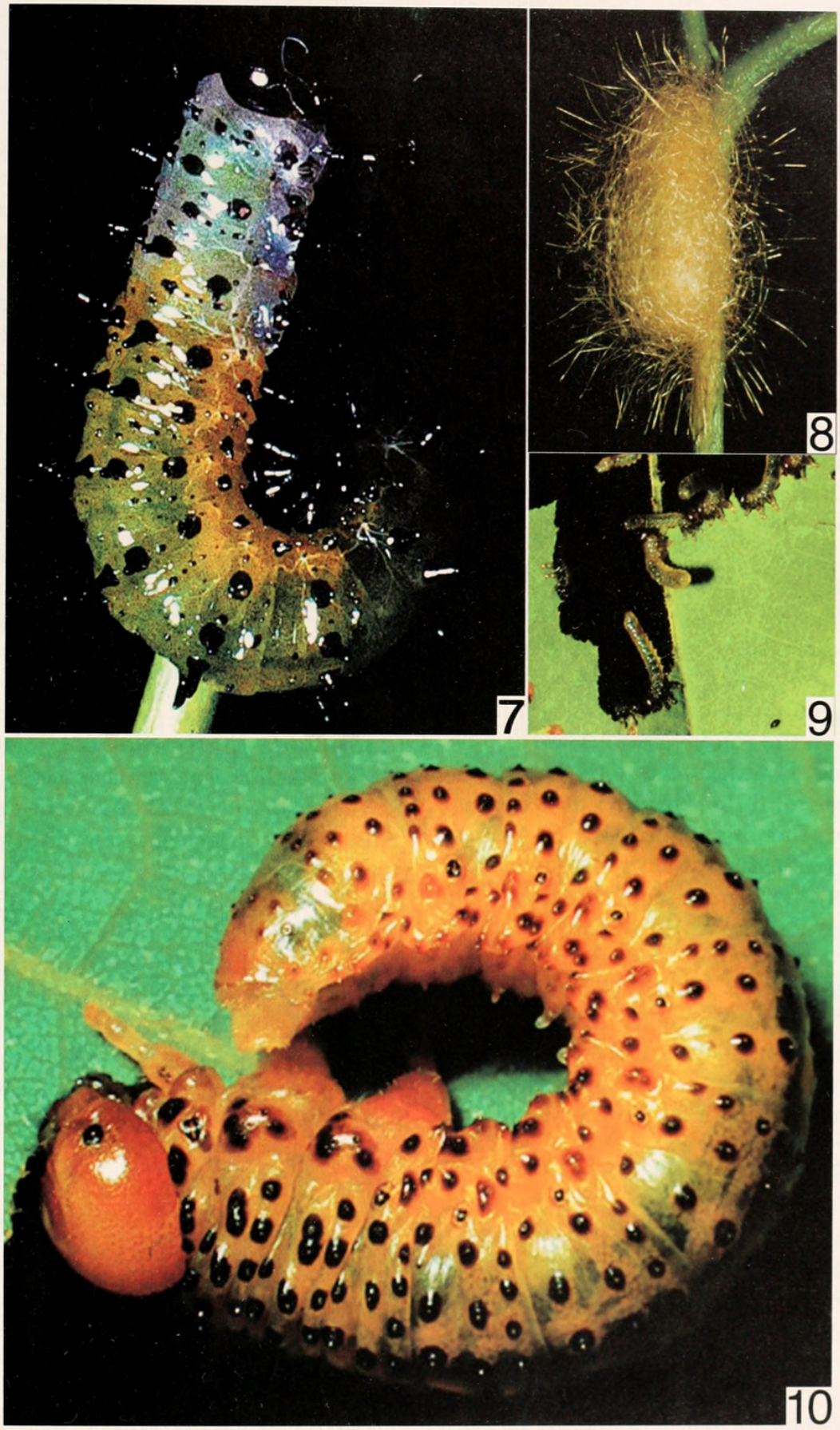

Figs. 1–6. Argidae. 1, Late instar larva of *Eriglenum crudum*. 2, Early instar larvae of *Sericoceros gibbus* on leaf edge; 3, Late instar larva of *S. gibbus*. 4, Adult female of *Sericoceros mexicanus* guarding eggs. 5, Larvae of *S. mexicanus*. 6, Larva of *S. vumirus*.

iae and tarsi black; wings hyaline with a black band below the stigma; and the hind wing without an anal cell. The antennae are short, with an antennal length to head width ratio of 4:3.

*Distribution.*—Costa Rica, El Salvador, Guatemala, Honduras, Mexico (Colima, Oaxaca, Veracruz), Nicaragua, Panama.

*Food plants and biology.*—This species has been reared from *Coccoloba uvifera* (L.) L., and *Coccoloba* sp. (Polygonaceae). A leaf with about 20 eggs on the surface is associated with a specimen from Veracruz, Mexico (Smith 1992).

In the ACG dry forest, the biology of *Sericoceros mexicanus* is similar to that described above for *Sericoceros gibbus*. The differences are that *S. mexicanus* eggs may be in patches of as many as 50–70 (each patch laid by one female) and turn from red to pink as they mature (see 84-SRNP-175B at http://janzen.sas.upenn.edu). The




Figs. 7–10. Argidae. 7, Larva of *Ptilia versicolor*. 8, Cocoon of *P. versicolor*. 9, Early instar larvae of *Durgoa mattogrossensis*. 10, Late instar larva of *D. mattogrossensis*.

egg patches are primarily on the undersides of the horizontally oriented leaves of *Coccoloba venosa* L. (Polygonaceae), while *S. gibbus* eggs are found on both sides of the largely pendant leaves of *C. guanacastensis*. The eggs of *S. mexicanus* cause the leaf to harden and discolor, and each egg leaves a darkened patch of tissue where it was attached. The female stands guard over the eggs until they hatch (Fig. 4). As groups of larvae consume the leaf (Fig. 5; see 84-SRNP-175C at http://janzen.sas.upenn.edu), they avoid the place where the eggs are or were attached. In addition to feeding on *Coccoloba venosa* (which occupies drier parts of the ACG dry forest than does the *Coccoloba guanacastensis* fed on by *S. gibbus*), *S. mexicanus* also has been found feeding on the coastal *Coccoloba uvifera* (89-SRNP-343 at http://janzen.sas.upenn.edu). The tough brown silk cocoon of *S. mexicanus* is an ovoid cylinder glued to litter, and the time from spinning to eclosion in the rainy season is 12–13 days.

*Sericoceros mexicanus* is parasitized by a medium-small tachinid, *Vibrissina* sp. (Diptera: Tachinidae), as are *S. vumirus* and *Durgoa mattogrossensis* (see below) (D. M. Wood, personal communication). The fly makes its puparium inside the sawfly cocoon, having emerged from the sawfly prepupa. There is one fly per sawfly, and the body mass of the fly appears to be about the same as that of the sawfly. Flies eclose from rainy season generations at about the same date as do the sawflies.

### *Sericoceros vumirus* Smith
(Fig. 6)

This species has the head black; thorax and abdomen orange; mid- and hind tibiae with basal third white, apical two-thirds black; tarsi black; wings uniformly black; and the hind wing with the anal cell present.

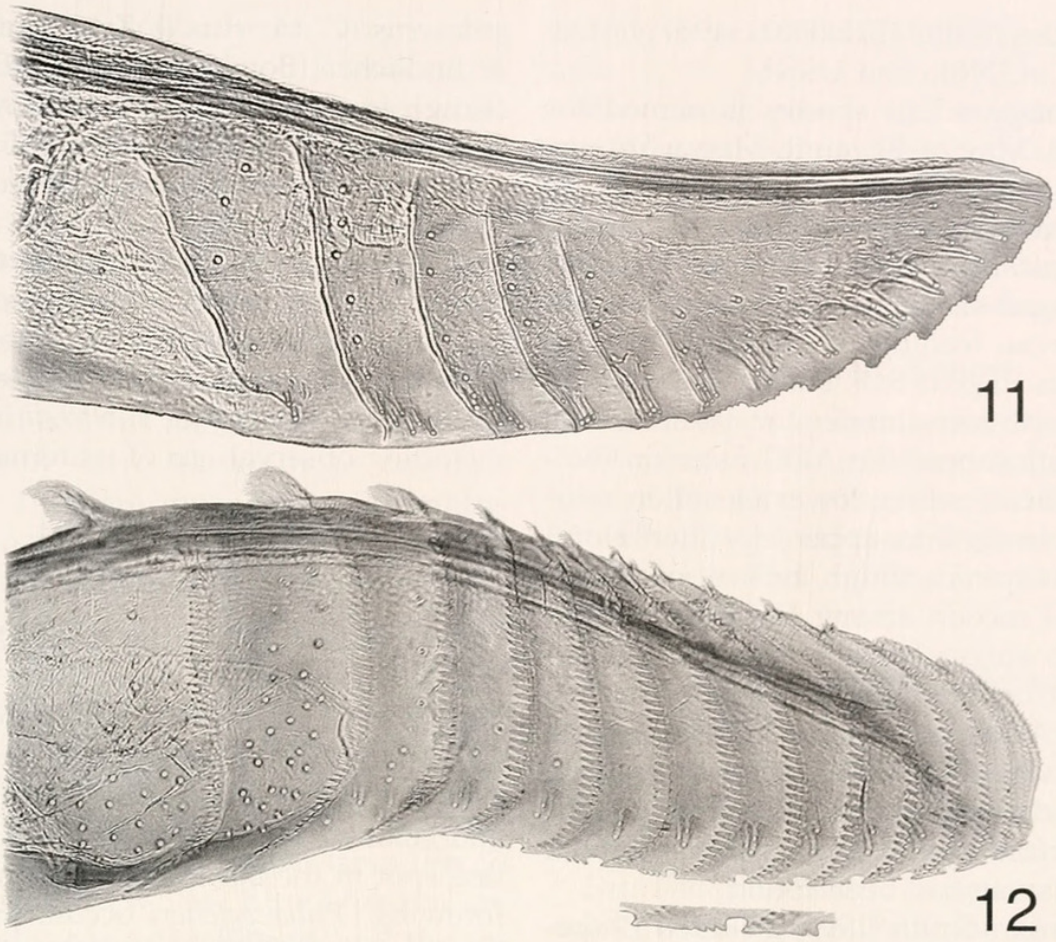
*Distribution.*—Costa Rica (Guanacaste); El Salvador, Mexico (Chiapas), Venezuela (Smith 1992).

*Food plants and biology.*—*Sericoceros vumirus* larvae occasionally are found feeding on new to very old mature leaves of *Lonchocarpus minimiflorus* Donn. Sm. (Fabaceae) in the ACG dry forest and on *Lonchocarpus guatemalensis* Benth. (Fabaceae) in the interface between ACG dry forest and rainforest, both in the rainy season. At present, the food plants are common, medium-sized trees in early to middle stages of secondary succession but will probably be rare once the ACG dry forest has returned to old-growth status after several centuries. *Lonchocarpus minimiflorus* is deciduous during the dry season, while *L. guatemalensis* is evergreen and grows in more moist habitats on the edge of the ACG dry forest. *Sericoceros vumirus* larvae are encountered from 2 to 4 m above ground feeding in small groups of 5–10 larvae in the early instars. Each group is presumably the result of a clutch of eggs from one female. Last instars are pinkish red on the thorax, posterior, and venter (dorsally dark green to pink) with small black platelike dots (Fig. 6; see 93-SRNP-7531 at http://janzen.sas.upenn.edu). They feed non-gregariously in the last instar. The tough silk cocoon is a brown, ovoid cylinder with rounded ends glued to leaf litter. The period from cocoon spinning until eclosion is 9–10 days, with no suggestion of prepupal or pupal dormancy during the rainy season. *Sericoceros vumirus* has at least two generations during the rainy season and probably passes the dry season as a dormant prepupa in its cocoon.

The parasitoid tachinid, *Vibrissina* sp., appears to have the same biology in *S. vumirus* as described above for *S. mexicanus*. This tachinid has been reared from *S. vumirus* feeding on both food plants.

## DIELOCERINAE

This is the first record of a member of the Dielocerinae in Costa Rica and represents the northernmost record for the subfamily.




Figs. 11–12. Female lancets. 11, *Themos mayi*. 12, *Didymia jonesi*.

### *Themos mayi* Smith, new species
(Fig. 11)

*Female.*—Length, 11.0–12.0 mm. Yellow, with apex of mandible, antenna, apex of sheath, outer surface of apical two-thirds to three-quarters and entire apex of tibiae, and all tarsi black; inner surface of apical tarsal segments yellow. Forewing black at base to about base of cell M and at apex from about two-thirds length of stigma, with broad yellow band at center; basal two-thirds of stigma and veins in yellow portion yellow; apical third of stigma and veins in dark portions black. Hind wing with basal third black and remainder hyaline, black extending a little more than half length of costa. Antennal length slightly longer than head width, with a ratio of 1.0:0.9. Lower interocular distance greater than eye length, with a ratio of 1.0: 0.6. Distances from eye to hind ocellus, between hind ocelli, and from hind ocellus to hind margin of head as 9:5:9. Tarsal claws bifid, with indistinct rounded basal lobe. Length of hind basitarsus subequal to length of remaining tarsal segments combined. Sheath short, broad; in lateral view straight at apex, in dorsal view uniformly broad with apex flat and blunt. Lancet as in Fig. 11.

*Male.*—Unknown.

*Holotype.*—♀, "Voucher: D. H. Janzen, G. W. Hallwachs, caterpillar (Lepidoptera) database, Area de Conservation Guanacaste, Costa Rica. http://janzen.sas.upenn.edu, 00-SRNP-9942" which has the detailed locality of Sendero Derrumbe, Estacion Cacao, Sector Cacao, ACG, 1100 m, 09/18/2000 (deposited at INBio).

*Paratypes.*—Same data as holotype except 00-SRNP-9944 (1 ♀); Estac. Cacao, 1000–1400 m, SW side Volcan Cacao, Guanac. Pr. Costa Rica, Mar. 1988 GNP Biod. Sur., 32330, 875700, bar code label:

Costa Rica INBIO CRI000022349 (1 ♀). Deposited at INBio and USNM.

*Etymology.*—This species is named for Philip F. May of Belmont, Massachusetts, in recognition of his magnificent support of the ACG since its inception in 1986.

*Food plant and biology.*—*Themos mayi* has been found six times as penultimate solitary larvae feeding on mature leaves of *Meliosma idiopoda* S. F. Blake (Sabiaceae) in old-growth forest understory at about 100 m elevation near the ACG Estación Biológica Cacao, where lower elevation rainforest blends into upper elevation cloud forest. It spins a tough, brown, ovoid cylindrical cocoon among leaf litter, and in the two successful rearings the time required from spinning to eclosion was 5–6 weeks. A female of what appeared to be *T. mayi* was observed tenaciously standing over a clutch of eggs fixed firmly to the leaf surface in the same general habitat where larvae had been found.

*Remarks.*—Smith (1992) included 12 species in *Themos,* all from South America from Venezuela to Brazil. This is the first species known from Central America and is the northernmost record for the genus. *Themos mayi* cannot be keyed through the first couplet of Smith's (1992) key. That couplet divides species into those with entirely hyaline wings and those with the wings black to purplish with a hyaline apex beyond the stigma. *Themos mayi* is the only known species with the forewing black at the base and apex with a broad yellow band at the center. That wing color pattern, coupled with the entirely yellow head, thorax, and abdomen, will separate this species from all others. The lancet is similar to those of other species, with the low, rounded serrulae most resembling those of *T. surinamensis* (Klug), *T. ochreus* Smith, and *T. concinnus* Mocsáry. However, all those species have very dark wings with the hyaline apex.

Recorded hosts for other species of *Themos* are *Luehea* sp. (Tiliaceae) for *T. malaisei* Smith from Brazil and Bolivia; *Eriotheca pubescens* (C. Martius & Zuccarini) Schott & Endlicher (Bombacaceae) for *T. olfersii* (Klug) from Brazil; and *Ceiba pentandra* (L.) Gaertn. (Bombacaceae) for *T. surinamensis* from Brazil, Ecuador, Surinam, and Venezuela (Smith 1992).

Maternal care is known for several species of *Themos,* which is consistent with the fact that all Dielocerinae exhibit this behavior. Dias (1975) gave a detailed account of the biology of *T. olfersii* in Brazil, including observations of maternal care.

## STERICTIPHORINAE

### *Ptilia* Lepeletier

The genus *Ptilia* occurs from Mexico to Brazil. Seven species are known. Two are known in Central America and both occur in Costa Rica. The other Costa Rican species, *P. peletieri* (Gray), is similar in size and color to *P. versicolor* but lacks a hyaline spot in the basal black portion of the forewing. *Ptilia peletieri* occurs in rainforests in southern Costa Rica, Panama, and northern South America, and its larval food plant is *Cnestidium rufescens* Planch. (Connaraceae) (Kimsey and Smith 1985).

### *Ptilia versicolor* (Klug)

(Figs. 7, 8)

*Ptilia versicolor* has the head black; thorax orange with mesonotum, except scutellum, black; abdomen orange with apical 2–3 segments black; forewing black at the base and apex, yellow at center and the black basal part with a central hyaline spot. The antenna is 1.75 times as long as the head width, and the sheath is pointed at its apex in lateral view. Many specimens of *P. versicolor* have been reared, and this species also is collected frequently in Malaise traps in the dry forest of the ACG.

*Distribution.*—Belize, Costa Rica, Guatemala, Honduras, Mexico (Chiapas, Guerrero, Jalisco, Nayarit, Oaxaca, Quintana Roo, San Luis Potosí, Tamaulipas, Veracruz, Yucatan) (Smith 1992).

*Food plant and biology.*—The larvae of *P.*

*versicolor* feed solitarily on very young shoot tips and leaves of *Rourea glabra* Kunth (Connaraceae), an evergreen scanden shrub, in the ACG dry forest. Larvae are encountered during both the rainy and dry seasons. Even when starving, the larvae will not eat mature leaves of the food plant. Compared to other argid larvae, the larvae of *P. versicolor* are very agile and quickly walk over the surface of the plant to new shoot tips and very young leaves when they have eaten those on their branch. They are much more caterpillar-like than are larvae of other argids. The larvae are encountered most commonly during the month before and after the rains begin because that is when *R. glabra* is most actively producing new leaves. Although larvae feed solitarily, there commonly are 2–10 larvae on a single branch, which probably started from a single clutch of eggs. The last instar larva (Fig. 7; see 84-SRNP-117 at http://janzen.sas.upenn.edu) has a black head, and the anterior half of the body is very light gray while the posterior half is yellow orange; the entire larva is dotted with black platelets, each with a short spike in the center. *Ptilia versicolor* shares its food plant with *Trochophora lobata* (see below).

The ovoid, cylindrical cocoon (Fig. 8) is spun on a newly defoliated branchlet of the food plant, rather than in the litter as is commonplace with ACG Symphyta. It is very conspicuous on the plant, with its light translucent golden beige to gray color with numerous long thin black spikes. At first glance, its color, form, and apparent translucence give the impression of a ctenuchid moth cocoon from which the adult has eclosed, presumably a color pattern selected for by its value in deterring predation by birds. About nine days pass between cocoon spinning and eclosion, and there is no suggestion of dormancy during wet or dry seasons. This is the only species of sawfly in the ACG dry forest known to produce continuous generations as long as new food plant foliage is available.

Even though the larvae are inconspicuous, they can be found easily by searching for the pink-red new foliage of the food plant. They are present (at varying numbers) all year. No parasitoids have been reared from 66 individual rearings.

### *Trochophora* Konow

The distinctive feature for species of *Trochophora* is the greatly enlarged jugal lobe of the hind wing (Smith 1992, figs. 663, 664). Two species are known, *T. lobata* from Costa Rica to Brazil and *T. opla* Smith from D. F., Brazil.

### *Trochophora lobata* (Erichson)

Any small argid encountered (ca. 6.0 mm long) in Costa Rica with a huge jugal lobe to the hind wing is undoubtedly *T. lobata* or an undescribed species.

*Distribution.*—Brazil (Amazonas, Maranhão, Mato Grosso, Pará, Roraima); Costa Rica (Guanacaste), Guyana, Panama, Venezuela (Smith 1992).

*Food plant and biology.*—The larva of *Trochophora lobata,* like that of *P. versicolor* described above, feeds only on the reddish-pink, unexpanded leaves and shoot tips of *Rourea glabra* (Connaraceae) in the ACG dry forest. The larva is much smaller than that of *P. versicolor* and more pinkish yellow (but also has fine black dots). Its color matches the new leaves quite well; hence, it is not nearly as conspicuous as the larva of *P. versicolor.* From 5–10 *T. lobata* larvae may be found feeding on a single expanding branch end, and there can be several hundred on a single food plant, but the larvae do not feed side-by-side as is the case with, for example, *Sericoceros. Trochophora lobata,* like *P. versicolor,* is capable of consuming the entire new leaf crop on a *R. glabra* shrub (which, however, remains evergreen since the new leaves are produced in small spurts to add to the standing mature leaf crop).

The tough, hard brown cocoon is nearly

spherical and spun between leaves in the litter. The time from spinning to eclosion is 10–25 days, but in one case a prepupa or pupa remained dormant for five months of the rainy season (before being killed by accident). *Trochophora lobata* larvae have been found only in late April and early May in the ACG dry forest, at the time of maximum new leaf production by *R. glabra,* and 2–4 weeks before onset of the rainy season. However, because there is little sign of a prepupal or pupal dormancy, it is possible that there are successive generations during the rainy season on the low and continuous production of new leaves by their food plant. This possibility, however, is reduced by the seemingly thorough defoliation of these low density new leaves by *P. versicolor.*

While more than 50 individual *T. lobata* have been reared in the ACG dry forest, only one batch of larvae produced parasitoids. From this batch of ten last instar larvae collected from a single *R. glabra* plant, three sawflies eclosed 12 days after spinning, and, five months later, several ichneumonids (*Physotarsus adriani* Gauld, see Gauld 1997) eclosed. The wasp had oviposited in the sawfly larva, and the wasp larva emerged from the prepupa to spin its cocoon. The overwhelming majority of this wasp subfamily—Ctenopelmatinae—are koinobiont endoparasitoids of sawfly larvae (I. D. Gauld, personal communication).

### *Didymia jonesi* Smith, new species
(Figs. 12–14)

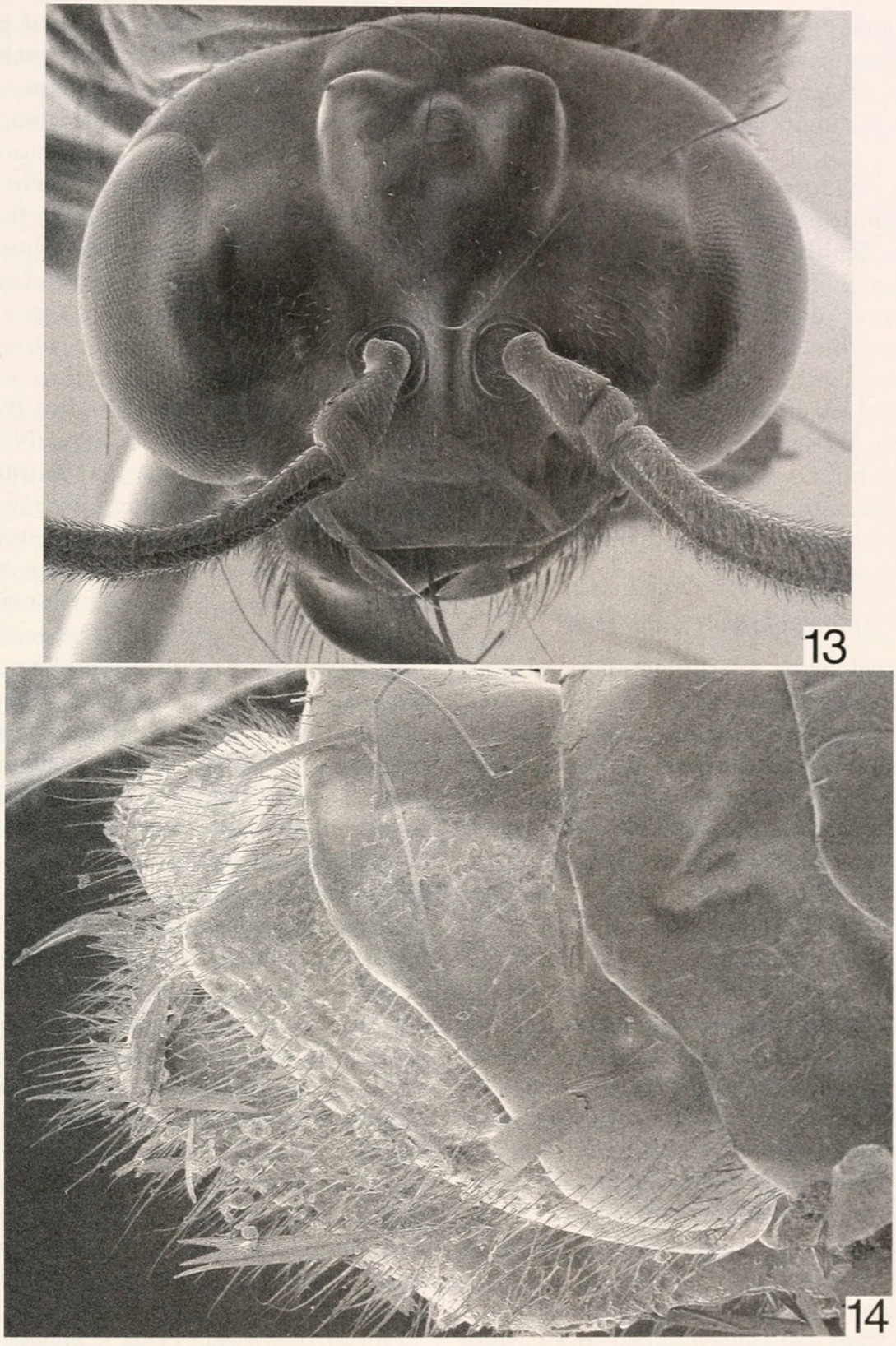
*Female.*—Length, 6.0 mm. Antenna, head, thorax, and legs black; apex of mandible reddish brown; outer surface of apex of forefemur, foretibia, and foretarsus white. Abdomen orange, about apical half of sheath black. Forewing with intercostal area, base of wing basal to base of cell M, and band below stigma black; area between base and band and apical to band hyaline; band below stigma nearly as broad as stigma at anterior but narrowing posteriorly; extreme apex of wing dusky, but not black. Hind wing hyaline with extreme base, intercostal area, and extreme apex dusky. Head and body shining and impunctate. Antennal length slightly longer than head width, ratio 1.00:0.95. Fourth segment of maxillary palpus short, broadened, about half length of fifth segment, fifth and sixth segment slender and about equal in length. Clypeus very shallowly, broadly emarginated, subtruncate. Eyes large and converging below, lower interocular distance subequal to eye length (Fig. 13). Distances between hind ocellus and eye, between hind ocelli, and between hind ocellus and posterior margin of head as 4.0:4.0:3.5. Forewing with radial cell closed, with apical accessory vein; apex of costa about as broad as intercostal area; first cubital crossvein (Rs) absent, thus with three cubital cells. Hind wing with cell R open at apex; anal cell present, with petiole length subequal to length of cell. Hind basitarsus subequal in length to length of remaining tarsal segments combined. Sheath uniformly slender in dorsal view, without laterally projecting scopae, rounded in lateral view (Fig. 14). Lancet as in Fig. 12, with low, flat serrulae and distinct annular spines.

*Male.*—Unknown.

*Holotype.*—♀, "Voucher: D. H. Janzen & W. Hallwachs, caterpillar (Lepidoptera) database, Area de Conservacion Guanacaste, Costa Rica. http://janzen.sas.upenn.edu, 00-SRNP-9026" which has the detailed locality of Sendero Toma Agua, Estacion Cacao, Sector Cacao, ACG, 1100 m, 02/29/2000 (deposited at INBio).

*Paratypes.*—Same data as for holotype except 00-SRNP-9027 (1 ♀); Est. Pitilla, 700 m, 9 km S Sta. Cecilia, P. N. Guanacaste, Prov. Guanacaste, Costa Rica, K. Taylor, 31 mar–29 abr 1992, L-N 330200, 380200, bar code label: Costa Rica, INBIOCRI000523814 (1 ♀). Deposited at INBio and USNM.

*Etymology.*—This species is named in honor of Randy Jones in recognition of his




Figs. 13–14. *Didymia jonesi*. 13, Head, front view. 14, Apex of female abdomen, sheath at left.

massive support of INBio and the ACG since their inception in the late 1980's.

*Food plant and biology.*—This sawfly has been reared from larvae feeding on *Connarus* sp. (Connaraceae).

*Remarks.*—*Didymia* contains about 20 species, mostly from Brazil and Peru; two species are known from Panama. *Didymia unifasciata* Smith from Panama has been reared from *Rourea glabra* (Kimsey and

Smith 1985). Smith (1992) did not record this genus from Costa Rica, but two other species, *Didymia unifasciata* Smith and *D. nasuta* (Cameron), have been collected since.

With the orange abdomen and black thorax and legs, this new species runs to *D. teusa* Smith from D. F., Brazil, in couplet 12 of Smith's (1992) key. However, *D. teusa* has only abdominal segments 2–4 orange, and the female lancet is entirely different (see Smith 1992, fig. 364). The lancet and wing maculation of the new species resemble those of *D. nasuta* (Smith 1992, fig. 360), but *D. jonesi* can be distinguished by the black thorax, orange abdomen, and lancet, especially by the distinctly differentiated serrulae.

### *Sphacophilus* Provancher

*Sphacophilus* is a large genus of 41 species, concentrated from southwestern United States to Central America, with a few species extending south to northern Argentina. About nine species occur in Central America, with five of these known from Costa Rica.

### *Sphacophilus janzeni* Smith

*Sphacophilus janzeni* is small, about 5.5 mm long, black with red on the thorax except for the black mesopleuron; hyaline wings with the area below stigma black; sheath broad, with scopae; and lancet with annular hairs, serrulae with subbasal teeth, and dorsal and ventral halves different. This species was described from numerous specimens from Sector Santa Rosa of ACG, from rearing and Malaise trap collections (Smith 1992).

*Distribution.*—Costa Rica (Guanacaste).

*Food plant and biology.*—The small green larvae of *S. janzeni* commonly are encountered eating very new and still expanding leaves on small saplings (20–200 cm tall) of *Hymenaea courbaril* L. (Fabaceae), an occasional large evergreen tree once common in the ACG dry forest. The larvae fit securely into the inner margin of the bay being eaten out of the margin of the leaf (see 83-SRNP-970 in http://janzen.sas.upenn.edu). There may be as many as four larvae on a single leaflet (the food plant has two leaflets per leaf), but more commonly there are one or two. There can be 1–20 larvae scattered among the new leaves within the crown of a single sapling. The larvae eat only new and expanding leaves and, even if starving, will not feed on leaves more than about a month old. When a moth caterpillar, such as *Schausiella santarosensis* Lemaire (Saturniidae) or *Moresa valkeri* Schaus (Notodontidae), is feeding in the same foliage, it avoids the leaflets on which the sawfly larvae are feeding, but if starving will consume these leaves also. Larvae are encountered most easily when small saplings of *H. courbaril* are producing their new leaves in the month following the beginning of the rainy season, but larvae also are found on new leaves during the last two months of the rainy season (adult trees produce new leaf crops in the first month of the dry season, while small saplings have a flush of new leaves at the beginning of the rainy season and continue to produce some new leaves throughout the rainy season). No larvae have been found on new *H. courbaril* leaves in the dry season, even though new leaves are commonplace on saplings.

The tough brown ovoid cylindrical cocoons are glued to leaf fragments in the litter. There are 7–15 days from cocoon spinning to eclosion. There is no sign of dormancy even by larvae that spun cocoons late in the rainy season. Reproductively inactive adults are possibly the stage that passes the dry season.

Out of 26 efforts to rear *S. janzeni* larvae, three individuals were parasitized by *Boethus forresti* (Ichneumonidae, Tryphoninae, Tryphonini). The wasps eclosed 15–20 days after the *S. janzeni* cocoons were spun. The wasp larva spins its cocoon inside the *S. janzeni* cocoon. Tryphonini are koinobiont parasitoids of sawfly larvae;

the egg is attached externally, and the larva feeds externally on the cocooned prepupal sawfly larva (I. D. Gauld, personal communication).

### *Sphacophilus edus* Smith

This species is similar to *S. janzeni*, but the mesepimeron and upper portion of the mesepisternum are red, the mesoscutellum is black, and the lower interocular distance equals the eye length. This species was described from specimens from Canal Zone, Panama (Smith 1992). The male is unknown.

*Distribution.*—Costa Rica; Panama.

*Food plant and biology.*—The last instars of *Sphacophilus edus* are yellowish with black dots on the thorax and abdomen and with brown heads, and feed side-by-side on relatively new foliage of *Heteropterys laurifolia* (L.) A. Juss (Malpighiaceae). *Heteropterys laurifolia* is an occasional evergreen vine on the banks of seasonal watercourses in ACG dry forest. Clutches of *S. edus* have been found only twice (two weeks before the beginning of the rainy season) despite intense searching of many individuals of the food plant during a decade of intense inventory (e.g., 00-SRNP-7510, 00-SRNP-7526, 00-SRNP-7521, 00-SNRP-7538 in http://janzen.sas.upenn.edu). The tough, brown, silk, nearly spheroidal cocoons are spun among litter, and it takes about 9 days from spinning to eclosion (n = 8). However, about 40 prepupae remained inactive in their cocoons and eventually died due to disease. In nature, it is possible that they remain dormant for a year until the food plant makes its next (annual) flush of new foliage. However, in captivity the pupae did not receive appropriate seasonal cues for further development.

A few individuals in both clusters of *S. edus* were parasitized by an undescribed species of *Proterops* (Braconidae, Ichneutinae). This wasp subfamily specializes in parasitizing Symphyta larvae (Sharkey and Wharton 1994), and this is the first Neotropical rearing record for *Proterops* (M. Sharkey, personal communication). In one clutch of hosts, the wasps required 15–20 days to eclose (n = 9), and in the other 61 days (n = 3). The wasp larva emerges from the prepupa of *S. edus* and spins its own cocoon inside that of *S. edus*.

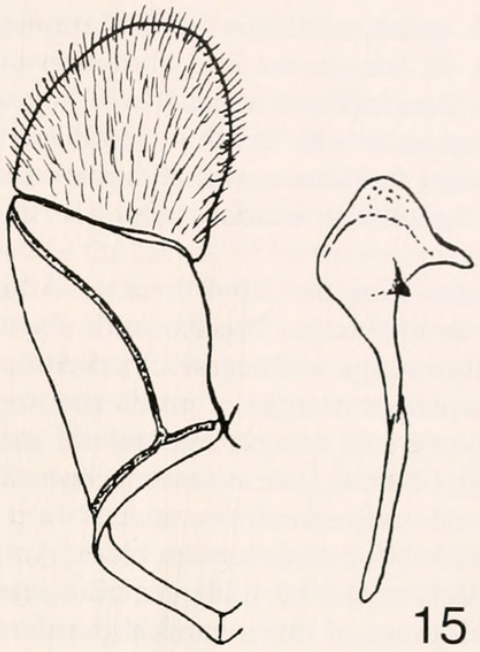



Fig. 15. Male genitalia of *Durgoa mattogrossensis*, ventral view of harpe and parapenis at left, lateral view of penis valve at right.

### *Durgoa* Malaise

*Durgoa* includes four species in South America. Three are known only from Brazil. Costa Rica is the northernmost record for the genus.

### *Durgoa mattogrossensis* Malaise
(Figs. 9, 10, 15)

The female of *Durgoa mattogrossensis* has the antenna and head black; thorax yellow; abdomen yellow with the apical tergum and sheath black; foreleg orange with the tibia and tarsus darker than the femur; and the mid- and hind coxae, trochanters, and femora orange with the tibiae and tarsi black; wings lightly, uniformly infuscated, slightly paler toward apex; veins and stigma black. The following is the first description of a male for the genus. There is

much more variation in the amount of black on the thorax and abdomen in the male than in the female. It will key to *D. mattogrossensis* in Smith's (1992) key, except that the thorax and abdomen are not entirely orange as described for the female.

*Male.*—Length, 8.5–9.0 mm. Antenna and head black. Thorax and abdomen mostly orange with cervical sclerites; narrow anterior margin of pronotum, tegula, spot on inner margin and lateral margin of each lateral lobe of mesonotum, large spot on mesoscutellum; metanotum and most of abdominal dorsum black. Amount of black variable, with cervical sclerites and dorsum of thorax and abdomen with smaller amounts of black or almost entirely orange. Wings uniformly, very lightly infuscated, slightly more hyaline at apex; veins and stigma black. Antennal length twice that of head width. Genitalia as in Fig. 15; penis valve with narrow dorsal lobe and with sclerotized laterally projecting spine.

*Distribution.*—Brazil (Bahia, Mato Grosso, Minas Gerais); Costa Rica; Peru; Venezuela (Smith 1992).

*Food plant and biology.*—A specimen from Bahia is labeled "on leaves of Leguminosae" (Smith 1992).

During its single annual generation, *Durgoa mattogrossensis* is the most conspicuous and easily located of all of the sawfly larvae of the ACG dry forest. It would be an ideal candidate for detailed ecological studies of a common and highly gregarious tropical dry forest sawfly. The first instar (Fig. 9) is dull gray green and gradually becomes more yellow and ostentatious as it matures through subsequent instars. The last instar is yellow to dull orange with small brown spots and a yellow-orange head with a brown "false eye" spot (Fig. 10; see 99-SRNP-10356 at http://janzen.sas.upenn.edu). Of the more than 100 species of Fabaceae in the ACG dry forest, *Bauhinia ungulata* L. (Fabaceae) is the only species used by the larvae of *D. mattogrossensis*. The plant is a very common shrub or small tree in dry forest secondary succession (though it might have been a much more scarce plant when confined to naturally-occurring disturbance sites). Adults eclose from underground cocoons in the first week of June, approximately three weeks after the beginning of the rainy season. Eggs are inserted in the margins of full-sized mature leaves at that time, and the larvae feed gregariously, side-by-side throughout development, eating leaves of all ages. However, if individual larvae are isolated in nature or the laboratory, they continue feeding and developing normally. If undisturbed, the larvae feed on a leaf until it is completely consumed (except for the thicker veins) and then walk to the next leaf and repeat the feeding process. Last instars are very sensitive to disturbance and readily drop off the foliage to the litter, where they burrow in to pupate below the litter in the top 1–5 cm of loose soil. The pupation chamber is ovoid, about 12 mm long, and lined with a dense layer of strong silk (to the outside of which is glued a 1–2 mm thick layer of dirt). The cocoons may be collected in massive numbers by digging through the upper soil immediately beneath large defoliated *B. ungulata*.

By late June there are millions of larvae defoliating their common food plant in central Sector Santa Rosa in ACG. A single 2 m tall *B. ungulata* can have as many as 300 *D. mattogrossensis* larvae feeding on it at one time. The intensity and thoroughness of defoliation is very heterogeneous within and between years. It is commonplace for one patch of *B. ungulata* to have no *D. mattogrossensis* larvae and another a few hundred meters away to be almost totally defoliated. Likewise, within a patch some plants are untouched, while others are fully defoliated. In some years, larvae occur in very low density (e.g., 1997, 2000), and in other years they are extremely abundant (e.g., 1999, 2001). By early

July, many of the larvae have dropped to the ground to spin their cocoons, but since there is a long period of egg laying well into mid-late June, and since some larvae grow slowly (apparently due to semi-starvation due to defoliation of their food plants by those who came before), last instar larvae may still be found as late as mid-July.

In nature, there is no indication of a second generation of *D. mattogrossensis* during the same rainy season as the first generation. In captivity, about 5% of the prepupae pupate shortly after spinning and eclose about one month after spinning, but the remainder stay in the prepupal state until the first month of the following rainy season (11–12 months after spinning), when they pupate and eclose shortly thereafter. In captivity (in dry glass bottles at ambient temperature), 10–20% of the prepupae do not respond to the onset of the first rainy season a year after spinning. These remain dormant until eclosing at the beginning of the second rainy season two years after spinning (some prepupae also die mummified, but it is not clear whether this is due to disease or failure to receive the appropriate eclosion cues in laboratory circumstances). However, in nature, with full wetting and chilling of the dormant prepupae in their cocoons in the soil, it is likely that all of the prepupae eclose about a year after spinning.

The larvae are infrequently attacked by two species of *Vibrissina* (Tachinidae). The fly larva remains dormant until the sawfly cocoon has been spun. It remains dormant in the apparently healthy *D. mattogrossensis* prepupa for 2–3 weeks, and then consumes the prepupa, emerges, and makes its puparium inside the sawfly cocoon. There is only one maturing fly larva per sawfly larva. The fly ecloses 1–2 weeks later, approximately 3–6 weeks after the sawfly spun its cocoon. However, in a few cases the fly waited 1–2 months before attacking the sawfly prepupa, and therefore eclosed 2–3 months after the sawfly spun its cocoon. While the great majority of *D. mattogrossensis* remain dormant in their cocoons for a year (and are thus univoltine), the flies do not. The flies therefore either have subsequent generations on other species of sawflies (and one of them does parasitize the larvae of *Sericoceros mexicanus* and *Serococeros vumirus*, see above) or survive 8–10 months as reproductively inactive adults. This pattern of parasitization implies that a single common species of host, *D. mattogrossensis*, may generate an enormous number of specialist tachinids that then are far more abundant attackers of other much rarer species of sawfly larvae than would be the case if the tachinid population were sustained only by the rare hosts (such as *Sericoceros*).

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