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RANZOVIUS CONTUBERNALIS: SEASONAL HISTORY, HABITS, AND DESCRIPTION OF FIFTH INSTAR, WITH SPECULATION ON THE ORIGIN OF SPIDER COMMENSALISM IN THE GENUS *RANZOVIUS* (HEMIPTERA: MIRIDAE)[1]

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Abstract.—Plant bugs of the genus *Ranzovius* are unique among Miridae in their obligate association with web-building spiders. *Ranzovius* spp. may be commensals, kleptoparasites, or predators of spider egg sacs. Two species of *Ranzovius* are known to occur in the eastern United States. *R. contubernalis* Henry lives mainly as a commensal in the webs of the subsocial theridiid *Anelosimus studiosus* (Hentz) and also, probably secondarily, in webs of the agelenid *Agelenopsis pennsylvanica* (C. L. Koch). Seasonal history, behavior, and feeding habits are summarized for populations of *R. contubernalis* studied in North Carolina, Virginia, and Washington, D.C. during 1979–83. The fifth-instar nymph is described and illustrated. In addition, notes on *R. agelenopsis* Henry, which inhabits the webs of *A. pennsylvanica,* are given for a population that co-occurs with *R. contubernalis* at Knoxville, Tennessee. The evolutionary steps that may have led to spider commensalism in *Ranzovius* are discussed.

Plant bugs or mirids, members of the largest family of Hemiptera-Heteroptera, are well known as pests of field and fruit crops and as predators of various soft-bodied arthropods and their eggs (Kullenberg, 1944; Wheeler, 1976). Most mirids live on the foliage, stems, or inflorescences of living herbs, shrubs, and trees but a few, mainly predaceous, species occur in other habitats. For example, isometopines (Wheeler and Henry, 1978) and *Phytocoris* spp. (Knight, 1923a) live on tree trunks; *Cylapus tenuicornis* Say (Heidemann, 1891; Banks, 1893) and *Fulvius* and *Peritropis* spp. (Knight, 1923b; Knight and McAtee, 1929) live among fallen logs or on tree stumps; *Trynocoris lawrencei* Herring has been taken in shelf fungi (Herring, 1976); and *Schaffneria* spp. inhabit the ground layer (Knight, 1966). The genus *Ranzovius* Distant exhibits one of the most remarkable habits recorded for the Miridae—an obligate relationship with web-building spiders.

The first species of the genus reported in association with spiders was *R. fennahi* Carvalho. Based on R. G. Fennah's observation in the West Indies, Carvalho (1954) recorded it as predaceous on egg sacs of the theridiid *Anelosimus eximius*

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(Keyserling). In southern California, Davis and Russell (1969) reported commensalism between *R. californicus* (Van Duzee) [cited as *R. moerens* (Reuter)—see Henry, 1984] and a solitary funnel-web or agelenid spider, *Hololena curta* (McCook). The bugs were observed feeding on entrapped insects or on plant material in the webs. Until Henry's (1984) revision of *Ranzovius,* all North American records of this presumed Neotropical group (Slater, 1974) were referred to *moerens,* and in the U.S. the genus was thought to occur only in Arizona, California, Florida, and Texas (e.g., Knight, 1968; Slater and Baranowski, 1978).

In 1979 the collection of *Ranzovius* from webs of *Anelosimus studiosus* (Hentz) in central Virginia (by JPM) prompted additional collecting in the eastern U.S. and observations on life history. In 1981, L. N. Sorkin (American Museum of Natural History, New York) and D. Faber (University of Wisconsin, Madison) collected what proved to be a different species from webs of an agelenid spider at Knoxville, Tennessee. Specimens from theridiid and agelenid webs were sent to T. J. Henry, mirid specialist with the Systematic Entomology Laboratory, USDA, Washington, D.C. His discovery that material from the eastern U.S. was not conspecific with that from California led to a revision of the genus (Henry, 1984). Described as new were *R. contubernalis* Henry, a species recorded from Connecticut south to Florida and west to Arizona, and *R. agelenopsis* Henry from Tennessee.

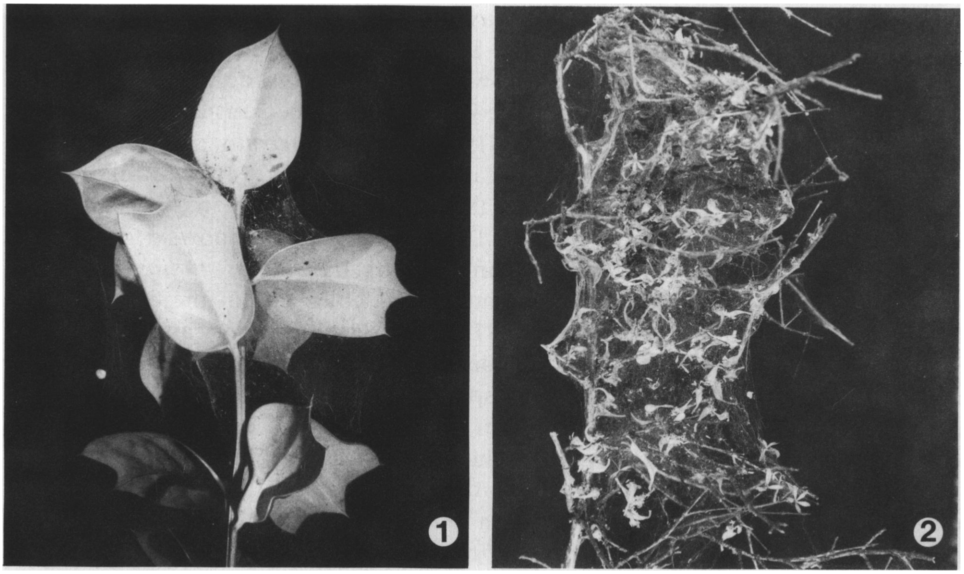
We summarize here our observations on seasonal history and habits of *R. contubernalis* in the eastern U.S. and describe the fifth-instar nymph. The habits of *R. agelenopsis* are briefly noted. We also speculate on the ecological and behavioral conditions that may have led to the evolution of spider commensalism in *Ranzovius.*

METHODS

Biological information was obtained from populations of *Ranzovius contubernalis* studied in ornamental plantings during 1979–80 at Steeles Tavern, Virginia (by JPM); 1981–83 at the U.S. National Arboretum, Washington, D.C. (by AGW and T. J. Henry); and 1982–83 at Staunton, Virginia and Charlotte, North Carolina (by AGW). The seasonal history reported for *R. contubernalis* thus is a composite based on the periodic sampling of populations at Washington from late May through October, Steeles Tavern from early June to mid-September, Staunton from late May to early September, and Charlotte from early April to early November. On each sample date, either the relative proportion of nymphs to adults was estimated in the field and the nymphal populations "rough-sorted" into early and late instars, or a sample (usually at least 5 individuals) was collected and the stages recorded after examination under a binocular microscope. Feeding habits and behavior were observed at all study sites and, to a limited extent, in the laboratory (mainly by JPM). The field notes on *R. agelenopsis* are based on collections at Knoxville, Tennessee, in early August 1981 (by D. Faber and L. N. Sorkin), mid-July 1982 (by AGW), and late July 1983 (by R. E. Kelly and G. L. Miller).

HABITAT PREFERENCES

Plant associations.—With the exception of a collection from native red-cedar, *Juniperus virginiana* L., we found *Ranzovius contubernalis* only in ornamental plantings: shrubs and hedges in the home landscape, in landscaped plantings of



Figs. 1–2. Webs of the subsocial theridiid *Anelosimus studiosus*. 1, New web on Chinese holly, *Ilex cornuta*. 2, Old web on stems of glossy abelia, *Abelia* × *grandiflora*, filled with arthropod exoskeletons, plant material, and other debris.

commercial establishments, on college campuses, and in an arboretum. Small, compact shrubs like boxwood (*Buxus*), certain hollies (*Ilex*) (Fig. 1), and yews (*Taxus*) seemed to be favored sites for web construction by *Anelosimus studiosus*, the most common host spider of *R. contubernalis* in the eastern United States. The mirid also was abundant in hedges of glossy abelia (*Abelia* × *grandiflora* (André) Rehd.) and azalea (*Rhododendron* spp.) and developed in webs on tree trunks covered by English ivy (*Hedera helix* L.). In areas where the spider was abundant, webs could be found on nearly all available shrubs and occasionally at heights of 2 m on the lowest branches of trees. The apparent scarcity of *R. contubernalis* outside landscape plantings may be an artifact of our collecting efforts. In Florida, the theridiid is known to construct its webs in a variety of habitats (Brach, 1977), and the mirid may well occur more frequently in natural areas than is indicated by our sampling.

Host spiders.—The theridiid *Anelosimus studiosus* ranges from Connecticut to Florida, west to eastern Texas, through Mexico and Central America, and south to Argentina (Levi, 1956, 1963). The webs of *A. studiosus* have been described as "unsightly masses of dead leaves tied together with silk," having a sheetlike extension somewhat like the silken sheets of agelenid spiders (Comstock, 1913) or superficially resembling the silken nests of webworms (Brach, 1977). In Florida, Brach described web formation by a founding female. Criss-crossed support strands are attached to branch terminals of a shrub, reinforced and branched to form a dense maze or mesh, and then a sheet is constructed on this scaffolding. The resulting web, about 60 × 60 mm, consists of a sheetlike platform having above a "space-filling meshwork of silk" that serves as a "labyrinthine snare"; at the edges of the platform are retreats constructed around dead leaves to which the spiders usually retire by day (Brach, 1977). According to Brach, the spiders tend to be more active at night, patrolling the webs and feeding on small Diptera and other entrapped insects. Theridiid webs are "selectively sticky," that is, they contain trapping threads studded with glue droplets (see Foelix, 1982). Plant material, excreta, and other debris often accumulate in the webs (Fig. 2) and, in Florida, Brach (1977) recorded other spiders, ants, cockroaches, and pyralid larvae as web inhabitants.

Anelosimus studiosus displays several elements of subsocial behavior: the persistence of colonies of up to 50 young in the web, regurgitation feeding of spiderlings by the mother, and cooperative prey capture, feeding, and web maintenance. However, tolerance among colony members is not permanent; when the founding female dies, the first-maturing sibling female becomes aggressive toward other adult females. In contrast, indiscriminant brood care is found in the Neotropical *A. eximius,* allowing the formation of large, placid colonies of as many as 1000 individuals (Brach, 1975, 1977; Foelix, 1982). Brach (1977) suggests that the development of tactile or specific-surface recognition of web mates and tolerance between females was important in the evolution of large, perennial colonies and quasisociality in *A. eximius* and a few other spiders.

After the first two seasons of observations, we thought that *Ranzovius contubernalis* might be restricted to webs of *Anelosimus studiosus.* But the mirid also occurs in webs of *Agelenopsis pennsylvanica* (C. L. Koch), a common North American agelenid known from Maine south to Mississippi and west to Oregon and Washington (Chamberlin and Ivie, 1941). Mirids also were collected in webs of agelenids too immature to identify with certainty, and it is possible that *R. contubernalis* is associated with other *Agelenopsis* spp. or other agelenid genera.

Webs of *Agelenopsis* spp. are horizontal, slightly concave, flat sheets having an open tube or funnel extending from one side, in which the spider waits for prey to strike the web. The nonviscid sheet simply impairs the movement of prey on its surface. Agelenids detect vibrations of insects that strike the web, whereupon the spider rushes from its retreat to seize the prey and carry it back to the tube (Turnbull, 1965; Kaston, 1981).

In North Carolina, Tennessee, and Virginia we have encountered webs of both spider species in the same shrub or hedge, often directly above one another, or side by side with the periphery of the webs in contact or nearly so. On Chinese holly (*Ilex cornuta* Lindl. & Paxt.) in Charlotte, N.C., agelenid and theridiid webs formed a nearly continuous "superstructure" extending for several meters along the lower half of the hedge, allowing mirids to move from web to web. In its association with agelenids, which we consider secondary, *R. contubernalis* was most common in late summer and early fall in expanded sheet webs of mature *A. pennsylvanica.* It appears that first generation *Ranzovius* develop mainly in webs of *Anelosimus* rather than in the inconspicuous webs constructed by young *Agelenopsis.*

Even though webs of certain other spiders, e.g., the linyphiid *Frontinella pyramitela* (Walckenaer) and various araneids, were constructed near those of *Agelenopsis* and *Anelosimus,* their webs did not support populations of *Ranzovius contubernalis.* We cannot agree with Knight's (1968) comment that "spider webs everywhere are much the same . . . ." Not only are there differences in the webs of various spiders, but the species also display behavioral differences.

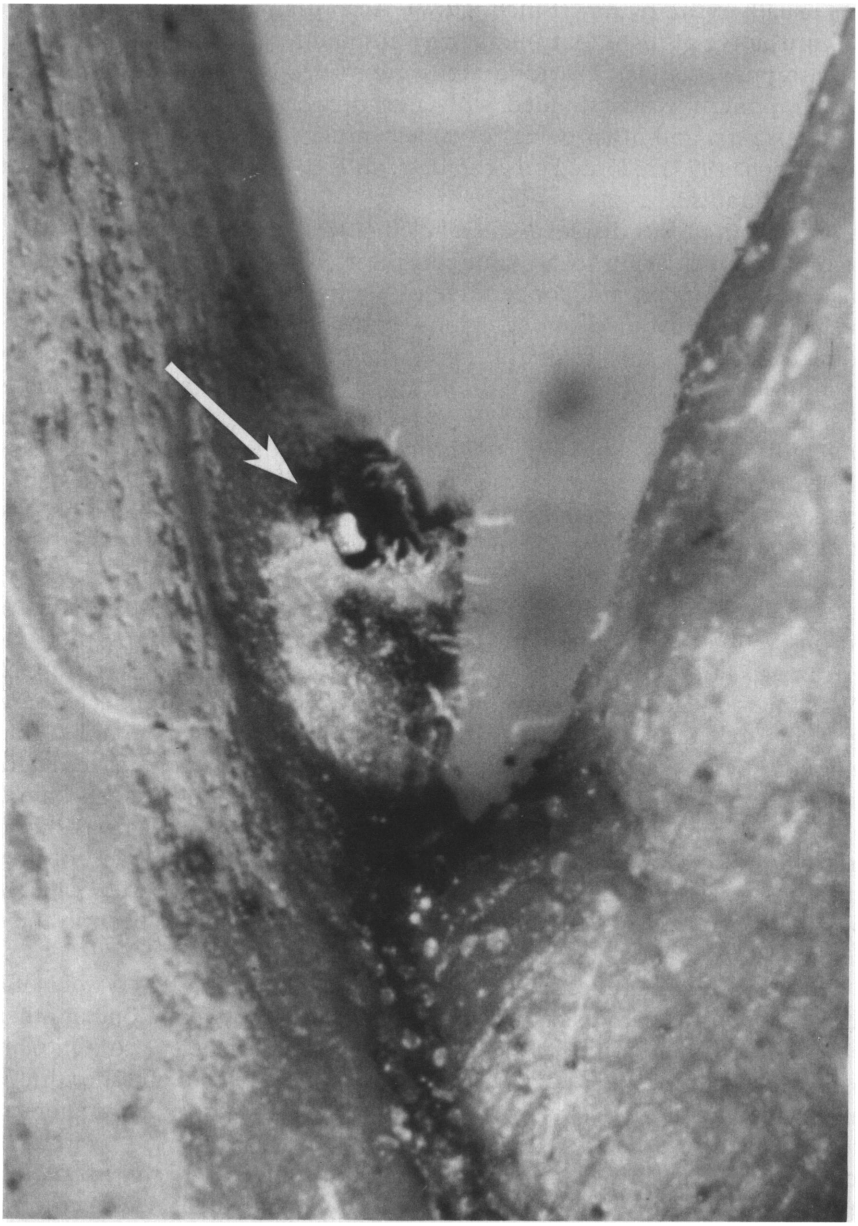


Fig. 3. Egg of *Ranzovius contubernalis* inserted in stem of yew, *Taxus* sp.

SEASONAL HISTORY

Eggs of *Ranzovius contubernalis* are deposited in stems of plants harboring host spiders (Fig. 3) and are inserted in branches that support (or are near) the webs. The hatching of overwintering eggs seems to occur soon after *Anelosimus studiosus* becomes active in spring and begins to expand its webs. At Charlotte the overwintered eggs had hatched by early April (first and second instars were present on 10 April), and by late May populations in webs of *Agelenopsis pennsylvanica* and *Anelosimus studiosus* on Chinese holly consisted mainly of fourth and fifth with a few third instars present. Webs often contained 5–10 nymphs and occasionally as many as 20. Adults were observed during the first week of June. This duration between the appearance of nymphs in early spring and the first appearance of adults agrees with that observed for *R. californicus* in webs of *Hololena curta* in southern California: 70 days in the first year of study, 46 days in the second year (Davis and Russell, 1969).

By early July nearly all first generation adults had died, and first and second instars of a second generation were present. Late instars and adults of this generation were collected in early August. A third generation was produced during mid-August–September; third to fifth instars and teneral adults were found from early to mid-September. Adults and a fifth instar were taken as late as 5 November.

In central Virginia and in the Washington area the overwintering eggs hatched approximately 4–5 weeks later than in southern North Carolina, based on the collection of third instars in late May. The adults began to appear in mid- to late June. Second generation adults were present by late July to mid-August. A third generation developed during late August and September.

In contrast, Davis and Russell (1969) reported that the population of *R. californicus* studied in southern California was univoltine. Nymphs appeared in mid-March, with egg hatch believed to continue until June. Adults, however, were present until late August or mid-September, a period longer than what might be expected for most adult mirids. With a recorded average nymphal period of 26.3 days, based on laboratory rearing at 30°C, multiple generations would seem possible for *R. californicus.*

Behavior and Feeding Habits

By day, nymphs and adults of *Ranzovius contubernalis* are found in the webs of host spiders or on the underside of leaves at the periphery of the webs. Brief observations suggested that the bugs were less active on webs at night, perhaps because the host spiders were more active then. Davis and Russell (1969) suggested that the observed inactivity of *R. californicus* at night might be due to the host agelenid's presence on the web platform.

The mirids walk upside down along the bottom of webs (Fig. 4) or upright on the top. Although Davis and Russell (1969) commented that the claws of *R. californicus* "can be either held straight down, parallel to the tarsus, for walking on the web or turned in, almost perpendicular to the tarsus, for hanging under the web," the claws of *Ranzovius* actually are similar to those of other phyline Miridae and may not be highly modified (see Henry, 1984). In contrast, spider commensals of the nabid genus *Arachnocoris* (Myers, 1925) and certain higher emesine Reduviidae that inhabit spider webs (Wygodzinsky, 1966) do have specialized claws.

Ranzovius contubernalis often rest in webs, their motionlessness and posture (antennae outstretched) rendering them easily mistaken for dead adults. When walking in webs, nymphs and adults move slowly with their antennae in constant motion, moving alternately up and down or weaving a rapid figure-eight. The bugs stop frequently to clean their antennae with the tarsi. When disturbed, the bugs run quickly across webs and usually hide among foliage at the webs' periphery.

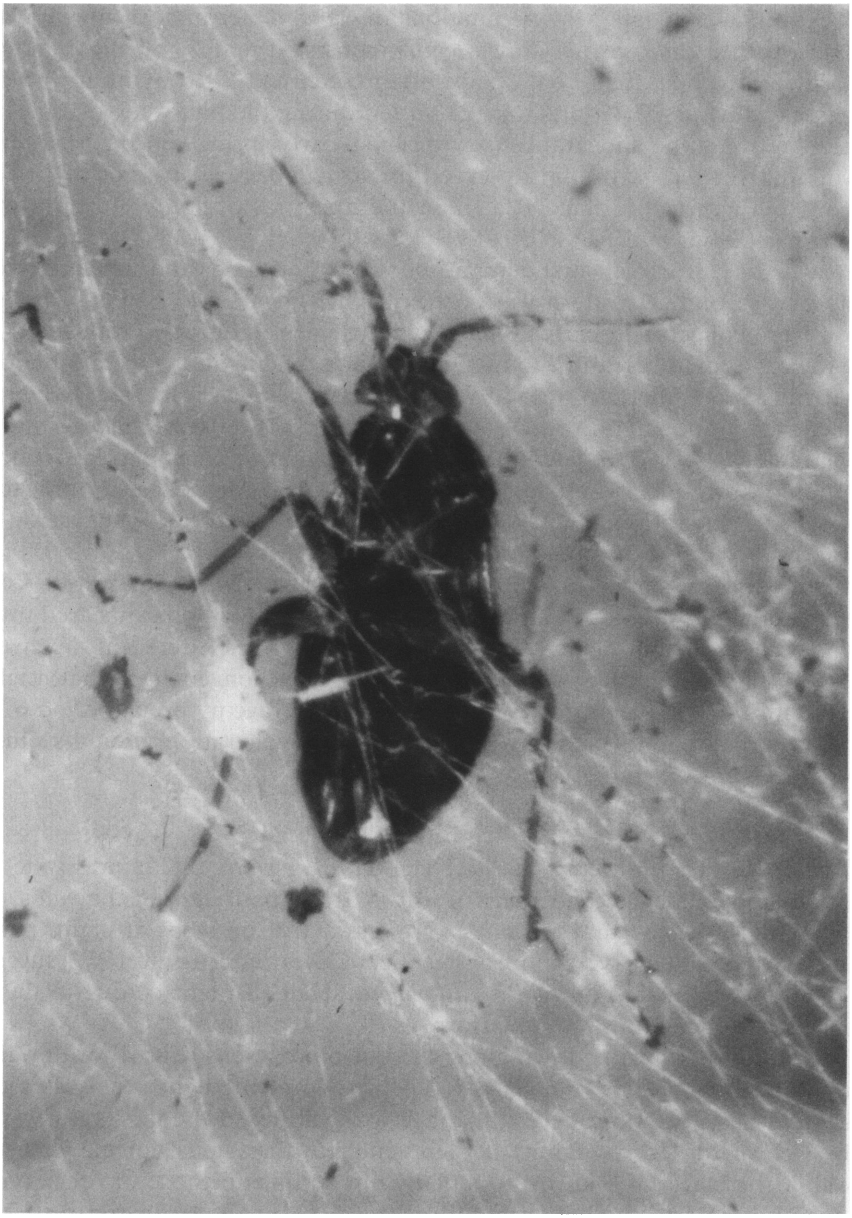


Fig. 4. Adult *Ranzovius contubernalis* hanging from bottom of web of *Anelosimus studiosus.*

Even though *Ranzovius* is fully capable of flight, the bugs do not fly when disturbed. In fact, a web and its supporting stems can be cut from a plant and transported to the laboratory without the adults escaping.

The movements of *R. contubernalis* in webs did not appear to elicit responses from host spiders, possibly because their small size and manner of walking do not produce vibrations similar to those of potential prey that strike the webs. Intruders in the webs of *Anelosimus studiosus* usually induce convergence by colony members, although the presence of another spider (Mimetidae) was not detected under experimental conditions (Brach, 1977). On one occasion we observed a nymph of *R. contubernalis* walking on a web directly beneath a subadult or mature *Agelenopsis pennsylvanica* without eliciting a response from the spider. Davis and Russell (1969) reported that *R. californicus* also "did not try to avoid the spiders," and they observed a nymph walking within a centimeter of a mature spider; however, when caged with immature *Hololena curta,* first- and second-instar mirids were killed after an average of 4.4 days (11 trials).

The food sources most readily available to *Ranzovius contubernalis* tend to fluctuate throughout the season and may depend on the plant species supporting webs of host spiders. The mirid appears to scavenge mainly on insects ignored by host spiders or that are too small to have triggered a feeding response. For example, in the agelenid *Agelenopsis potteri* (Blackwall) prey capture does not exceed a certain level, with no individual catching all available prey (Turnbull, 1965), and in *Anelosimus eximius* the efficiency of prey capture decreases with prey size so that mosquito-sized or small insects often are ignored (Brach, 1975). In North Carolina large numbers of black citrus aphid, *Toxoptera aurantii* (Fonscolombe), which infested new growth of Chinese holly, became entrapped in webs of *Anelosimus studiosus* and at times furnished an abundant food source for the bugs. On boxwood, the large numbers of boxwood psyllid, *Psylla buxi* (L.), trapped in webs during peak adult activity provided the mirids a ready supply of food. In webs of *A. studiosus* and *A. pennsylvanica, Ranzovius contubernalis* also fed on small Diptera, a winged ant, a moth, the flatid *Anormenis septentrionalis* (Spinola), the cicadellid *Orientus ishidae* (Matsumura), the cercopid *Prosapia bicincta* (Say), and an adult psocid.

Several large insects fed on by *Ranzovius contubernalis* obviously were not fresh. However, even nutrients in these rather dry cadavers may be accessible to the bugs. The saliva of mirids appears to allow nutrients to be extracted from fungus-killed anthomyiid flies, with the bugs often concentrating on the eyes (Wheeler, 1971). The haustellate mouthparts and saliva of plant-feeding Heteroptera facilitate opportunistic feeding on dried bird droppings, dung, and carrion (Adler and Wheeler, 1984).

The relationship of *Ranzovius contubernalis* to its spider hosts appears to represent primarily a benign commensalism, i.e., the fitness of its hosts is not lowered (see Wise, 1982). Although Davis and Russell (1969) referred to *R. californicus* as a commensal in webs of *Hololena curta* (which of course applies in the broad sense), some of its behavior might be termed kleptoparasitic, i.e., involving a stealing of prey items. This species sometimes fed on insects that the host agelenid had tied to its web. When small Diptera were thrown on a web, a nymph attacked one of the struggling flies, but the spider soon emerged from its retreat to claim the fly.

In one web we also observed *Ranzovius contubernalis* on a staminate oak catkin, the nymph apparently feeding on pollen. Davis and Russell (1969) noted that *R. californicus* fed on honeysuckle stamens that had dropped onto webs of *Hololena curta.* On one occasion we observed predation on molting spiderlings of *Anelosimus studiosus,* but *R. contubernalis* was not seen to feed on eggs of its host spiders. In the field when JPM disturbed an egg sac of *A. studiosus,* the female spider quickly grasped it in her chelicerae.

In the laboratory adult *Ranzovius* fed on eggs of cabbage looper, *Trichoplusia* *ni* (Hübner) (Lepidoptera: Noctuidae), and on a dead adult of their species. When confined in rearing containers, the mirids showed some cannibalism.

DESCRIPTION OF FIFTH INSTAR

Fig. 5

Length 1.60 mm. Elongate oval, general coloration red, pronotum darker red, wing pads fusco-reddish, legs and antennal segment IV paler, segment III white; rostral segments III–IV, tarsi, and apex of hind tibia tinged with fuscous. Dorsum sparsely clothed with pale, recumbent setae, lateral margin of pronotum and abdomen fringed with darker setae, antennal segment I incrassate, with dark, bristlelike setae, 2 longer erect setae at apical ⅓ of dorsal surface; II incrassate, with rows of dark bristlelike setae, length less than width of head across eyes; III–IV slender, with finer setae. Antenna: I, length, 0.22 mm; II, 0.40 mm; III, 0.30 mm; IV, 0.26 mm. Rostrum: length 1.06 mm, reaching just beyond bases of metacoxae. Wing pads reaching base of 5th abdominal segment; dorsal abdominal scent gland opening distinct (but secondary doubling barely visible), a sclerotized bar above. Hind tibia with row of 4–5 faint, dark spots or bands, 2 stout spines at base on outer face.

Description based on nymph (in alcohol), taken in theridiid spider web with adults of *Ranzovius contubernalis,* near Matthews, N.C., 5 Nov. 1979.

NOTES ON *RANZOVIUS AGELENOPSIS*

Collected only on the University of Tennessee campus at Knoxville, this mirid undoubtedly has a much wider distribution. In 1981 and 1982 it was common in webs of *Agelenopsis pennsylvanica* among English ivy on tree trunks and, although webs were abundant in ivy growing on the ground, the mirid was not found in such situations (1982 observations). We note that *Anelosimus studiosus* was common among ivy trees at the National Arboretum in Washington, but this spider was not observed on ivy-covered trunks at Knoxville. The theridiid, however, was present on the University of Tennessee campus. In 1982, collections from webs of *Agelenopsis* and *Anelosimus* on two boxwood plants yielded both *R. agelenopsis* and *R. contubernalis* but, because only the former mirid was presumed present, bugs from the various webs were not kept separate. In 1983 when a web of each spider species was examined, the webs yielded only *R. contubernalis.* Thus, we know that at the type-locality of *R. agelenopsis* this species lives in agelenid webs occurring among ivy on tree trunks and that on boxwood at Knoxville, *R. contubernalis* develops in agelenid and theridiid webs, as is typical in other areas of the eastern U.S. On boxwood where the two mirids co-occurred, *R. agelenopsis* may be confined to agelenid webs, but detailed experimental work is needed to clarify the ecological relationships of these bugs in the only known area of sympatry. Whether agelenids are the sole host spiders for *R. agelenopsis* or not, it does appear that these spiders are at least the primary hosts for this mirid, whereas they seem to be secondary hosts for *R. contubernalis.*

We observed *Ranzovius agelenopsis* feeding on dead invertebrates, including ants and a sowbug (Isopoda), in webs of *Agelenopsis pennsylvanica* on tree trunks. In the laboratory L. N. Sorkin (pers. comm.) observed feeding on dead *Drosophila,* the bugs often penetrating the flies' eyes.

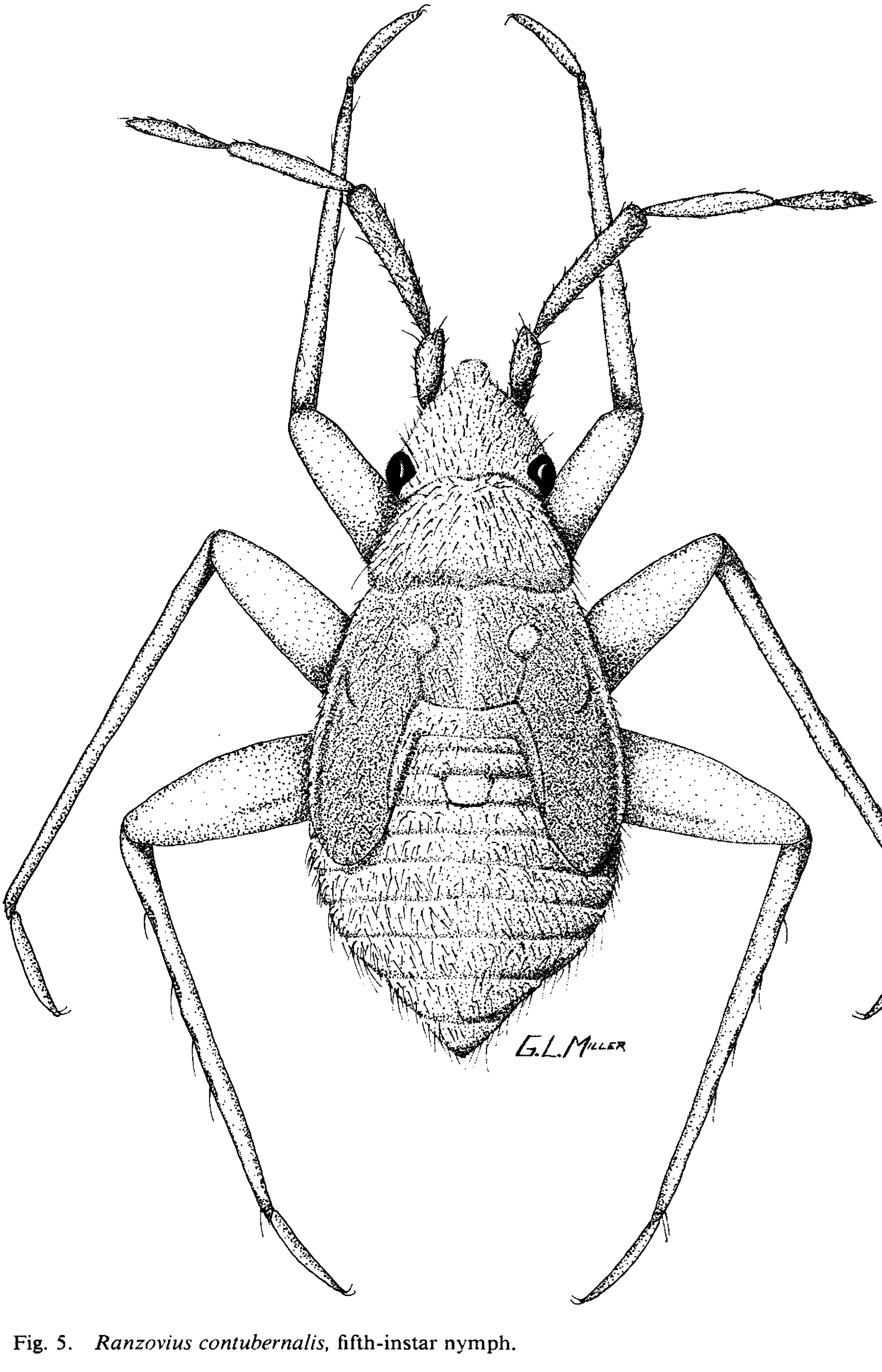


Fig. 5. *Ranzovius contubernalis,* fifth-instar nymph.

PROBABLE ORIGIN OF FEEDING HABITS IN *RANZOVIUS*

Ranzovius species share an apparent obligate association with spiders that also has evolved in several predatory heteropterans: species of the nabid genus *Arachnocoris* (Myers, 1925), certain emesine reduviids (Wygodzinsky, 1966), and the plokiophilid subfamily Plokiophilinae (Carayon, 1974). In addition, a predaceous bug of the family Anthocoridae inhabits the webs of a colonial spider in South Australia (China and Myers, 1929).

The mirid genus *Ranzovius* probably originated in the Neotropics, with the ancestral bug inhabiting shrubs and trees. Like many phyline mirids, it most likely was a "mixed feeder," that is, both phytophagous and zoophagous (Kullenberg, 1944). Phylines, as well as certain other groups of Miridae, feed opportunistically on readily available nitrogen-rich food sources. They will attack small-bodied arthropods (aphids, mites, etc.) and will exploit stationary food sources like arthropod eggs (e.g., Kullenberg, 1944; Butler, 1965; Wheeler, 1976), mummified aphids (Wheeler et al., 1968), and cadavers of flies killed by phycomycosis (Wheeler, 1971). We speculate that *Ranzovius* began to feed fortuitously as a timid carnivore or scavenger at the periphery of spider webs built on the bugs' host plants. The large, communal, perennial webs of the Neotropical *Anelosimus eximius* (Brach, 1975) would have offered an abundance of food in the form of entrapped arthropods and plant debris. Because the ready food supply would have made a more intimate association with spiders a profitable way of life, the bugs eventually may have ventured onto webs for feeding.

Their small size—adults range from slightly less than 2.00 mm long to slightly more than 2.50 mm and are among the smallest Miridae—might have preadapted them for walking on nonadhesive strands of silk and made them less likely to trigger vibrations eliciting response from colony members. Fennah, quoted in Carvalho (1954), suggests that in spider webs *Ranzovius* may "not give the necessary stimulus for attack by pulling on the threads." Although *A. eximius* is "quite aggressive" (Brach, 1975), this subsocial spider, whose webs probably were inhabited by a variety of commensals and kleptoparasites, may be somewhat more tolerant of *Ranzovius* than solitary spiders. Also, these spiders presumably had developed a "sensory screen" or adaptation for filtering vibrations so that conspecifics would not elicit predatory responses.

A predictable food source in communal webs would have made commensalism (in the broad sense) an inexpensive strategy in terms of time and energy expended and brought about a specialization of the web-living habit. Selection would have favored behavioral modifications (or perhaps slight modifications in tarsal structure) allowing webs to be traversed more easily or setting up vibrations more similar to those of its subsocial host than to those of potential prey organisms striking the web.

We hypothesize that the ancestral *Ranzovius* and its presumed spider host possessed certain attributes that facilitated the evolution of commensalism: sharing of the same habitat, the bugs' opportunistic feeding habits, and a concentration of communal hosts in perennial webs harboring a predictable food supply. Brockman and Barnard (1979) identified these and other ecological conditions and behavioral patterns that have led to kleptoparasitism in birds. In *Ranzovius,* the various feeding strategies possible—carnivory on spider egg sacs or molting spiderlings, kleptoparasitism, or scavenging—apparently all occur, just as they do in commensal spiders of the theridiid genus *Argyrodes* (see Wise, 1982). For an apparent opportunist like *Ranzovius* the habits of egg predation and scavenging would be behaviorally and physiologically similar. A species, depending on the particular set of ecological conditions, could function as a predator, kleptoparasite, or scavenger.

DISCUSSION

All *Ranzovius* species whose habits are known live in spider webs. *R. contubernalis* is found mainly in webs of the subsocial *Anelosimus studiosus* (Theridiidae) and, to a lesser extent, in webs of the solitary *Agelenopsis pennsylvanica* (Agelenidae) and perhaps other agelenids. The relationship to host spiders appears mainly commensal rather than kleptoparasitic or predatory.

More common in the southern United States, *Ranzovius contubernalis* has been recorded as far north as Connecticut (Henry, 1984) (which also is the northernmost record for *A. studiosus*), although this is the only record north of the Washington, D.C. area. The mirid is known to occur as far west as the Santa Rita Mountains in southeastern Arizona (Henry, 1984), but *Anelosimus studiosus* is known only as far west as eastern Texas (Levi, 1956). The spider associations of *R. contubernalis* in the westernmost area of its range need to be established.

Additional field and laboratory research is needed to clarify basic life history phenomena of *Ranzovius* species in temperate and tropical regions. Experimental work would reveal interesting facts about the nature of the relationship between *Ranzovius* spp. and their spider hosts, including possible impact on mirid and host fitness.

The sympatry of *R. agelenopsis* and *R. contubernalis* in Tennessee raises several questions. Do the mirid-spider relationships indicate ecological partitioning by the two *Ranzovius* species, and is the apparent rareness of *R. agelenopsis* a result of competition with *R. contubernalis*? Is their sympatry at Knoxville the result of secondary overlap in the range of *agelenopsis*? Crucial to a better understanding of the relationship between these species is a critical study of their Tennessee populations and particularly extensive collecting to determine the range of *R. agelenopsis*.

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