POLYPHYLETIC ORIGIN OF THE LEAFHOPPER FAUNA OF *ILEX DECIDUA*

HERBERT H. ROSS
State Natural History Survey, Urbana

Among leafhoppers, the genus *Erythroneura* is unusual in having some 300 or more species in the Midwest. Favorite hosts for species of two large groups of *Erythroneura* are chiefly the common trees, such as oaks, hickories, beech, honey locust, alder and elms. Species of a third large group feed on grape, dogwood, redbud, and witchhazel.

In 1951, collecting at Grantsburg in southern Illinois, we found a great variety of species on a new host plant, *Ilex decidua* Walt., one of our native hollies. Analysis of this material showed that about 20 species were present in the collections, but comparison with collections made on all surrounding host species demonstrated that *Ilex* was the specific host of only four. The remainder had "drifted" onto the *Ilex* from nearby trees. Of these drifts whose host was known, three came from elm, one from maple, two from sycamore and seven from *Quercus lyrata* and *Q. palustris*. This last group from oak predominated among the drifts, undoubtedly because the two oaks were numerous in the area and their leafhopper populations abundant.

In the same area in 1952, *Erythroneura* was scarce. The same species of *Erythroneura* were found, but each was collected almost exclusively on its host tree and there was evidence of only limited drift.

At West Vienna, Ill., on the same date in 1952, we found a large colony of *Ilex decidua* with an abundance of *Erythroneura*. As in the 1951 Grantsburg collection, there was a considerable drift of elm and oak species of *Erythroneura* onto *Ilex*, chiefly species from *Quercus lyrata*.

In the first and last collections mentioned there was practically no drift of *Ilex* species to other trees. A total of eight large collections averaging about 300 specimens were made on elm, maple, and the two oaks in the two localities, and only three specimens of the total four *Ilex* species were among them. It seemed that when drift occurred there was a marked tendency for many and varied species to drift onto *Ilex*, but little for *Ilex* species to drift away from their true host.

The four *Ilex* species were *atrimucronata* Beamer, *falcata* Beamer, and *mansueta* Beamer, hitherto rare in collections, and *ilicis* n. sp. These are the first host records for *Erythroneura* in the plant family Aquifoliaceae.

Because *Ilex* is frequently associated with *Quercus lyrata* and *palustris*, it was thought at first that this tendency of the oak species to drift to *Ilex* might have some bear-

ing on the origin of the *Ilex* species, but this idea soon proved erroneous. The *Ilex* species all belong to the *obliqua* group of *Erythroneura*. The drifts from oak were principally the species *velox, knullae, gemina, gemoides, paluloides* and *richardsi,* which all belong to the *maculata* group of *Erythroneura,* and are thus only indirectly related to the *Ilex* species. The seventh oak species drift was *lyratae,* a possible close relative of an *Ilex* species, but only a single specimen was taken in the three collections on *Ilex*.

A phylogenetic analysis of the four *Ilex* leafhopper species brings out some interesting points concerning their possible origin. This analysis is based on structures of the male genitalia, which offer the best known structures to use in classifying species of *Erythroneura*. The four species of *Erythroneura* taken on *Ilex* are as follows:

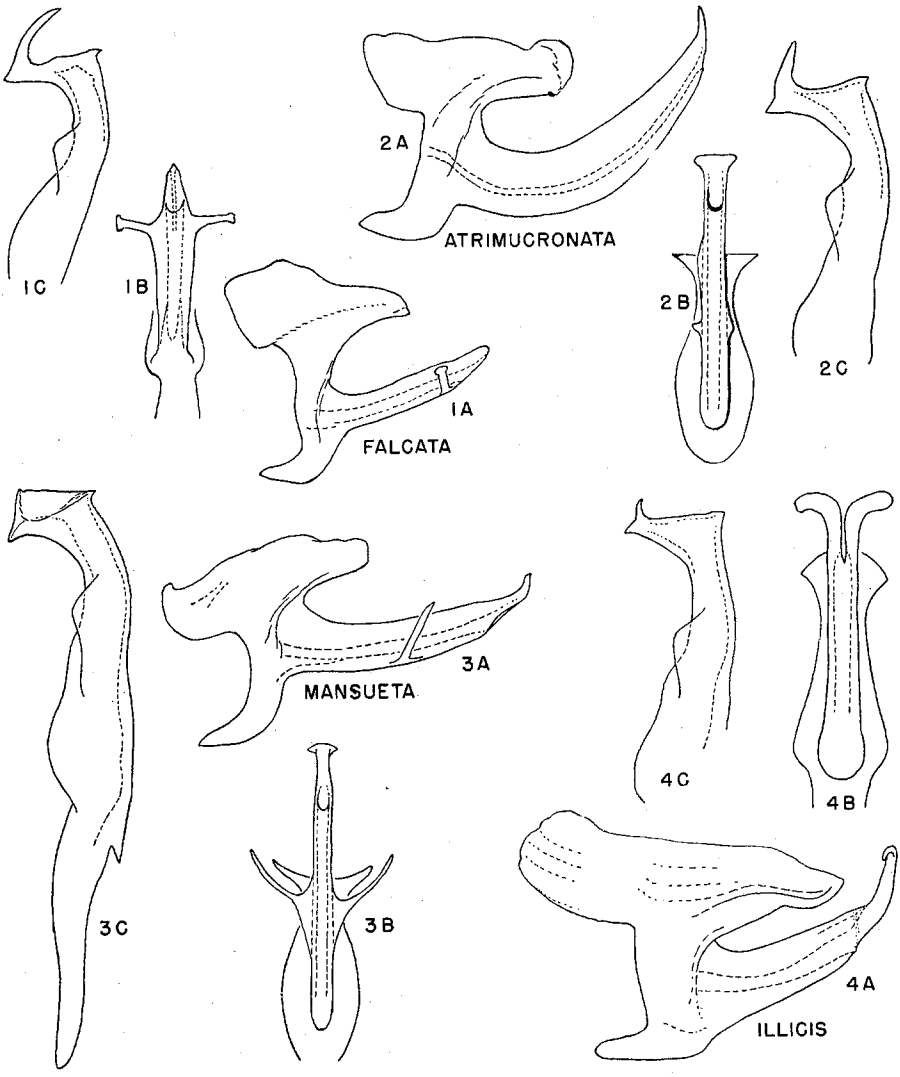
1. **Falcata** Beamer, fig. 1.—This species is the closest known relative of *cruciformis* Beamer, but is more specialized in details of structure of aedeagus and styles. *E. cruciformis* has been taken chiefly on Juglandaceae. More primitive species in the group occur on *Fagus, Acer,* and *Quercus*. It would seem that the primitive host of the group was one of these, and that *falcata,* being at the end of its line, represents a population transfer from an earlier host to *Ilex*.

2. **Atrimucronata** Beamer, fig. 2.—The shape of the aedeagus indicates that this species is a very close relative of *juglandacea* Ross, whose host is *Juglans*. It is difficult to tell which is the more primitive, although *atrimucronata* has narrow lateral flanges on the aedeagus which would indicate that it is more specialized in this character.

3. **Mansueta** Beamer, fig. 3.—There is little doubt that this species arose from a form very like *atrimucronata,* the differences in genitalia coming about by a simple filling in of the space between the posterior point and heel of the style, and the development of lateral processes on the aedeagus. *Mansueta,* however, has preserved the generalized striped pale color pattern of the *obliqua* group. On the basis of genitalia it would appear that *atrimucronata* and *mansueta* represent a pair of species that developed from a more primitive ancestor which transferred to *Ilex*. The species *juglandacea* probably arose from a segregate of the same primitive ancestor which became established on *Juglans*. As we know of no other closely related or more primitive allied forms, we cannot even hazard a guess as to the possible original host of this line. It seems certain, however, that *atrimucronata* and *mansueta* together represent a second transfer to *Ilex* independent of *falcata*.

4. **Ilicis** n. sp., fig. 4.—The deep, slender shape and peculiar apicolateral processes of the aedeagus indicate a close relationship with *victorialis* Knull (host *Vaccinium*) and *rugosae* Ross (host *Alnus*). Because of the extreme development of these characters, *ilicis* appears to be the most specialized member of this complex. It is therefore inferred that *ilicis* had its origin in a more primitive form on some other host, and that it represents a third independent population transfer to *Ilex*.

On this basis we can conclude that



FIGS. 1-4.—Male genitalia of *Erythroneura*. *A*, aedeagus, lateral aspect; *B*, aedeagus, postero-ventral aspect; *C*, style, ventro-lateral aspect.

the *Erythroneura* fauna of *Ilex decidua* includes the end products of three phyletic lines, and that each line represents an independent population transfer to *Ilex* from hosts as yet undetermined. The natural mechanism by which these host transfers occur in these leafhoppers we do not know.

Certain species new to science are reported in the above paragraphs. Their descriptions follow. Types are

deposited in the collection of the Illinois Natural History Survey.

OBLIQUA GROUP

Erythroneura ilicis n. sp.

The deeply divided apex of the phalicata distinguishes this species immediately from its nearest known relative, *victorialis* Knull.

Length 3 mm. Color of body and wings coppery brown, the membrane of the wings a little darker. Male genitalia as in fig. 4. Pygofer hook evenly curved. Style with foot nearly at right angles to shaft, heel large and square, anterior and posterior points short and nearly subequal, the posterior point slightly longer and sharper. Aedeagus with very large dorsal apodeme; phalicata deep but fairly narrow, the apical portion curved dorsad and completely divided into a pair of broad lobes curved laterad.

Holotype, male: Grantsburg, Illinois, on *Ilex decidua,* August 31, 1951, Richards and Ross. *Allotype,* female: same data but September 23, 1952, Ross and Evers. *Paratypes*: 43 males, 39 females from Grantsburg and West Karnak, Illinois. All were taken from *Ilex decidua* Walt. except for a single male on *Acer rubrum.*

MACULATA GROUP

Erythroneura paluloides n. sp.

This species is most closely related to *immota* Beamer, but can be distinguished readily by the sharply bent dorsal aspect of the pygofer hook, fig. 5B.

Length 3.5 mm. Ground color very pale straw color, with the typical maculata group markings light orange, those on the elytron fused to make short, parallel, oblique bars. Male genitalia as in fig. 5. Lateral aspect of pygofer hook with a long narrow base and a swollen apical portion which tapers to a point; dorsal aspect sharply bent at end of base, the apical portion sinuate and roughened with minute serrations. Style with distinct heel but with anterior and posterior points reduced to mere angles. Aedeagus with small dorsal apodeme; phalicata placed high on socket, clavate, deeper than wide, and with fairly prominent serrations.

Holotype, male: Grantsburg, Illinois, on *Quercus palustris,* August 31, 1951, Richards and Ross. *Paratypes*: 48 males from Crab Orchard Lake, Grantsburg, Pulaski, Mermet and Metropolis, Illinois. In 1951 at Grantsburg this species constituted 10 percent of the large populations on *Quercus palustris,* with drifts on *Ilex decidua.* In 1952 at Grantsburg only a few specimens were taken, on *Quercus palustris* and *Q. lyrata.* It seems that *Quercus palustris* is the probable host, but this conclusion needs verification by additional collections.

Erythroneura richardsi n. sp.

Most closely related to *acantha* Ross, this species differs in its less spiculate phalicata, which is also much narrower from ventral view. In addition the apical portion of the pygofer hook is much straighter from lateral view.

Size and color similar to the preceding. Male genitalia, fig. 6, with pygofer hook long, of nearly equal thickness, and shaped as in figs. 6A and B. Style with obtuse foot, the heel and anterior point angulate, the

posterior point visible only as a minute projection. Aedeagus with phalicata situated high on socket, lateral aspect of phalicata clavate, ventral aspect slender and narrow, the apical portion bearing scattered serrations.

Holotype, male: Grantsburg, Illinois, on *Quercus lyrata,* August 17, 1951, Ross and Stannard. *Paratypes*: 23 males from Grantsburg and Oliver (Rocky Branch Creek), Illinois. The specimens from Grantsburg, all taken in 1951, were in about equal numbers from *Quercus palustris, Q. lyrata,* and *Ilex decidua.* None were taken the following year. Large collections from *Ilex decidua* at West Karnak in 1952 contained none, indicating a strong probability that *Ilex* is not a true host. Again, we need more collections.

Erythroneura velox n. sp.

The apex of the pygofer hook is the same general shape as that of *firma* Beamer and *uvaldeana* Knull, from both of which it differs in the shorter, nearly straight, and more oblique ventral arm of the apex. This difference, although comparatively slight, is exhibited perfectly by over 75 specimens from two localities.

Size and color similar to preceding, but with the orange markings much paler and in some specimens inconspicuous. Male genitalia, fig. 8, with pygofer hook divided at apex to form a short, straight dorsal projection and a longer, slightly curved, oblique ventral projection. Style with long, narrow foot, with no anterior point but with a moderately long posterior point. Aedeagus with phalicata situated high on socket; lateral aspect of phalicata regular, very slightly curved, ventral aspect regular and narrow, apical portion with a few serrations, and base with a narrow flange.

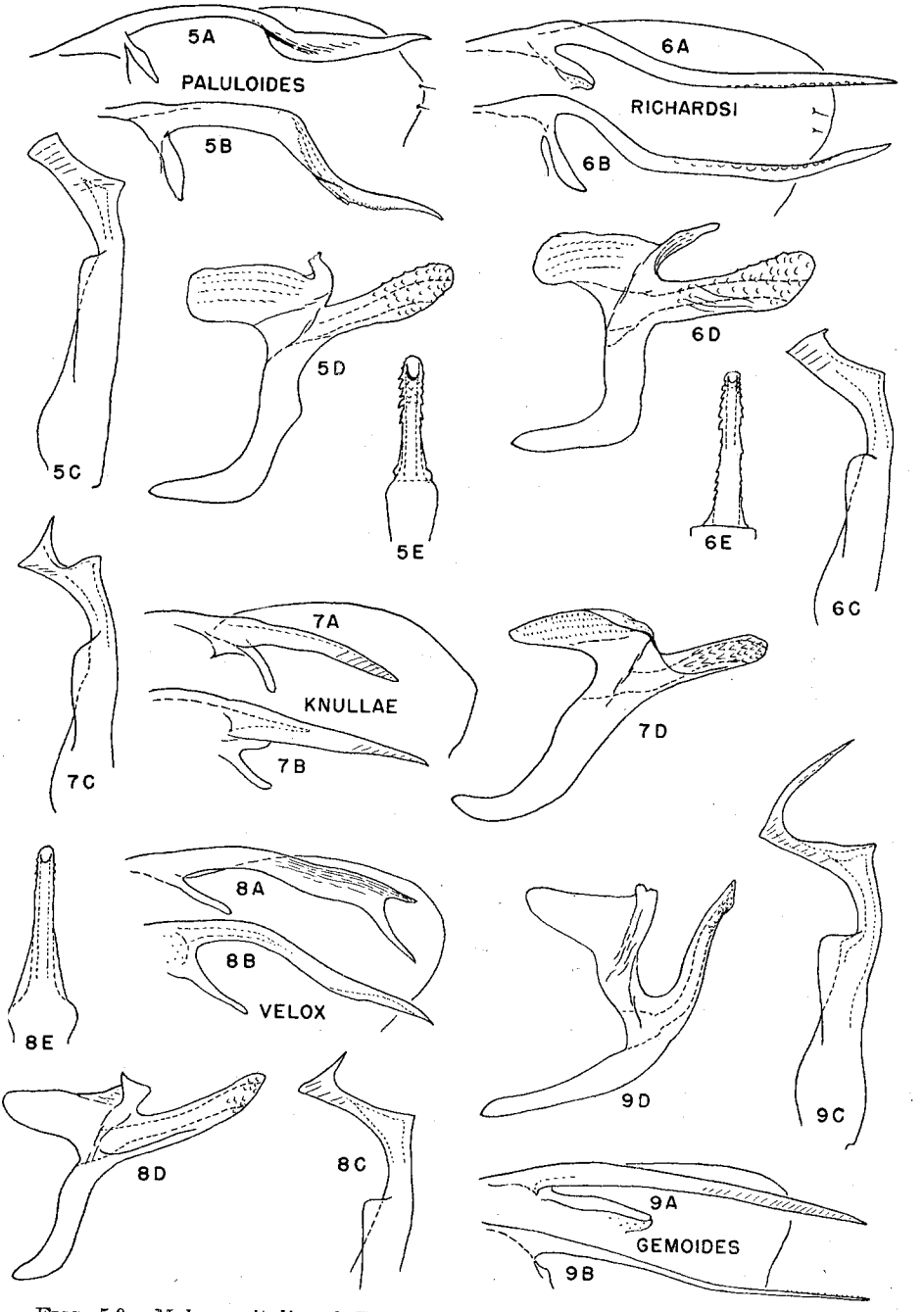
Holotype, male: Grantsburg, Illinois, on *Quercus lyrata,* August 28, 1952, Richards and Stannard. *Paratypes*: 81 males from Grantsburg and West Karnak, Illinois. With the exception of a few drifts on *Ilex decidua,* these were taken on *Quercus lyrata,* which is undoubtedly the preferred host.

Erythroneura gemoides n. sp.

This species is most closely related to *gemina* Beamer, differing primarily in the long pygofer hook which extends considerably beyond the pygofer.

Size and color similar to *paluloides* but with the elytral marks not coalesced. Male genitalia, fig. 9, with pygofer hook extending considerably beyond pygofer, lateral aspect straight and blade like, dorsal aspect thin and slightly curved. Style with elongate posterior point which is slightly longer than length of foot. Aedeagus with phalicata near ventral margin of socket; phalicata slender and slightly sinuate, with only a few serrations near apex.

Holotype, male: Grantsburg, Illinois, on *Quercus palustris,* August 31, 1951, Richards and Ross. *Paratypes*: 62 males from Grantsburg and northwest of Tamms, Illinois. At Grantsburg in 1951 this species constituted about 50 percent of the large populations on *Quercus palustris,* with numerous drifts on *Q. lyrata* and *Ilex decidua.* In 1952 it was confined entirely to *Quercus palustris,* indicating this species as the true host.



FIGS. 5-9.—Male genitalia of *Erythroneura*. *A*, *B*, pygofer hook, lateral and dorsal aspects, respectively; *C*, style, ventro-lateral aspect; *D*, aedeagus, lateral aspect; *E*, phalicata, postero-ventral aspect.

Erythroneura knullae n. sp.

This species is a close relative of *solita* Beamer, but differs in lacking the prominent sclerotized projection above the base of the phalicata.

Length 3.5 mm. Ground color whitish with typical *maculata* group spotting, in most specimens (including the holotype) these spots bright red and small. In an occasional specimen the spots are larger and paler. Male genitalia, fig. 7, with pygofer hook short, slightly curved and pointed. Style with prominent heel, and with posterior point having an unusually broad base and tapering to a sharp point. Aedeagus with phalicata near dorsal margin; lateral aspect of phalicata straight and regular, bearing moderately long serrations, ventral aspect moderately wide with lateral flanges at the base.

Holotype, male: Grantsburg, Illinois, on *Quercus palustris,* August 31, 1951, Richards and Ross. *Paratypes*: 46 males from Grantsburg, Dale, Metropolis and West Karnak, Illinois. These include a series of 26 males from *Quercus lyrata* at West Karnak, which indicates this as the true host. This is corroborated by the restriction of this species to the same host in the 1952 Grantsburg collections.