OVIPOSITOR STUDIES OF THE LEAFHOPPER GENUS ERYTHRONEURA

(HOMOPTERA: CICADELLIDAE)

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Since determination of species in *Erythroneura* is based mainly on wing venation, color pattern, and inner male genitalia, it was believed that a study of ovipositors might lead to discovery of characters that would be of use in identification of females. Such a study was begun in 1937. Most of the work was done at the Stone Laboratory, the remainder at Ashland College. I wish to express my appreciation to Dr. D. M. DeLong for his early assistance in the work; to Dr. F. H. Frison for loan of material from the Illinois Natural History collections; to Mrs. Dorothy J. Knull for identification of specimens, for use of material, and advice; and to Dr. T. H. Langlois, the present Director of the Stone Laboratory, for use of facilities. I also wish to express my appreciation to Ashland College for giving me the opportunity to continue these studies while teaching there.

METHOD OF PREPARATION OF OVIPOSITORS

The tip of the abdomen of a mounted specimen was removed by the use of minuten nadeln. This was soaked in 70% alcohol, using artists' porcelain paint dishes for this purpose. One hour was sufficient for softening, although a longer period of time was not detrimental. The ovipositor sheath and valvulae were then dissected under binoculars with minuten nadeln and dehydrated on the slide by first removing as much of the alcohol as possible with a small piece of cheese cloth. The ovipositor was then shifted to a dry place on the slide after which a drop of dioxane was added and immediately removed with the aid of cheese cloth. Next a drop of thin balsam was placed on the genitalia and a cover glass put in place. The following step was the most delicate of the whole process. The cover slip was gently but firmly rotated in such a manner as to slip the four ovipositor blades apart. This was accomplished with the aid of a heavy, No. 7, insect pin. The position of the heavy-toothed blade was marked with india ink and the slide, after drying for several days, was ready for study. No staining was necessary since the amber color of the chitin gave satisfactory outline of the ovipositor.

INTRA-SPECIFIC COMPARISONS OF OVIPOSITORS

Erythroneura basilaris (Say), *E. compta* McA. and its variety *E. compta* var. *rufomaculata* McA., and *E. tricincta* Fitch were chosen for studies of large series to determine whether there are variations within the species. These were selected because they form well marked series, and individuals of each species were collected from the same host on the same day, indicating that they should belong to identical species. *E. basilaris* (Say) was collected on July 5, 1938, from red elm (*Ulmus fulva*) on North Bass Island, Ohio. *E. compta* McA. on July 22, 1937, from cultivated grapes (*Vitis* sp. and *Muscadinia* sp.) on North Bass Island, Ohio, and *E. tricincta* Fitch on July 19, 1938, from cultivated grapes on Middle Bass Island, Ohio.

Ovipositor slides of 53 specimens of *E. basilaris* (Say), 95 specimens of *E. compta* McA. and 89 of *E. tricincta* Fitch were prepared. After making camera

TABLE I

SHOWING CONFORMITY OF OVIPOSITOR FORM IN SPECIES OF FIVE GROUPS OF *Erythroneura*.

COMES GROUP

	TYPICAL	ATYPICAL		TYPICAL	ATYPICAL
aclys McA.	3		*elegans* McA.	6	
nudata McA.	2		*infuscata* (Gill.)	4	
beameri Rob.	9		*kanwakae* Rob.	9	2
bistrata	9		*ontari* Rob.	10	
cancellata McA.	3		*pontifex* McA.	7	
coloradensis (Gill.)	11		*rubra* (Gill.)	5	
comes (Say)	31	5	*tricincta* Fitch.	9	1
compta McA.	15		*vitifex* Fitch.	4	4
corni Rob.	5		*vitis* (Harris)	14	4
delicata McA.	9	1	*vitis* var. *corona* McA.	13	

MACULATA GROUP

abjecta Beamer	2		*era* McA.	6	
accola McA.	4		*gemina* McA.	3	
adunca Beamer	3		*hartii* (Gill.)	4	
affinis Fitch.	14		*hymac* Rob.	2	1
arta Beamer	10		*illinoiensis* (Gill.)	6	1
basilaris (Say)	15		*ingrata* Beamer	3	
bella McA.	6		*kansana* Baker	4	3, 1, 1
bigemina McA.	2	1	*knighti* Beamer	6	4, 1
brevipes Beamer	4		*lawsoni* Rob.	11	1, 1
calamitosa Beamer	1	1, 1, 1	*lata* Beamer	2	
campora Rob.	7	6, 4, 1	*maculata* (Gill.)	12	2
carmini Beamer	3		*minor* Beamer	3	
certa Beamer	12	4, 2, 2, 1	*morgani* (DeL.)	12	
concisa Beamer	2		*omani* Beamer	4	
confirmata McA.	4		*pallida* Knull and Auten	2	
consueta Beamer	3		*pyra* McA.	8	
contracta Beamer	2	1	*rotunda* Beamer	2	
curvata Beamer	5		*torella* Rob.	3	
delongi Knull and Auten	3		*trivittata* Rob.	3	
dira Beamer	3		*ungulata* Beamer	2	
parallela McA.	5		*usitata* Beamer	5	

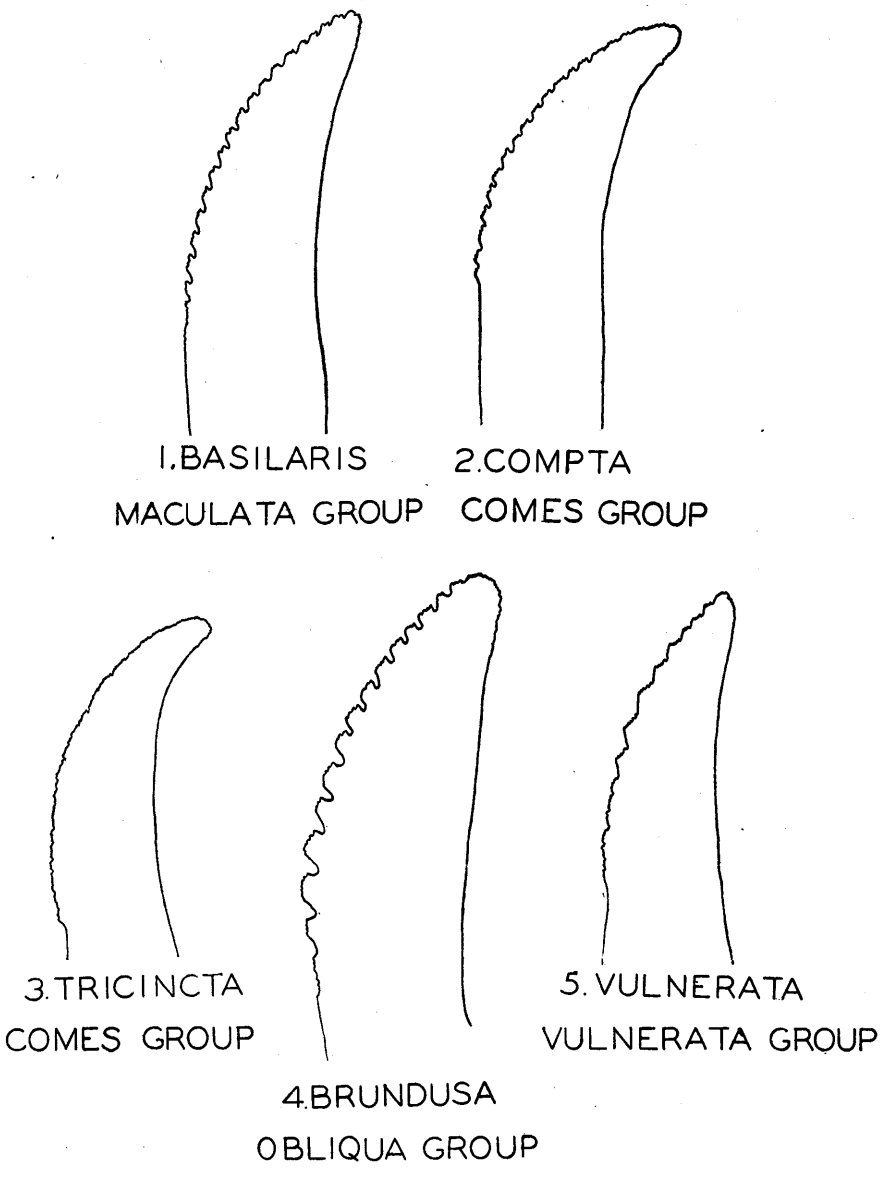
OBLIQUA GROUP

albescens Beamer	6		*funesta* Beamer	6	
angularis Beamer	9	1	*gleditsia* Beamer	3	
apacha Baker	4		*hamata* Beamer	3	
atrimucronata Beamer	2		*kanza* Rob.	7	
bitincta McA.	2		*lawsoniana* Beamer	3	
brundusa Rob.	10		*plena* Beamer	7	
clavata DeL.	4	3	*rubens* Beamer	2	
crevecoeuri (Gill.)	2		*rubroscuta* (Gill.)	3	
cruciformis Beamer	4		*tenuispica* Beamer	5	1
diffisa Beamer	8	4	*tridens* Beamer	2	
electa McA.	2	1	*stolata* McA.	2	
fulvocephala Rob.	4	4, 2, 2			

VULNERATA GROUP

nigerrima McA.	7		*vulnerata* Fitch.	16	
nigra (Gill.)	3		var. *fulmina* McA.	2	

lucida drawings of a sample of each species the other slides were compared with these drawings by placing the slide on the stage of the microscope and following the outline of the ovipositor by means of the camera lucida. This method of checking eliminated making drawings of all 237 slides.



FIGS. 1–5. Projection drawings of the coarse-toothed median valvulae of the ovipositors of five species of *Erythroneura*.

The coarser-toothed median valvula was used for this study although the lateral valvulae and the finer-toothed median valvula may possess interesting characters. The median valvula was found to be different in each species studied. The general

shape of the blade, length of toothed area, and slant and depth of teeth are apparently specific, although minor variations in number of teeth are present.

E. basilaris (Say) in figure 1 shows heavy dentition, general arrangement of the teeth in two subdenticles, and an angular rather than a curved tip, resulting in the ovipositor having an almost straight dorsal edge. All 53 specimens studied showed these characteristics.

E. compta McA. in figure 2 shows that the teeth are of an irregular low type and the tip of the blade is broad and toothed both dorsally and ventrally. The tip is greatly curved, resulting in a concave dorsal margin. All 95 specimens of *E. compta* McA. and its variety *rufomaculata* McA. conformed to this general pattern.

E. tricincta Fitch in figure 3 shows that the teeth are very fine and merely dent the edge of the blade, a constant character. The tip is curved and more pointed than in either *basilaris* or *compta*.

After making studies of the three large series it seemed reasonable to include two smaller series representing the obliqua and vulnerata groups. Ten specimens of *E. brundusa* Rob., a well marked species, were used and all conform to the general pattern illustrated in figure 4. Figure 4 shows coarse teeth, somewhat as in *E. basilaris* (Say) although deeper and not divided into two subdenticles. The dorsal margin is slightly sinuous. Sixteen specimens of *E. vulnerata* Fitch showed the general pattern illustrated in figure 5. In this figure the toothed margin is somewhat of a staircase type, slightly flattened, and with the subdenticles on the riser.

In recapitulation, the characters shown by these drawings, namely, the coarse teeth of two subdenticles in the maculata group, the distinctive curved tip and fine, irregular teeth in the comes group, the very coarse teeth and sinuous dorsal margin in the oblique group, and the staircase angle of the teeth together with the pointed tip extending slightly ventrad in the vulnerata group, are sufficiently definite to be used with color pattern and wing venation to place individuals in their proper group.

INTER-SPECIFIC COMPARISONS OF OVIPOSITORS

The ovipositors of other species of *Erythroneura*, previously identified on the basis of wing venation, color pattern, and association with males, were studied. The results are given in Table I. Number of specimens studied are indicated by the numbers in the columns under the headings "Typical" and "Atypical." A specimen was considered typical if its combination of characters agreed with the characters of the majority of the specimens referred to as that species. Atypical specimens were those which varied from this combination of characters. These variants probably belong to other species and are the result of inability to identify the females with only the aid of wing venation, color pattern, and association of males. As many as four types of variants (species?) were recorded under a species.

From the evidence presented I conclude that the coarser-toothed median valvula of the ovipositor is of sufficient constancy within a species to be of use in identification.

In this paper no attempt was made (1) to make a key for species identification, (2) to describe the detailed characteristics for any species, (3) to describe the variations present within a species, (4) or to describe the variations occurring within a group. That considerable specific differences occur within groups is demonstrated in the compta group, figures 2 and 3, where differences in size and shape of teeth between *compta* and *tricincta* are very evident, yet their group relationship is plainly indicated by marked similarity in the general shape of the median valvula. Obviously the next step is to make keys for species identification, using ovipositor characters together with wing venation and color pattern as is done with the males.