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A REVISION OF THE NORTH AMERICAN CADDISFLY GENUS
BANKSIOLA (TRICHOPTERA: PHRYGANEIDAE)

By

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TORONTO

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ALTHOUGH caddisflies of the genus *Banksiola* are among the larger and more conspicuous North American Trichoptera, the identification of most of the species has been clouded with uncertainty. Positive identification of males and females of most species has not been possible because clear figures of the diagnostic genital structures were not available. Incomplete description has been further complicated by synonymy, and of nine names assigned to *Banksiola*, two emerge as synonyms as a result of the present study. In addition, two species are transferred to other genera. This work is part of a phylogenetic and revisional study of the world phryganeids, but since considerably more work remains to be done before completion of that study, the essential features of recognition and distribution of the species of *Banksiola* are brought together in the present paper.

As defined in this study, the genus *Banksiola* is confined to North America and is composed of five known species. Four of these have been recorded only from the east and one is transcontinental. Keys for the identification of the adults are not given here because males and females of all the species can be readily identified by reference to the illustrations of genital structures.

Following the reference to the original description of each species, there is listed the sex of the holotype specimen, the locality in which it was collected, and the name of the institution where the holotype is deposited. Any subsequent designation of type material is also noted. The references are not complete and only those of importance in the nomenclature or identification of the species are given. All figures for length give the measurement of the specimens from the anterior margin of the head to the apex of the folded wing. Under the known range for each species are listed the provinces and states from which specimens have been examined by the writer. These include all the previously published provincial and state records and, in addition, a number of new records hitherto unpublished.

Banksiola Martynov

Banksiola Martynov, 1924, p. 216. Type species by original designation:
Neuronia concatenata Walker.
Banksiola Ross, 1944, p. 169.

Phryganeids, ranging in length from 12 to 20 mm. Colour varying shades of brown; leg spines black, spurs yellow. Fore wings with a

reticulate pattern of brown markings, running together in places to form irregular blotches; hind wings with a small area of similar reticulations along the apical margin. Venation as in figures 1C and 2B; apical forks as follows¹:

	fore wing	hind wing
♂	1 2 3 - 5	1 2 - - 5
♀	1 2 3 - 5	1 2 - 4 5

Fork 4 in the hind wing of the female is absent occasionally in *B. crotchii* and usually in *B. smithi*.

Males with ninth sternum simple and not produced as a ledge beneath the base of the claspers. Clasper with a dorsal process which is sclerotized and continuous with the body of the clasper laterally; mesally, however, the sclerotization is greatly reduced, and in this nearly membranous mesal area at the base of the dorsal process lies an ovoid sclerite; mesal surface of the clasper base with small tooth-like projections. Aedeagus with prominent spines, either on the bulbous apex or on a membranous extensile appendage. Tenth segment simple and roof-like.

Females with an invaginated pouch in the floor of the opening to the genital chamber, appearing through the wall of the subgenital plate as a membranous fold.

***Banksiola calva* Banks**

Banksiola calva Banks, 1943a, p. 366. Holotype ♂; Medford, Mass.; Mus. Comp. Zool. Harv.

Banksiola cava Banks, 1951, p. 21. Misspelling.

ADULTS. Length: male 13 mm.; female 14 mm. Colour brown. Antennae weakly annulate with light and dark brown. Fore wings with a rather coarse pattern of brown reticulations, intermediate between the fine, dense markings of *B. crotchii* and the coarse blotches of *B. dossuaria*.

Male genitalia (Fig. 1) with clasper produced into a prominent finger-like process, and on the dorsal edge of this process arises a slender pointed lobe; claspers concave mesally, bearing tooth-like projections along the adjoining mesal edges. Aedeagus, a sclerotized tube with an enlarged membranous apex bearing a few stout spines.

Female genitalia (Fig. 2) with subgenital plate terminating in a rather long, broad, truncate lobe with a short point on each lateral corner; on each side of this mesal lobe is a long, slender process.

¹This method of showing the combinations of apical forks present in each wing is used here for the first time. The apical forks are numbered according to a system of long standing in the systematic study of Trichoptera, and clearly illustrated by Mosely and Kimmins (1953: Fig. 4). The — indicates that the particular wing vein is not divided to form an apical fork.

Banksiola calva Banks

FIG. 1A, Terminal abdominal segments of male, lateral view; FIG. 1B, terminal abdominal segments of male, ventral view; FIG. 1C, wing venation of male. FIG. 2A, Terminal abdominal segments of female, ventral view; FIG. 2B, wing venation of female.

RANGE. This species is known only from Massachusetts and New Hampshire.

Banksiola smithi (Banks)

Neuronia smithi Banks, 1914, p. 149. Holotype ♂; Lakehurst, N.J.; Mus. Comp. Zool. Harv.

Banksiola smithi Martynov, 1924, p. 216.

ADULTS. Length: male 13 mm.; female 16 mm. Colour brown. Antennae weakly annulate with light and dark brown. Fore wings with a rather dense pattern of brown reticulations, similar to that of *B. calva*.

Male genitalia (Fig. 3) with clasper having a long, curved dorsal process, immediately below which is a much shorter pointed lobe; ventral portion of each clasper produced posteriorly to form a scoop-

Banksiola smithi (Banks)

FIG. 3, Terminal abdominal segments of male: 3A, lateral view; 3B, ventral view (aedeagus omitted). FIG. 4A, Terminal abdominal segments of female, ventral view; FIG. 4B, outline of apex of subgenital plate of female, ventral view.

like plate which is concave within; mesal edge of each clasper raised in a low, longitudinal ridge with a few tooth-like projections. Aedeagus, an expanded, membranous tube arising from a sclerotized base and bearing sharp spines at the apex.

Female genitalia (Fig. 4) having the apical margin of the subgenital plate usually broad and serrate and with a triangular lobe at each side (Fig. 4A).

In a series from Lakehurst, N.J., variations were noted in the median apical portion of the subgenital plate. In some specimens the serrations were reduced, leaving a smooth edge, although the shape of this portion of the plate remained angular. In other specimens this median apical portion of the subgenital plate was more rounded and the serrations were replaced by a median triangular notch (Fig. 4B). In all cases there was a sharp constriction at each side of the subgenital plate.

This is the only species of *Banksiola* in which fork 4 of the hind wing of the female is usually lacking. In a large series of specimens from Lakehurst, N.J., only a few individuals showed any sign of fork 4. In some the fork was present in both hind wings, and in others present only in one of the hind wings. In still other specimens a separation in M_{3+4} occurred but the two separate branches were fused again before reaching the wing margin, resulting in a closed loop in M_{3+4} .

RANGE. Records are available from Maine, New Hampshire, Massachusetts, New Jersey, New York, and Michigan.

***Banksiola dossuaria* (Say)**

Phryganea dossuaria Say, 1828, p. 97. Salem, Mass.

Banksiola dossuaria Martynov, 1924, p. 216.

Banksiola dossuaria Milne, 1934. Neoholotype ♂, Mt. Mansfield, Vt.; Neoallotype ♀, Shawbridge, Que.; Mus. Comp. Zool. Harv.; designations not previously published.

ADULTS. Length: males 12–13 mm.; females 15–17 mm. Colour brownish orange. Antennae dark brown without annulations. Dorsum of head bright brownish orange. Fore wings with larger and more discrete brown blotches than in the other species, superficially similar to the wing markings of panorpid scorpionflies.

Banksiola dossuaria (Say)

FIG. 5, Terminal abdominal segments of male: 5A, lateral view; 5B, ventral view. FIG. 6, Terminal abdominal segments of female, ventral view.

Male genitalia (Fig. 5) with clasper having two large, finger-like processes; mesal portion of each clasper strongly produced as a stout pedestal with a flat posterior face bearing many tooth-like projections. Aedeagus tubular, terminating in a membranous bulb, and bearing several sharp spines at the apex.

Female genitalia (Fig. 6) with subgenital plate terminating in a median rounded lobe with a pointed process on each side.

RANGE. Records are available from Nova Scotia, Quebec, Ontario, Maine, New Hampshire, Vermont, New York, Massachusetts, Connecticut, and New Jersey.

***Banksiola concatenata* (Walker)**

Neuronia concatenata Walker, 1852, p. 8.

Banksiola concatenata Martynov, 1924, p. 216. Type species of *Banksiola* by original designation.

Neuronia concatenata Betten and Mosely, 1940, p. 88. Lectotype ♀; Georgia; Brit. Mus. (Nat. Hist.).

Banksiola cornuta Banks, 1951, p. 20. Holotype ♂, Cohasset, Mass.; Mus. Comp. Zool. Harv. NEW SYNONYMY.

ADULTS. Length: males 15–16 mm.; females 16–19 mm. Colour brown. Antennae weakly annulate with narrow bands of light brown and wider bands of darker brown. Fore wings with a rather dense pattern of dark brown reticulations, although the markings are not as fine or dense as those of *B. crotchii*.

Banksiola concatenata (Walker)

FIG. 7, Terminal abdominal segments of male: 7A, lateral view; 7B, caudal view; 7C, dorsal view. FIG. 8A, Terminal abdominal segments of female, ventral view; FIG. 8B, variation in apex of subgenital plate of female, ventral view.

Male genitalia (Fig. 7) with clasper produced dorsally into a large finger-like process, bearing two sharp points at the apex; clasper produced ventrally into a sharp ledge which is continuous across the posterior face of the fused clasper bases as a single, broad, concave plate with small tooth-like projections along the lateral margins; between these two projections is a sharp, shelf-like flange. Aedeagus

with a tubular, sclerotized base, from which arises a membranous extensible appendage bearing a terminal brush of short setae.

Female genitalia (Fig. 8) with subgenital plate terminating in four hairy points. Variations have been noted in the material examined. In most specimens the four points were about the same shape (Fig. 8A) but in a series from Lakehurst, N.J., the bases of the median points were united and the lateral points were lengthened (Fig. 8B).

RANGE. I have seen specimens of *concatenata* from Florida, Alabama, Georgia, New Jersey, New York, and Massachusetts.

Mr. D. E. Kimmins of the British Museum (Natural History) has kindly compared specimens from New York with Walker's type from Georgia. He has also sent sketches of the internal genital structure of the type female of *concatenata*. Comparisons have clearly indicated that the type female of *concatenata* Walker belongs to the same species as material now at hand from the eastern United States.

Ever since 1940 when Betten and Mosely's valuable clarification of the Walker types was published, North American students of Trichoptera have been aware that a confusion existed between the true *concatenata* and a more widespread species which had been mistaken for it. This condition was finally corrected when Betten (*in* Ross, 1944) described as *selina* the second species. Prior to that description, however, many records occurred in the literature under the name *concatenata*, which were actually based on specimens of *selina*. So many instances of the confusion of *selina* and *concatenata* have come to light during recent examination of previously identified material that it is now necessary to reject all previous records for *concatenata*, except, of course, those of Walker's original females from Florida and Georgia.

Banks' holotype male of *cornuta* has been examined and is identical with the males of *concatenata* as here described. The figures of various phryganeid species accompanying the description of *cornuta* include one (Banks, 1951, Pl. 2, Fig. 4) of the ventral view of a female subgenital plate which is labelled "*B. cornuta* female". No female was located with the male of *cornuta* in Banks' collection and no other indication was found of the specimen from which the drawing was made. In any event, this is not the female of *concatenata* but is probably that of *dossuaria*.

***Banksiola crotchii* Banks**

Banksiola crotchii Banks, 1943b, p. 80. Holotype ♂; Victoria, B.C.; Mus. Comp. Zool. Harv.

Banksiola selina Betten, *in* Ross, 1944, p. 169. Holotype ♂, Allotype ♀; Zion, Ill.; Ill. Nat. Hist. Sur. **NEW SYNONYMY.**

ADULTS. Length: males 12–15 mm.; females 14–20 mm. Colour brown. Antennae strongly annulate with sharply defined bands of dark

and light brown of equal width. Fore wings with a dense pattern of fine brown reticulations, running together in places to form conspicuous dark blotches.

Banksiola crotchi Banks

FIG. 9, Terminal abdominal segments of male: 9A, lateral view; 9B, caudal view. FIG. 10, Terminal abdominal segments of female, ventral view.

Male genitalia (Fig. 9) with clasper produced dorsally into a stout curved hook bearing a sharp point directed mesally; base of clasper with variously formed tooth-like projections on the mesal surface, and with a larger lobe, variously shaped, on the posteromesal edge. Aedeagus with a tubular, sclerotized base produced into a long, curved plate extending beyond the claspers; arising from this base is a membranous apical portion with an extensile appendage, usually on the left side, and bearing a long patch of short bristles.

Female genitalia (Fig. 10) with subgenital plate consisting of a heavily sclerotized, circular flap sharply constricted off from the remainder of the eighth sternum; at the apex of the plate is a pair of pointed, hairy lobes and between these a thin, hairy plate.

More variation was seen in the material of this species than in any of the others. This may be partly a result of the fact that more specimens of this species were available for study than of all the other species combined. Size was highly variable, with males ranging from 12 to 15 mm. and females from 14 to 20 mm. in length. Fork 4 in the hind wing of the female was present in almost all of the specimens examined, but its position was highly varied. In many specimens the division into M_3 and M_4 was about halfway between the wing margin

and crossvein r-m, while in others the fork was extremely short, with the division just inside the wing margin. Many intermediates occurred, as well. Generally both hind wings of the same individual showed the same position for the fork, but occasionally when the fork was very close to the margin of one wing, it would be completely absent from the other. Material from a single collection often showed many of these variations. Occasionally female specimens were found in which fork 4 did not occur in either hind wing.

Variations in the external genital structures were common. In the male the most conspicuous variation was in the lobes on the posterior face of the clasper base. These ranged from simple, rounded, or somewhat serrate lobes to one or two prominent teeth. Banks (1951: Pl. 2, Figs. 13, 16, 17) has figured some of the marked variations in these lobes from three different eastern localities. Marked variability in these structures was also noted by the present writer in males from the same locality. The form of the lobes shown by Banks (1943b) in the description of *B. crotchii* from British Columbia in which two sharp teeth are separated by a deep notch, is an extreme case of the variations seen. Intermediates between this condition and the low, rounded plate in figure 9B were common, and no clear delineation was apparent for any of the types of lobe formation. Since the shape of these lobes was the major character distinguishing *crotchii* from *selina*, I am considering the two as synonymous names of a single, variable species which must now take the older name *crotchii* Banks.

The subgenital plate of the female was also extremely variable in the material examined. There was marked individual variation in the size and shape of the subgenital plate in specimens from a single locality. The length, shape, and position of the hairy lobes terminating the plate were also highly variable in material from a single locality. The identification of this species, as defined herein, is in no way affected by these variations. The subgenital plate of *crotchii* is quite unlike that of any of the other known species of *Banksiola*.

B. crotchii thus emerges as a variable, transcontinental species. In all of the variations described no geographic trends were apparent. The only suggestion of a geographic correlation in this variation was shown by three females from two localities in Oregon in which there was a very narrow subgenital plate. No other Oregon specimens were available and this variation was not found in other western material.

RANGE. This species is transcontinental in the northern part of North America and extends southward along the east and west sides of the Great Plains. Specimens have been examined from Newfoundland (including both the Island and Labrador), Nova Scotia, Quebec, Ontario, Maine, New Hampshire, Massachusetts, New York, Pennsylvania, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Manitoba, Saskatchewan, Alberta, British Columbia, Oregon, and California.

The immature stages of this species have been figured by Ross

(1944) under the name *selina*. The head of the larva is shown (Ross: Fig. 562) with a median black stripe on the frontoclypeus and the lateral margins of the frontoclypeus are without emargination. Numbers of this same species have been reared from a variety of habitats in Ontario by the present writer and in all cases the frontoclypeus of the larva lacked a median black stripe but did have lateral emarginations. The head of these specimens was indistinguishable from the figure of the larva of Genus A (Ross: Fig. 566). The diagonal black lines on the prothorax sometimes joined before the posterior margin (Ross: Fig. 562) and sometimes at the posterior margin of the prothorax (Ross: Fig. 566).

Dr. Ross kindly loaned his series of reared material of this species, and examination of these specimens has shown that in every case where the frontoclypeal apotome was available, the medium black stripe was absent and the lateral borders were emarginate. Thus the head of the larva of *B. crotchii* (= *selina*) is not as figured by Ross in figure 562, but is similar to figure 566 for the larva of Genus A. The prothoracic markings on some specimens resemble those in figure 562 while on others these markings are more similar to those in figure 566. The pupal structure for this species figured by Ross (Figs. 567, 570) is in agreement with that of specimens reared by the present writer.

Larvae of this species have been collected and reared by the present writer from habitats ranging from small permanent ponds to slow-flowing rivers.

Hagenella canadensis* (Banks) *new combination

Neuronina canadensis Banks, 1907, p. 118. Holotype ♂; Guelph, Ont.; Mus. Comp. Zool. Harv.

Genus ? *canadensis* Martynov, 1924, p. 216.

Oligostomis canadensis Milne, 1934, pp. 5, 8.

Banksiola canadensis Ross, 1944, p. 169.

Banksiola canadensis Leonard and Leonard, 1949, p. 4.

Alleodes canadensis Banks, 1951, p. 21. NEW GENERIC SYNONYMY.

Martynov (1924) erected the genus *Hagenella* for the species *sibirica* Martynov (type species by original designation) and *dentata* Martynov from the U.S.S.R. and *clathrata* Kolenati from northern Europe. To this group has been added *apicalis* Matsumura from Japan (Tsuda, 1942), and now *canadensis* Banks from northeastern North America is also assigned to this genus. *Hagenella canadensis* (Banks) is very similar to *H. sibirica* (Martynov) in general appearance and genital structure. The genus *Alleodes* Banks with *canadensis* as the type species, therefore falls as a synonym of *Hagenella*.

Leonard and Leonard (1949) have figured the male terminalia of this species.

Oligotricha childreni* (Betten and Mosely) *new combination

Neuronia childreni Betten and Mosely, 1940, p. 90. Holotype ♀; locality unknown; Brit. Mus. (Nat. Hist.).

Neuronia childreni Banks, 1943a, p. 367.

Banksiola childreni Ross, 1944, p. 296.

Banksiola childreni Banks, 1951, p. 21.

The venation of the female holotype as figured by Betten and Mosely shows forks 1, 2, 3, 5 in both fore and hind wings. The presence of fork 3 in the hind wing of the female does not agree with any of the known species of *Banksiola*, where fork 3 is absent in the hind wing of the female. Females of the genus *Oligotricha*, however, have venation similar to that of *childreni*.

Although the median lobes of the subgenital plate of the holotype were damaged, Betten and Mosely gave their interpretation of the probable structure. Whether or not their reconstruction of the median lobes is correct may be resolved later, but for present purposes it should be pointed out that the elongate lateral processes of the subgenital plate of *childreni* are more similar to those of *Oligotricha* females than to those of *Banksiola* females. It may also be useful to point out here that figure 43B in Betten and Mosely (1940), showing the terminal abdominal segments of *childreni* in lateral view, has been printed upside down.

The suggestion by Banks (1943a) that *childreni* is the female of *Hagenella canadensis* (Banks) is untenable. While it is true that the wing venation is similar for females of both species, the structure of the female terminalia of *Hagenella* is quite different from that shown in the figures of *childreni*.

Although I have not examined the holotype of *childreni*, I believe present evidence clearly indicates that this species is more closely related to species of *Oligotricha* than to species of *Banksiola*.

ACKNOWLEDGMENTS

The use of material for this study from many persons and institutions is gratefully acknowledged. I am particularly indebted to Mr. Oliver S. Flint, Jr. of Cornell University, to Dr. Herbert H. Ross of the Illinois Natural History Survey, to Dr. George E. Ball of the University of Alberta, to Dr. D. G. Denning of Berkeley, California, and to Dr. Justin W. Leonard of the Michigan Department of Conservation. Appreciation is extended also to those in charge of the insect collections of the Museum of Comparative Zoology at Harvard University, the Canadian Department of Agriculture, the University of Massachusetts, and the Nova Scotia Museum of Science.

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