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AQUATIC INSECTS OF UPPER THREE RUNS CREEK, SAVANNAH RIVER PLANT, SOUTH CAROLINA PART II: DIPTERA[1]

John C. Morse[2], Jay W. Chapin[3], David D. Herlong[4], and Ray S. Harvey[5]

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ABSTRACT

The Diptera fauna of Upper Three Runs Creek and its tributaries on the Savannah River Plant near Aiken, South Carolina, is documented to support ecological investigations by the Savannah River Laboratory. Diptera and other aquatic insects were collected biweekly from September 1976 through August 1977 with light traps and semiquantitative benthic sampling techniques. At least 230 species (13 families) of aquatic flies were identified from 5,948 specimens. At least 52 species and two genera of chironomids appear to be new to science. Several other species are rarely collected or are here reported from South Carolina for the first time. Collectors (gatherers and filterers) accounted for 62% of the total insect fauna, scrapers 15%, predators 12%, and shredders (herbivores and detritivores) 11%. Most of the insects were associated with "snag" habitats.

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Key Words: Ceratoponidae, Chironomidae, Athericidae, Culicidae, Tabanidae, Simuliidae, Tipulidae, Trichoceridae, functional groups, snag habitats

INTRODUCTION

As discussed in detail in Part I of this series (Morse *et al.* 1980), aquatic insects were collected biweekly from six locations on Upper Three Runs Creek, Savannah River Plant near Aiken, South Carolina, from September 1976 through August 1977, using light traps and semi-quantitative benthic sampling methods. See Part I (Morse *et al.* 1980) for site and habitat descriptions and for a discussion of the methods used. In that publication, faunistic results were provided for all insect taxa except Diptera and relative abundance data for all but Diptera and non-dryopoid Coleoptera.

At least 551 species of aquatic insects (including the 230 dipterous species reported here) were identified from 34,206 specimens examined in the study. Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for each species, a revised list of the 25 most commonly collected species is provided in Table 1.

The periods of adult flight activity as indicated by light trap collections, the different life-history stages captured, and overall abundance ranking are indicated in Tables II-VI for each dipterous taxon identified from the drainage system. These findings are summarized below by the five cooperating taxonomic specialists.

CERATOPOGONIDAE

by Walter I. Knausenberger[6]
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At least 41 species or presumed species of biting midges were distinguished among 547 larvae and 17 adults (Table II). This entire assemblage of species is most intriguing in its overall diversity and in the unique distribution of species among tribes and sub-families.

This is easily the largest complement of Nearctic aquatic Ceratopogonidae reported from a single small stream system, especially considering that most specimens were larvae. Reasons for the unusually diverse list include: (a) the specialized collection procedures (including benthic, debris, littoral, and vegetation samples) used in this study were more likely to yield ceratopogonids than standard procedures would be; (b) heretofore, aquatic biologists have been unable to identify their ceratopogonid specimens properly with available literature (but see below); and (c) Upper Three Runs Creek is indeed diverse with respect to ceratopogonids, in comparison with the relevant fauna which

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Table 1. The 25 Most Commonly Collected Benthic Insects

Rank[1]	Taxon	Number of specimens/ Number of times collected[2]	Habit(s)[3]	Trophic relationship(s)[3]
1.0	Polypedilum sp. (Diptera)	983/93	Climbers, clingers	Herbivores, gatherers, predators
2.0	Cheumatopsyche spp. (Trichoptera)	665/88	Clingers	Filterers
3.5	Tribelos sp. (Diptera)	457/56	Clingers	Gatherers, scrapers
3.5	Macronychus glabratus Say (Coleoptera)	315/65	Clingers	Gatherers?, scrapers
5.0	Lepidostoma spp. (Trichoptera)	293/61	Climbers, sprawlers, clingers	Detritivores
6.0	Gonielmis dietrichi (Musgrave) (Coleoptera)	336/55	Clingers, climbers	Gatherers?, scrapers?
7.0	Baetis sp. (Ephemeroptera)	313/58	Swimmers, climbers, clingers	Gatherers, scrapers
8.5	Phylocentropus spp. (Trichoptera)	454/49	Burrowers	Filterers
8.5	Simulium dixiense Stone & Snoddy (Diptera)	598/45	Clingers	Filterers
10.0	Rheotanytarsus sp. (Diptera)	261/55	Clingers	Filterers
11.0	Hydropsyche elissoma Ross (Trichoptera)	327/41	Clingers	Filterers
12.0	Stenonema sp. nr. smithae Traver (Ephemeroptera)	153/59	Clingers	Gatherers, scrapers
13.0	Brachycentrus nigrosoma (Banks) (Trichoptera)	223/44	Clingers	Filterers, scrapers
14.0	Perlesta placida (Hagen) (Plecoptera)	187/52	Clingers	Predators
15.0	Stenelmis markeli Motschulsky (Coleoptera)	259/40	Clingers	Scrapers, gatherers
16.0	Gomphus (Gomphus) sp. (Odonata)	136/49	Burrowers	Predators
17.0	Conchapelopia sp. (Diptera)	147/45	Sprawlers	Predators
18.0	Cricotopus sp. (Diptera)	156/39	Clingers, miners, tube builders	Herbivores, gatherers
19.0	Hexagenia sp. (Ephemeroptera)	223/31	Burrowers	Gatherers
20.0	Caenis sp. (Ephemeroptera)	182/33	Sprawlers	Gatherers
21.0	Paraphaenocladius sp. (Diptera)	96/43	Sprawlers?	Gatherers
22.0	Procladius sp. (Diptera)	191/27	Sprawlers	Predators, gatherers
23.0	Ancyronyx variegata (Germar) (Coleoptera)	84/42	Clingers, sprawlers	Gatherers?, scrapers?
24.0	Triaenodes spp. (Trichoptera)	96/36	Swimmers, climbers	Herbivores
25.0	Stenelmis spp. (Coleoptera)	89/37	Clingers	Scrapers, gatherers

[1] Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for all species.

[2] Out of a total of 125 benthic samples.

[3] Merritt and Cummins, 1978.

the author has examined from other comprehensive collections made in lotic waters of AK, AL, CO, ND, NY, PA, SC, VA, WV, and Ontario. Interestingly, two small spring-fed sandhill streams in North Dakota yielded about 30 species (to my knowledge, a previous high for a small stream), but with a markedly different species distribution among genera (Knausenberger, unpubl. data).

The tribe Sphaeromiini, which usually is greatly under-represented in typical benthos collections, here constitutes a suprising 37.5% of the species and

Table II. Ceratopogonidae

	Form(s)[1]	Rank[2]	Adults taken in Light Traps: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Atrichopogon levis (Coquillett)	A		
Bezzia (Aspinabezzia) prob. glabra (Coquillett)	L	211.0	
Bezzia (B.) sp. 1	L	92.5	
Bezzia (B.) sp. 2	L	258.5	
Bezzia (Phaenobezzia) prob. opaca (Loew)	L	258.5	
Bezzia (Pseudobezzia) setulosa (Loew)	A		
Bezzia (Pseudobezzia) sp. 1	L	258.5	
Bezzia (Pseudobezzia) sp. 2 pulverea (Coquillett) grp.	L	141.0	
Culicoides prob. haematopotus Malloch	L	199.0	
Culicoides sp. poss. venustus Hoffman	L	258.5	
Culicoides sp. prob. crepuscularis Malloch	L	211.0	
Dasyhelea sp.	L	258.5	
Forcipomyia (Caloforcipomyia) glauca Edwards	A		
Forcipomyia (F.) nr. bipunctata (L.)	A		
Forcipomyia (F.) prob. bystraki Grogan & Wirth	A		
Mallochohelea sp. 1	L	188.5	
Mallochohelea sp. 2	L	258.5	
Mallochohelea sp. 3	L	258.5	
Mallochohelea sp. 4 poss. atripes Wirth	L	121.0	
Palpomyia lineata (Meigen)	L	258.5	
Palpomyia sp. poss. plebeia (Loew)	L	211.0	
Palpomyia sp. poss. subaspera (Coquillett)	L	160.5	
Palpomyia sp. 1 poss. tibialis (Meigen) grp.	L	169.0	
Palpomyia sp. 2 poss. plebeiella Grogan & Wirth	L	220.0	
Palpomyia sp. 3 poss. flavipes (Meigen) grp.	L	211.0	
Palpomyia sp. 4 prob. lineata (Meigen)	L	199.0	
prob. Isohelea sp.	L	258.5	
Probezzia (P.) sp. 1 grp.	L	52.0	
Probezzia sp. 2	L	56.0	
Probezzia sp. 3	L	258.5	
Sphaeromiini gen. sp. 1 grp.	L	85.0	
Sphaeromiini gen. sp. 2 grp.	L	76.0	
Sphaeromiini gen. sp. 3	L	99.0	
Sphaeromiini gen. sp. 4	L	115.0	
Sphaeromiini gen. sp. 5	L	258.5	
Sphaeromiini gen. sp. 6	L	258.5	
Sphaeromiini gen. sp. 7	L	152.0	
Sphaeromiini gen. sp. 8	L	199.0	
Stilobezzia (S.) poss. sybleae Wirth	L	183.0	
Stilobezzia prob. (Neostilobezzia) lutea (Malloch)	L	90.0	
Stilobezzia (S.) prob. antennalis (Coquillett)	L	63.0	

[1]A = adult, L = larva, P = pupa

[2]Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for each species

39% of the individuals. This tribe consists of seven genera, combined with perhaps 40 species in the South Carolina region, although few have yet been recorded from that State. The tribe Palpomyiini now has four genera, of which *Bezzia* and *Palpomyia* are most significant. This tribe has a combined total of over 85 Nearctic species. Together, these two tribes constitute the larval "*Palpomyia-Bezzia* complex" of authors. That larvae of this complex can be distinguished in practice is shown by the preliminary species assignments given in Table II.

Sphaeromiine larvae tend to be psammophilic and therefore usually are found primarily in larger rivers and certain lakes having sandy shores. Palpomyiini larvae, which tend to frequent algae, macrophytes, detrital snags and/or soft mud, are also represented by a diverse set of species, a majority of them at site "A". In general, among-site distribution of many species in Upper Three Runs Creek provides useful insight into their habitat preferences.

Atrichopogon, Culicoides and *Dasyhelea* species were decidedly underrepresented, the first and last probably due to their habit of clinging to debris and vegetation, thus escaping detection. One expected genus, *Alluaudomyia*, is not represented at all, probably because the procedures used did not adequately sample the surface film, which members of the genus frequent.

As a rule, and as demonstrated by the present results, adult captures by light trap tend to be quite unrepresentative of benthic populations of ceratopogonids in running waters (and lakes). However, many species of *Culicoides* do come to lights, and their absence from the light trap record suggest that this stream system may not offer sufficient suitable habitat for signifi-

cant *Culicoides* populations to develop. All the Forcipomyiinae recorded here are at most semi-aquatic: *Atrichopogon levis* lives on damp soil with algae or moss in shaded depressions subject to flooding, and *Forcipomyia* spp. typically live under the bark of dead trees.

Finally the prominent use of qualifiers, such as "prob." and "poss." (but not ":" – see Knutson *et al.* 1980), in the species list is apparent, as is also that over one-half of the species are identified by numbers. These factors can be attributed to (a) the underdeveloped status of larval systematics in Ceratopogonidae, and reflects reasoned prudence in identification of specimens from unassociated larval material for which many species and even genera are not known, or for which existing gaps make definite species assignments inadvisable at present; and (b) the fact that many speciments were not in the last instar, for which characters are most fully developed. Of course, this is a fairly characteristic situation for larval Diptera in general and midges in particular. Undoubtedly, at least a few of these specimens represent species entirely new to science, while for a majority of the larvae, descriptions have not been published yet. However, this state of affairs is improving (Glukhova 1977, 1979; Grogan and Wirth 1979; Knausenberger in diss., Wirth and Grogan 1979). Continued progress depends upon refined collection procedures and association of larvae with their respective adults by rearing.

CHIRONOMIDAE

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A total of at least 146 species of Chironomidae were identified among 4,359 larvae, pupae, and adults examined (Table III). Identifications were based on adult taxonomy except where immatures were distinctive enough not to be confused with adults of the same or similar species. Many of the identifications are tentative because the material was limited, or published information defining generic or species limits was inadequate. This inadequacy was particularly evident for at least 52 undescribed species and two new genera. All these forms will ultimately be described by various authorities and some differences may be interpreted as representing specific variation. Description of the new *Larsia* species, the species of Tanytarsini and *Pseudorthocladius*, and the two new genera are being prepared by the specialists indicated in Table III.

The total number of species collected is close to the 143 collected by Coffman (1973) in Linesville Creek, an 8-9 km long woodland stream in western Pennsylvania. His list was based on pupal collections and probably represents only aquatic forms. Because the Upper Three Runs Creek identifications were based largely on adults, they contain semiterrestrial forms, terrestrial forms, and possibly adults from other bodies of water. This sam-

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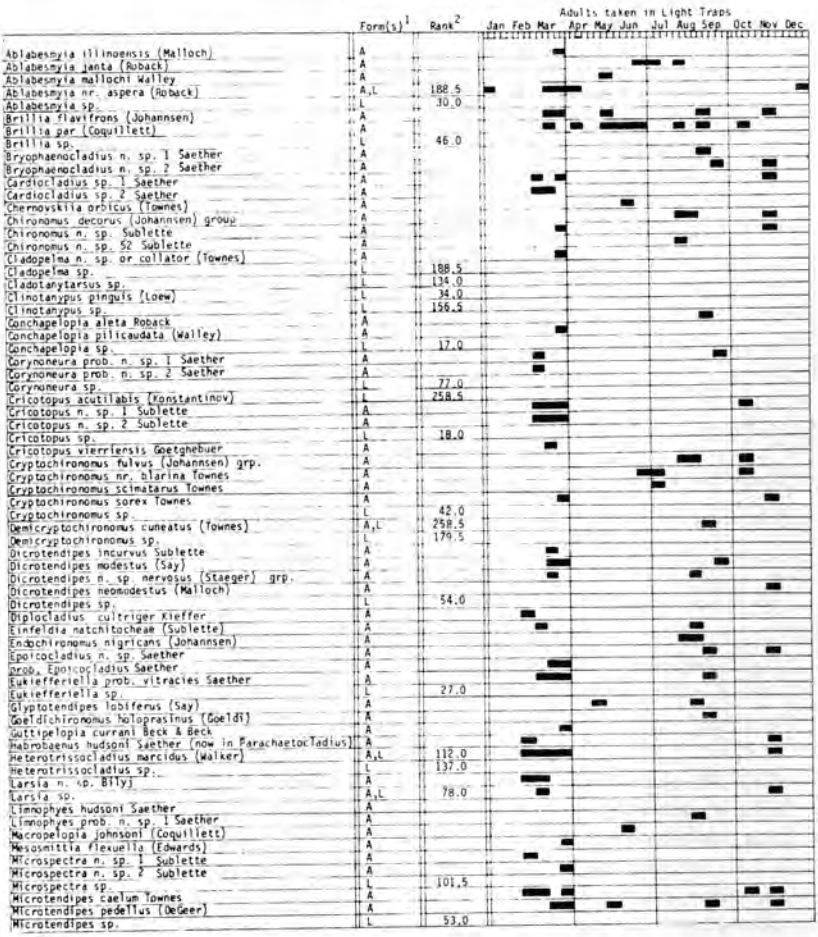
Table III. Chironomidae

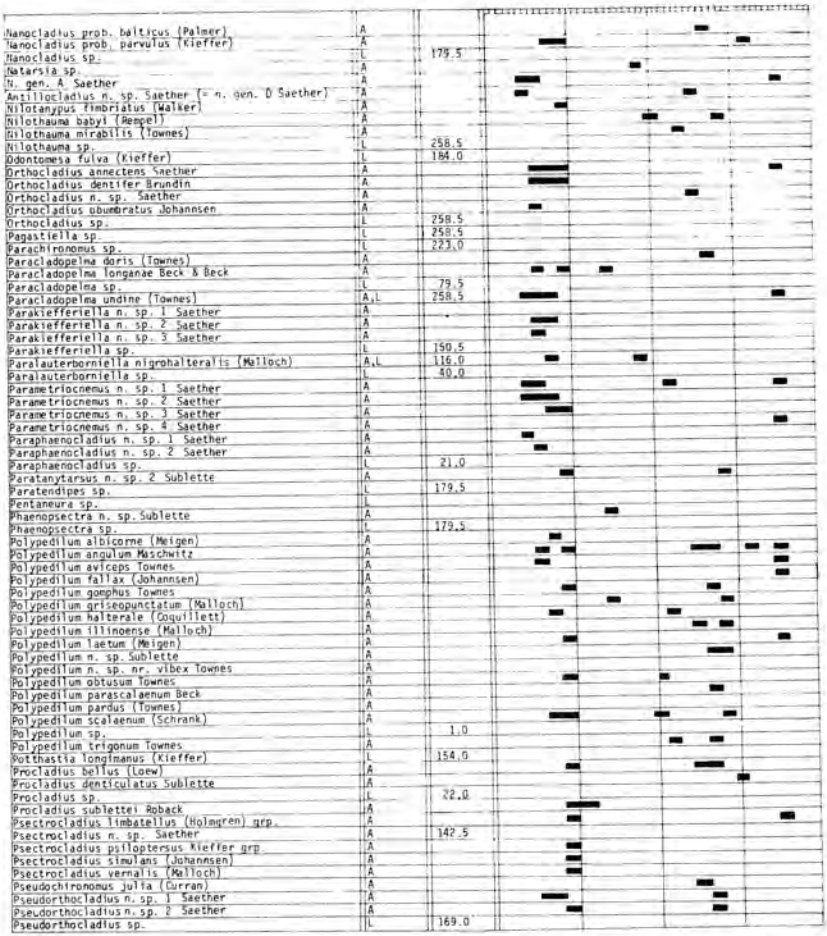


	Form(s)[1]	Rank[2]
Ablabesmyia illinoensis (Malloch)	A	
Ablabesmyia janta (Roback)	A	
Ablabesmyia mallochi Walley	A	
Ablabesmyia nr. aspera (Roback)	A,L	188.5
Ablabesmyia sp.	L	30.0
Brillia flavifrons (Johannsen)	A	
Brillia par (Coquillett)	A	
Brillia sp.	L	46.0
Bryophaenocladius n. sp. 1 Saether	A	
Bryophaenocladius n. sp. 2 Saether	A	
Cardiocladius sp. 1 Saether	A	
Cardiocladius sp. 2 Saether	A	
Chernovskiia orbicus (Townes)	A	
Chironomus decorus (Johannsen) group	A	
Chironomus n. sp. Sublette	A	
Chironomus n. sp. 52 Sublette	A	
Cladopelma n. sp. or collator (Townes)	A	
Cladopelma sp.	L	188.5
Cladotanytarsus sp.	L	134.0
Clinotanypus pinguis (Loew)	L	34.0
Clinotanypus sp.	L	156.5
Conchapelopia aleta Roback	A	
Conchapelopia pilicaudata (Walley)	A	
Conchapelopia sp.	L	17.0
Corynoneura prob. n. sp. 1 Saether	A	
Corynoneura prob. n. sp. 2 Saether	A	
Corynoneura sp.	L	77.0
Cricotopus acutilabis (Konstantinov)	L	258.5
Cricotopus n. sp. 1 Sublette	A	
Cricotopus n. sp. 2 Sublette	A	
Cricotopus sp.	L	18.0
Cricotopus vierriensis Goetghebuer	A	
Cryptochironomus fulvus (Johannsen) grp.	A	
Cryptochironomus nr. blarina Townes	A	
Cryptochironomus scimatarus Townes	A	
Cryptochironomus sorex Townes	A	
Cryptochironomus sp.	L	42.0
Demicryptochironomus cuneatus (Townes)	A,L	258.5
Demicryptochironomus sp.	L	179.5
Dicrotendipes incurvus Sublette	A	
Dicrotendipes modestus (Say)	A	
Dicrotendipes n. sp. nervosus (Staeger) grp.	A	
Dicrotendipes neomodestus (Malloch)	A	
Dicrotendipes sp.	L	54.0
Diplocladius cultriger Kieffer	A	
Einfeldia natchitocheae (Sublette)	A	
Endochironomus nigricans (Johannsen)	A	
Epoicocladius n. sp. Saether	A	
prob. Epoicocladius Saether	A	
Eukiefferiella prob. vitracies Saether	A	
Eukiefferiella sp.	L	27.0
Glyptotendipes lobiferus (Say)	A	
Goeldichironomus holoprasinus (Goeldi)	A	
Guttipelopia currani Beck & Beck	A	
Habrobaenus hudsoni Saether (now in Parachaetocladius)	A	
Heterotrissocladius marcidus (Walker)	A,L	112.0
Heterotrissocladius sp.	L	137.0
Larsia n. sp. Bilyj	A	
Larsia sp.	A,L	78.0
Limnophyes hudsoni Saether	A	
Limnophyes prob. n. sp. 1 Saether	A	
Macropelopia johnsoni (Coquillett)	A	
Mesosmittia flexuella (Edwards)	A	
Microspectra n. sp. 1 Sublette	A	
Microspectra n. sp. 2 Sublette	A	
Microspectra sp.	L	101.5
Microtendipes caelum Townes	A	
Microtendipes pedellus (DeGeer)	A	
Microtendipes sp.	L	53.0

pling bias is counterbalanced (in terms of both number of individuals and number of species) by the fact that many adults of aquatic species do not readily come to lights and may thus avoid capture. Several generic determinations were made only on larval material which could have contained multiple species. Considering all these sampling problems, the number of chironomid species recorded for Upper Three Runs Creek is probably higher than the number that actually exists in the stream itself.

The most diverse and abundant genus is *Polypedilum.* This group was very common in the larval collections; this is probably indicative of emphasis on "snag" habitats rather than because of overall abundance. Larvae of a number of species probably were not collected because of their small size or because certain types of habitats were difficult to sample. Because of the large number of undescribed species and limited knowledge of chironomid distribution, it is not realistic to comment on range extensions.

Table III. Chironomidae (continued)



Nanocladius prob. balticus (Palmer)	A	
Nanocladius prob. parvulus (Kieffer)	A	
Nanocladius sp.	L	179.5
Natarsia sp.	A	
N. gen. A Saether	A	
Antillocladius n. sp. Saether [= n. gen. D Saether]	A	
Nilotanypus fimbriatus (Walker)	A	
Nilothauma babyi (Rempel)	A	
Nilothauma mirabilis (Townes)	A	
Nilothauma sp.	L	258.5
Odontomesa fulva (Kieffer)	L	184.0
Orthocladius annectens Saether	A	
Orthocladius dentifer Brundin	A	
Orthocladius n. sp. Saether	A	
Orthocladius obumbratus Johannsen	A	
Orthocladius sp.	L	258.5
Pagastiella sp.	L	258.5
Parachironomus sp.	L	223.0
Paracladopelma doris (Townes)	A	
Paracladopelma longanae Beck & Beck	A	
Paracladopelma sp.	L	79.5
Paracladopelma undine (Townes)	A,L	258.5
Parakiefferiella n. sp. 1 Saether	A	
Parakiefferiella n. sp. 2 Saether	A	
Parakiefferiella n. sp. 3 Saether	A	
Parakiefferiella sp.	L	150.5
Paralauterborniella nigrohalteralis (Malloch)	A,L	116.0
Paralauterborniella sp.	L	40.0
Parametriocnemus n. sp. 1 Saether	A	
Parametriocnemus n. sp. 2 Saether	A	
Parametriocnemus n. sp. 3 Saether	A	
Parametriocnemus n. sp. 4 Saether	A	
Paraphaenocladius n. sp. 1 Saether	A	
Paraphaenocladius n. sp. 2 Saether	A	
Paraphaenocladius sp.	L	21.0
Paratanytarsus n. sp. 2 Sublette	A	
Paratendipes sp.	L	179.5
Pentaneura sp.	L	
Phaenopsectra n. sp. Sublette	A	
Phaenopsectra sp.	L	179.5
Polypedilum albicorne (Meigen)	A	
Polypedilum angulum Mäschwitz	A	
Polypedilum aviceps Townes	A	
Polypedilum fallax (Johannsen)	A	
Polypedilum gomphus Townes	A	
Polypedilum griseopunctatum (Malloch)	A	
Polypedilum halterale (Coquillett)	A	
Polypedilum illinoense (Malloch)	A	
Polypedilum laetum (Meigen)	A	
Polypedilum n. sp. Sublette	A	
Polypedilum n. sp. nr. vibex Townes	A	
Polypedilum obtusum Townes	A	
Polypedilum parascalaenum Beck	A	
Polypedilum pardus (Townes)	A	
Polypedilum scalaenum (Schrank)	A	
Polypedilum sp.	L	1.0
Polypedilum trigonum Townes	A	
Potthastia longimanus (Kieffer)	L	154.0
Procladius bellus (Loew)	A	
Procladius denticulatus Sublette	A	
Procladius sp.	L	22.0
Procladius sublettei Roback	A	
Psectrocladius limbatellus (Holmgren) grp.	A	
Psectrocladius n. sp. Saether	A	142.5
Psectrocladius psilopterus Kieffer grp.	A	
Psectrocladius simulans (Johannsen)	A	
Psectrocladius vernalis (Malloch)	A	
Pseudochironomus julia (Curran)	A	
Pseudorthocladius n. sp. 1 Saether	A	
Pseudorthocladius n. sp. 2 Saether	A	
Pseudorthocladius sp.	L	169.0

MISCELLANEOUS DIPTERA

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At least 17 species of miscellaneous dipterans in nine families were identified from 146 larvae and adults (Table IV). All identifiable species were typical of the southeastern fauna and no new range extensions were found. The three species of *Anopheles* collected all bite man and are a source of annoyance when numerous.

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Table III. Chironomidae (continued)

			Adults taken in Light Traps: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Rheocricotopus kenorensis Saether	A		
Rheocricotopus n. sp. Saether	A		
Rheocricotopus sp.	L	49.5	
Rheotanytarsus n. sp. 2 Sublette	A		
Rheotanytarsus n. sp. 3 Sublette	A		
Rheotanytarsus n. sp. 4 Sublette	A		
Rheotanytarsus n. sp. 5 Sublette	A		
Rheotanytarsus sp.	L	10.0	
Robackia claviger (Townes)	A		
Smittia n. sp. 1 Saether	A		
Smittia n. sp. 2 Saether	A		
Smittia n. sp. 3 Saether	A		
Smittia n. sp. 4 Saether	A		
Stempellina n. sp. 2 Sublette	A		
Stempellinella n. sp. 3 Sublette	A		
Stenochironomus hilaris (Walker)	A		
Stenochironomus macateei (Malloch)	A		
Stenochironomus poecilopterus (Mitchell)	A		
Stenochironomus sp.	L	88.0	
Stictochironomus sp.	L	144.0	
Synorthocladius semivirens (Kieffer)	A,L	258.5	
Synorthocladius sp.	L	160.5	
Tanypus punctipennis Meigen	A		
Tanytarsus dendyi Sublette	A		
Tanytarsus n. sp. 1 Sublette	A		
Tanytarsus n. sp. 2 Sublette	A		
Tanytarsus n. sp. 3 Sublette	A		
Tanytarsus n. sp. 4 Sublette	A		
Tanytarsus n. sp. 5 Sublette	A		
Tanytarsus n. sp. 7 Sublette	A		
Tanytarsus n. sp. 13 Sublette	A		
Tanytarsus n. sp. 16 Sublette	A		
Tanytarsus sp.	L	31.5	
Thienemanniella partita Schlee	A		
Thienemanniella sp.	L	43.5	
Tribelos jucundus (Malloch)	A		
Tribelos sp.	L	3.5	
Zavrelimyia sinuosa (Coquillett)	A		
Zavrelimyia sp.	L	145.5	

[1]A = adult, L = larva, P = pupa

[2]Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for each species

Specimens of *Chrysops* spp. were more common than any other of these insects. At least three species were represented according to M. A. Tidwell (personal communication). All apparently were undescribed in the larval stage and not included among tabanid larvae previously reported from other parts of the Southeast (Tidwell 1973).

Specimens of Cecidomyiidae were second only to the Tabanidae in total number collected. All were free living, larval forms from a single collection and appeared to be of a single species.

Table IV. Miscellaneous Diptera

	Form(s)[1]	Rank[2]	Adults taken in Light Traps: Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ATHERICIDAE:			
Atheria lantha Webb	L	138.0	
CECIDOMYIIDAE:			
Gen. sp.	L	172.5	
CHAOBORIDAE:			
Chaoborus punctipennis (Say)	A		
CULICIDAE:			
Aedes sp.	A		
Anopheles crucians-georgianus complex	A		
Anopheles punctipennis (Say)	A		
Anopheles quadrimaculatus Say	A		
Culex sp.	A		
Uranotaenia sapphirina (Osten Sacken)	A		
DIXIDAE:			
Dixa sp.	L	110.0	
EMPIDIDAE:			
Hemerodromia sp.	L	258.5	
PTYCHOPTERIDAE:			
Bittacomorpha sp.	L	258.5	
STRATIOMYIIDAE:			
Odontomyia sp.	L	258.5	
Solva pallipes Loew	A,L	258.5	
TABANIDAE:			
Chlorotabanus crepuscularis (Bequaert)	A,L	258.5	
Chrysops spp.	L	68.0	
Tabanus molestus Say	A		
Tabanus sp.	A		

[1]A = adult, L = larva, P = pupa

[2]Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for each species

SIMULIIDAE

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Five species of black flies were identified from 796 specimens of larvae and pupae (Table V). *Simulium dixiense* was by far the most abundant, comprising more than 76% of specimens collected. Although *Ectemnia invenusta* was recorded previously from South Carolina, as *Cnephia invenusta*, by Noblet *et al.* (1978) from Chesterfield, Kershaw, Marion, and Richmond counties, this apparently is the first record for Aiken County. It is interesting to note that this species is primarily northern in distribution being recorded from Ontario, Quebec, Minnesota, Maine, and New York. I have seen no distribution records of this species in the area between New York and South Carolina. Both Davies *et al.* (1962) and Stone (1964) report that the immature stages are found in deep, swift flowing streams, sometimes up to four feet in depth which could explain why it is lacking in collections from states between New York and South Carolina.

The other species *S. jenningsi, S. tuberosum*, and *S. jonesi* are commonly collected in the Southeast.

Table V Simuliidae

	Form(s)[1]	Rank[2]	Adults taken in Light Traps: Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec
Ectemnia invenusta (Walker)	L	81.0				
Simulium dixiense Stone & Snoddy	P,L	3.5				
Simulium jenningsi Malloch	L	258.5				
Simulium jonesi Stone & Snoddy	P,L	51.0				
Simulium sp.	L	33.0				
Simulium tuberosum (Lundstroem)	L	145.5				
Simulium venustum/vericundum/tuberosum grp.	P	211.0				

[1] A = adult, L = larva, P = pupa

[2] Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for each species

TIPULIDAE AND TRICHOCERIDAE

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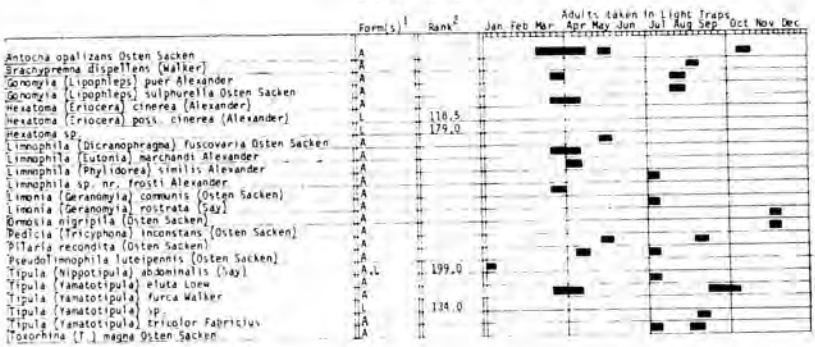
At least 21 aquatic species of Tipulidae were identified from 100 adults and larvae (Table VI). Most of the crane flies collected during this survey belong to species that have broad ranges in eastern North America. Many, in fact, have been recorded from southeastern Canada southward to Florida and westward to the Mississippi River valley or the central plains. For some of these, however, records from South Carolina are not common and are more likely to be from the mountainous northwestern part of the State. An example (but not an aquatic species) is *Dolichopeza americana* Needham, the previously known range of which extended from central Georgia northeastward to Labrador and northwestward to South Dakota, Alberta, and Alaska, with records for only Greenville and Pickens counties in South Carolina.

Table VI. Tipulidae



[1]A = adult, L = larva, P = pupa

[2]Based on an average, for all benthic samples, of ranked numerical abundance and ranked frequency of collection for each species

Tipulid species whose ranges have been extended by this survey, or which are otherwise notable, include the following:

Antocha (Antocha) opalizans Osten Sacken – primarily a boreal species, known previously from Quebec and Maine westward to Wisconsin and southwestward to northern Georgia, mainly along the Appalachian Mountains because in the larval form the species inhabits riffles in clear, cool streams.

Pedicia (Tricyphona) inconstans (Osten Sacken) – widespread in eastern North America, from Newfoundland and westward to Minnesota and southwestward to Missouri and Georgia, but to my knowledge not previously recorded from South Carolina. Common in wet margins of small streams and in swamps.

Limnophila (Euphylidorea) similis Alexander – specimens from the survey area represent a taxonomically confusing group of flies (the *similis* species group) in which species have been recognized largely on the basis of relatively minor color differences. The typical *similis* is recorded from New York, New England, and adjacent Ontario; *consimilis* Dietz occurs in that area but also westward to Michigan and southwestward along the Appalachians to Tennessee and North Carolina. Seven other nominal species occur within this range, one of them, *subsimilis* Alexander, in eastern Tennessee. The sample from the Upper Three Runs area includes both what I regard as typical *similis* and specimens that could be identified as *consimilis*. The group are species of mesic woodlands bordering small streams and swamps.

Limnophila (Euphylidorea) sp. near *frosti* Alexander and *lutea* Doane – represented by two small males with body length only about 4 mm; with elongate, slender, outwardly bowed and sharply tipped gonapophyses; wings strongly tinged with yellowish brown and exhibiting, in several cells, paler zones paralleling main longitudinal veins, as described for *L. frosti*, but lacking a distinct stigmal spot. *Limnophila frosti* is known from the female only, from central Florida.

Limnophila (Eutonia) marchandi Alexander – has been recorded from New England westward to Michigan and southwestward to northern Florida,

but it is an uncommon species and I am not aware of any previous collections of it from South Carolina. It is typical of swampy woods, thus is not particularly a montane species and may not occur in the northwestern part of the State.

The following five species, though not aquatic, were taken in the light traps and represent new records for South Carolina:

Tipulidae - crane flies

Tipula (Schummelia) annulicornis Say – generally a northeastern species, recorded earlier from New England westward to Michigan, Indiana, and southwestward to eastern Tennessee. Its larvae probably occur in damp, organic soil.

Tipula (Triplicitipula) perlongipes Johnson – described from Florida but probably widespread in southeastern United States; recorded heretofore from Florida, North Carolina, Indiana, and Kansas. The larvae are almost surely terrestrial, in woodland soil.

Trichoceridae - winter crane flies

Trichocera bimacula Walker – common and widespread, recorded earlier from Nova Scotia westward to Wisconsin and Kansas, southwestward to North Carolina. Its larvae occur in decomposing matter such as a leaf litter.

Trichocera brevicornis Alexander – recorded heretofore only from Georgia. Terrestrial, probably in leaf litter, as larvae.

Trichocera fattigana Alexander – known previously from Georgia, Tennessee, and Illinois. Larvae terrestrial, in damp, decomposing leaf litter.

DISCUSSION

Even with the addition of the Diptera to the list of most common taxa in Upper Three Runs Creek, the dominance of species requiring stable solid substrates is high; climbers, clingers, and sprawlers (Merritt and Cummins 1978) constitute 89% of the total specimens in Table I. Of these most common species, only *Phylocentropus* spp., *Gomphus (Gomphus)* sp., and *Hexagenia* sp. are burrowers in the homogeneous, sandy stream bottom. These findings invite ecological research into the significance of insect communities of vascular hydrophytes (especially *Vallisneria*) and other so-called "snag" habitats in flowing waters.

Another surprising result of these investigations (Fig. 1) is the predominance of collectors (gathers and filterers; 62%) and the small proportion of shredders (herbivores and detritivores; 11%) among the major taxa from Table I. In these computations, the total number of specimens for each taxon was distributed evenly among the various trophic relationships cited for it by Merritt and Cummins (1978). Comparing the insect trophic structure for Upper Three Runs Creek with Cummins' model (*e.g.*, 1977) further demonstrates the remarkable divergence of this community from other stream communities investigated, again suggesting an important role for snag habitats in sandy bottomed streams.

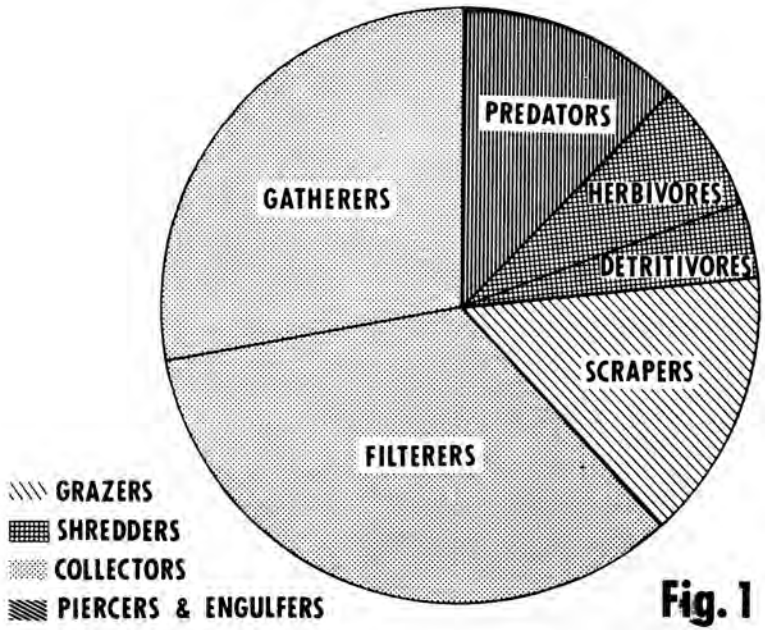


Fig. 1. – Proportions of tropic relationships of the 25 most common benthic insect taxa in Upper Three Runs Creek and its tributaries (from Table I); collectors-filterers = 34%, collectors-gatherers = 28%, scrapers = 15%, predators = 12%, shredders-herbivores = 7%, shredders-detritivores = 4%.

The overall diversity reported for this stream (at least 551 insect species) and the numerous range extensions and previously undescribed taxa (at least 62 new species and two new genera) mentioned above and in Part I of this series (Morse *et al.* 1980) may be attributed to at least four factors: (1) the use of semi-qualitative, rather than exclusively quantitative, benthic sampling techniques, (2) the use of light traps for capturing more thoroughly identifiable adults, (3) the relarively high intensity of sampling (biweekly for a full year), and (4) the cooperation of so many first-rate taxonomic specialists, including 14 section authors and the various colleagues whose assistance they solicited. The checklist, in particular, is longer than any we know for comparable streams in North America.

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