*Dasyhelea oppressa* Thomsen

ALABAMA: Town Creek, March 24 (L & P-14), April 25 (P-3), May 12 (L-11), June 8 (P-1); Waterloo, March 4 (L-3). MISSISSIPPI: Tishomingo, June 2 (P-2). TENNESSEE: Bluff City, July 19 (P-1); Johnson City, July 19 (P-8); Sugar Tree, May 14 (JT-8); Maynardville, April 12 (L-3).

Adults of *D. oppressa* were reared from a stump hole; tree holes in red oak, white oak, and beech; and from exuding sap on the trunk of an elm tree.

*Monohelea stonei* Wirth

ALABAMA: Greenbrier, June 11 (RT-1).

One female specimen was collected in a rotary trap operating in a pasture at the edge of Beaverdam Swamp during the dusk period. We have not previously found this genus or species in Alabama.

*Sphaeromias longipennis* Lw.

TENNESSEE: Washington, April 20 (P-1).

A male of this species was reared from a clump of woolgrass on the margin of Chickamauga Reservoir with *C. piliferus*. It is our first record for this genus and species in the Tennessee Valley.

*Stilobezzia bulla* Thomsen

ALABAMA: Wright, June 29 (P-2).

Two pupae of *S. bulla* were found in clumps of sedges on the margin of Pickwick Reservoir with those of *C. stellifer*. This is our first record for this species in the Tennessee Valley.

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# OBSERVATIONS ON BLACKFLIES (SIMULIIDAE) IN THE TENNESSEE RIVER BASIN

W. E. Snow, Eugene Pickard, and J. B. Moore*

A comprehensive survey of biting Diptera (Culicidae, Heleidae, Simuliidae, and Tabanidae) which originate in reservoirs of the Tennessee Valley Authority and in tributary portions of the Tennessee River Basin was undertaken in the years 1953-1955. Incidental observations were made in 1956. The objectives of this study of biting insects were to determine: (1) the species composition, distribution ,seasonal activity, and economic importance, (2) the effects of the current water level schedules on production, and (3) the effects of the current larvicidal program and other measures (for the control of *Anopheles quadrimaculatus* mosquitoes) on the biting insect populations. This paper deals primarily with the ecology and distribution of the blackflies observed in the Tennessee River Basin during the course of this investigation.

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*History*

Information reported in the literature on the occurrence of blackflies in the Tennessee Valley has been scant and generally limited to the eastern portion of the watershed. Underhill (1939) collected larvae and pupae of *Simulium jenningsi* Mall. (as *S. nigroparvum* Twinn) from the Clinch River in the southwestern part of Virginia. In a study of adult insects found on summer foliage in the Great Smoky Mountains, Whittaker (1952) (corresp., 1956) observed *S. parnassum* Mall. and *S. venustum* Say at lower elevation and *Prosimulium hirtipes* (Fries) sparingly from 3,100-5,600 ft.

This paper records at least 15 species of blackflies that occur in the Tennessee Valley and are included in the genera *Cnephia* (1), *Prosimulium* (2), and *Simulium* (12). Three of the 12 species of *Simulium* are as yet undescribed and apparently occur infrequently. The numerical designations applied to the undescribed species reported for this region are those suggested by Dr. Alan Stone (corresp., 1956). Unpublished records of blackflies in the Tennessee Valley by A. F. Bartsch at Kingsport, Tennessee, and Calvin M. Jones at DeSoto Falls, Ft. Payne, Alabama, have been included with due recognition in the distribution records included at the end of the paper. The generic interpretations for species of the family Elmidae covered in this paper are those of Sanderson (1955).

*Methods*

Because of the vast area involved and the necessity of including other families of biting Diptera in the survey, it was not possible to sample black fly collecting stations regularly through the year. Numbers of larvae and pupae per unit rock or grass blade were recorded, but no quantitative estimate of populations was attempted . Rearing methods as mentioned by Stone and Jamnback (1955) were attempted only for pupae. When possible, pupae attached to grass leaves, stems, or twigs were preferred as

the adult was afforded a suitable temporary resting site after emergence. If the vial was plugged with cotton (rather than a cork), excessive condensation was prevented on the inside of the vial which might otherwise trap newly emerged adults before hardening sufficiently. If large numbers of pupae were found on rocks, they were often confined beneath a bell jar when practical and allowed to emerge with caddisflies and other associated forms. While on collecting trips quart size ice cream cartons with screen wire in the top or paper bags were used to confine pupae on clumps of grass taken from stream beds until emergence occurred. After all blackfly emergence had occurred, the debris could be shaken over a cloth or paper and the elmids picked up. It was not uncommon to have emergence of tendipedids from these clumps of grass.

Adult flies were captured at light, on vegetation, in cars, and while biting various mammalian hosts. The number of flies biting per ear for hosts other than man was used as the standard estimate of annoyance.

*Areas of Observations and Blackfly Associations*

Although the Tennessee River watershed extends into seven southeastern states, its main impoundages are confined to Alabama and Tennessee. At full pool elevation, 10,336 miles of shoreline are included in the reservoir system of the TVA.

For the purposes of this report the blackflies in the Tennessee Valley have been grouped in three major study areas: (1) an eastern mountainous area, (2) a limestone lowland area, and (3) a western low hilly area.

*Eastern Mountainous Area*

The eastern mountainous area is a combination of the mountain masses and the ridge and valley system shown in fig. 1. The mountain masses occupy the southeastern 20.6 percent of the valley and include the Great Smoky Mountains National Park. They are geologically very old and complex and rise to heights of over 6,000 feet. This is often referred to as the Southern Blue Ridge province of the Appalachian Mountain system extending from Georgia and Alabama northeastward into New England. Swift-flowing mountain streams bordered by rhododendron and mountain laurel are characteristic. The ridge and valley section bounds the mountain masses on their north and west, constituting approximately 27.7 percent of the Tennessee Valley. The uplifting of the Appalachian Mountain system subjected the bordering rocks to enormous compressive forces, particularly those thrust against the Cumberland Plateau, thus leading to faulting, folding, and tipping of the rock strata. Subsequent erosion removed the softer materials thus making the valleys, while the harder materials stand as more or less continuous northeast-

southwest ridges ranging in elevation from 1,200-2,550 feet. From the air this section appears as a great series of waves, with oak and pine forests on the wave crests and cleared, cultivated lands forming the smooth troughs between. These ridges and valleys are part of that great similar belt extending from the Champlain Lowlands of upper New York through eastern Pennsylvania, Virginia, and to Birmingham, Alabama. With the formation of relatively large bodies of water behind dams and accumulation of silt from extensive cultivation of the main river valleys, blackfly propagation appears generally limited to the clearer free-flowing tributary systems.

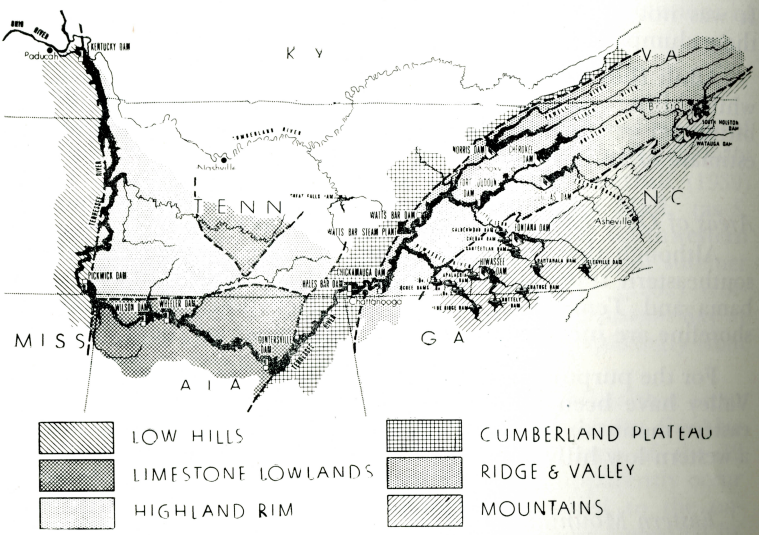


Fig. 1. Physiographic map of the Tennessee Valley.

The highest average annual precipitation for the watershed is 84.04" recorded in the eastern mountainous section (Great Smoky Mountains) at elevation 6,400' on Clingmans Dome. Rainfall in the ridge and valley section along the northwest edge of the mountain shows Rogersville, Tennessee (elevation 1,375') with average annual rainfall of 44.40" and lower monthly averages in October (2.51") and in November (2.63"). Kingsport and Bristol, Tennessee, to the northeast show average annual rainfall of 46.07" and 40.21", respectively. Along the hilly southwest edge of the mountains precipitation is noticeably heavier with Andrews, North Carolina, (elevation 1,840') having an annual average of 60.74" and lower monthly averages in October (3.44") and November (3.58"). Chatuge Dam (elevation 1,930') near Hayesville, North Carolina, has an annual average of 51.71", and

Murphy, North Carolina, along Hiwassee Reservoir records an annual average of 55.59". Taken as a whole the eastern portion of the Tennessee Valley watershed sampled southwest of the mountainous area has experienced highest rainfall in the early part of the year, particularly March, and lowest rainfall in the fall, especially October. However, in the ridge and valley stations along the northwest edge of the mountains, heaviest rainfall occurs in July and is lightest in September and October. During April water temperatures in the rocky mountain streams ranged from 55-59° F., whereas temperatures of streams sampled in the pastured valleys were from 61-70° F. and may account for early appearance of overwintering *Simulium vittatum* Zett. In summer water temperatures in the streams observed stayed in the 66-73° F. range except at Andrews, North Carolina, where the July reading was 60° F.

Based on our limited observations and those of Whittaker (1956), *P. hirtipes* was the principal simuliid occurring in the subalpine coniferous forest, *Abies Fraseri* (Pursh) Poir., above 6,200' in the eastern part of the watershed. Larvae and pupae of a species, probably *Simulium tuberosum* (Lundstr.), were noted near Newfound Gap (5,058') in a clear mountain stream containing the liverwort, *Scapania nemorosa* (L.) Dumont. At lower elevations *S. tuberosum* was frequently taken in mountain streams and was especially abundant at an old mill site on the Oconaluftee River near Cherokee, North Carolina. In a turbulent mountain stream with dense marginal stands of rhododendron near Andrews, North Carolina, *P. hirtipes* and *S. tuberosum* were associated with the elmids *Stenelmis crenata* (Say) and *Promoresia tardella* (Fall) occurring in the moss, *Fontinalis dalecarlica* Br. & Sch. The waterpenny, *Psephenus herricki* DeKay, was prevalent as larvae on submerged rocks. As a rule, in the mountain streams *P. hirtipes* overwintered in the larval stage and appeared as an adult in March and April and was followed by *S. tuberosum* in late spring and summer.

In free-flowing portions of the Watauga and Holston Rivers and their tributaries, *S. vittatum* was the dominant species (fig. 2). It was especially abundant where drainage passed through broad pastured valleys having herds of livestock. Higher water temperatures in shallow streams along the right bank of the Holston River near Surgoinsville, Tennessee, appeared responsible for emergence of first broods in late February and March. Larvae were very abundant on the stems of emergent water willow, *Justicia americana* (L.) Vahl., and trailing grass. In one gravelly stream several miles west of Surgoinsville along U.S. 11W, *S. vittatum* was associated with *P. hirtipes* and *S. tuberosum* in February. The main plant in the stream bed was *Veronica Anagallis-aquatica* L. In addition to harboring blackfly larvae on the leaves, the following elmids were found about its roots:

*S. crenata, Dubiraphia quadrinotata* (Say), *Promoresia* sp., and *Optioservus* sp. Larvae of *P. herricki* occurred on small rocks. The snail, *Oxtytrema simplex* (Say), was especially abundant in streams of the cultivated valleys. According to field observations, *S. vittatum* was a highly compatible species in areas under cultivation but did not thrive in the forested mountains. Breeding was continuous through the growing season and only slightly retarded in the winter.

Larvae of *Simulium pictipes* Hagen were also found to pass the winter in cold mountain streams at lower elevations. They were usually found in small colonies on the upper surface of rocks and were very numerous on a concrete spillway (Chatuge

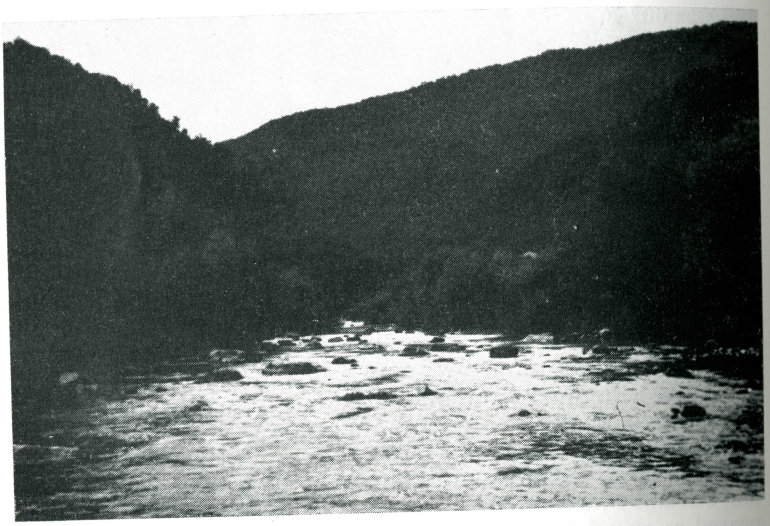

Fig. 2. Fast flowing, rocky-bottomed stream near Carderview, Tennessee, where *S. pictipes, S. tuberosum,* and *S. vittatum* overwintered in the larval stage (Doe Branch, August 11, 1954).

Dam) associated with the Hiwassee River near Hayesville, North Carolina, in the fall of 1954.

The mating of blackflies was observed only once during the course of the investigations. On October 26, 1954, at Chatuge Dam near Hayesville, North Carolina, large populations of *S. pictipes* and a species in the *jenningsi* group, probably *Simulium fibrinflatum* Twinn, were found in the early morning hours resting on the concrete walls and iron railings. At 0800 hours the flies were still more or less immobilized by cold, the temperature having reached a low of 38° F. the previous evening. By 0900 hours, with the temperature in the upper 50's, flies disturbed

from resting positions were able to become airborne only by first falling downward. Mating of *S. pictipes* was observed between 0915 and 0930 hours after a heavy fog had lifted and the temperature had risen above 60° F. The males appeared to orient themselves flying upside down into a slight breeze about 6 to 8 feet above the spillway surface. The abdomen was curved sharply upward and contact was easily made with the female as she flew overhead in an upright position. Approximately 25 or 30 males could be seen flying in this manner in a radius of 30 feet. One pair settled on an observer and remained attached for about ten seconds in a venter to venter position, the female being uppermost. The flight of the males gradually decreased in height so that by 1000 hours with hazy sun they were hovering about 6 to 10 inches over the water surface in small clusters of 5 to 8 flies along the spillway wall. The other species (*S. fibrinflatum* prob.) remained clustered on the wall of the spillway and made no attempt to fly at this time. However, when adults were confined in an aspirator, mating was undertaken freely and was non-specific, some males attempting to mate with other males of the same species and with *S. pictipes* which were also in the aspirator. Downes (1956) has recently pointed out that among certain groups of biting Diptera including blackflies, the male sense organs were less specialized and cannot mediate recognition in flight over some swarm marker. Hence, females are recognized only on contact and it is quite non-specific. Nevertheless, an equivalent of specific assembly—the spillway wall in this case—always exists. Apparently, *S. pictipes* which mates in flight used the surface of the water over the spillway as a specific assembly point, whereas the other species substituted the wall surface for specific assembly.

In the mountainous area *S. venustum* was infrequent as compared to *S. tuberosum*. Records of Whittaker (corresp., 1956) show *S. venustum* also less abundant than *S. parnassum* based on sweeping collections from chestnut oak-chestnut heath (3,100') and table mountain pine heath (3,500') in the Smokies during June and July. In the cultivated valleys *S. venustum* was regularly found with *S. tuberosum* and *S. vittatum*, but did not appear as early as the latter species though usually in April. One collection near Charleston, Tennessee, from trailing grass in a small stream running through pastured lands showed mature larvae and pupae of *S. venustum*, *S. vittatum*, and *Prosimulium magnum* D. & S. on March 27. The species, *S. fibrinflatum*, was collected only in the eastern mountainous area and at elevations below 3,000'. Larvae of this blackfly were most abundant on rocks below the Chatuge Dam spillway near Hayesville, North Carolina, and in the Little River Canyon below DeSoto Falls near Ft. Payne, Alabama. This species was found only in the summer and fall months.

Larvae and pupae of an undescribed species (No. 4) of the

subgenus *Eusimulium*, related to *Simulium latipes* (Meig.) and *S. pugetense* (D. & S.), were collected from a rocky tributary of Cherokee Reservoir near Morristown, Tennessee, on April 19, 1955.

*Limestone Lowland Area*

The second major study area was located in the limestone lowlands (St. Louis-Warsaw-Tuscumbia formation) along the Tennessee River in north Alabama where it flows across the southern extension of the Highland Rim Plateau province. The Highland Rim lies primarily in Tennessee and takes the shape of a great letter "U" occupying about 16.5% of the Tennessee Valley. The southern extension of this Rim is characterized by round-topped hills and V-shaped valleys. Free-flowing streams with clear water and frequent shoals are common along the right bank of the river where much of the limestone cover has been eroded away and the streams are mainly bedded in the underlying chert (Ft. Payne). Sampling was mainly confined to Cypress and Shoals Creek tributaries entering the Tennessee River near Florence, Alabama. Elevation ranged from 400-800' in this portion of the watershed. Annual rainfall at Florence, Alabama, is 51.67" with low monthly average in September (2.85") and October (3.22"). Water temperatures in March and April when the first brood of adults was emerging ranged from 55-66° F. with an average of 59.7° F.

Species of blackflies remaining in the larval stage during the winter in north Alabama and not known to pupate and emerge until early spring were *Cnephia mutata* (Mall.), *P. magnum*, and *S. pictipes*. Larvae and pupae of *S. tuberosum*, *S. vittatum*, and *S. venustum* were present through the winter with occasional emergence of adults during warmer winter periods. The main emergence of overwintering immature blackflies occurred in late March and April.

A favorable site for the larval development of *S. pictipes* was on flat, bare rock just above the crest of a small waterfall in the Goose Shoals branch of Shoals Creek (fig. 3). Larvae of *S. pictipes* also occurred with a species, probably *S. venustum*, among shallow beds of *Podostemum ceratophyllum* Michx. where the common elmids were of the genus *Promoresia*. Larvae of the net-winged midge, *Blepharicera tenuipes* (Walk.), were also present on the rocks along with numerous snails of the species *Oxytrema deshayesiana* (Lea). The caddisfly, *Oecetis inconspicua* (Walk.), was on the wing as early as March 4 in 1955. Another species, *Dolophilus moestus* (Banks), was swept from the marginal black alder in May 1953. On Cypress Creek, beds of *P. ceratophyllum* were present in deeper water (1-2') toward the middle of the stream, while colonies of water willow, *J. americana*, were established on flat rock along the margins of shoals. Roots and runners of water willow served as an excellent site for larval attachment during periods of high water in the spring when the

flat marginal rocks were covered with several inches of water. Larvae of *P. magnum* were found mainly on the roots and stems of willow weed, whereas *S. venustum, S. vittatum, S. jenningsi,* and *S. jenningsi* group (species undescribed) were present in both situations. The common elmids were *Microcylloepus pusillus* (LeC.) and a species of *Optioservus*. The caddisfly, *Hydropsyche depravata* Hagen, was captured by sweeping along the margin on April 2, 1956. A rocky woodland stream along the left

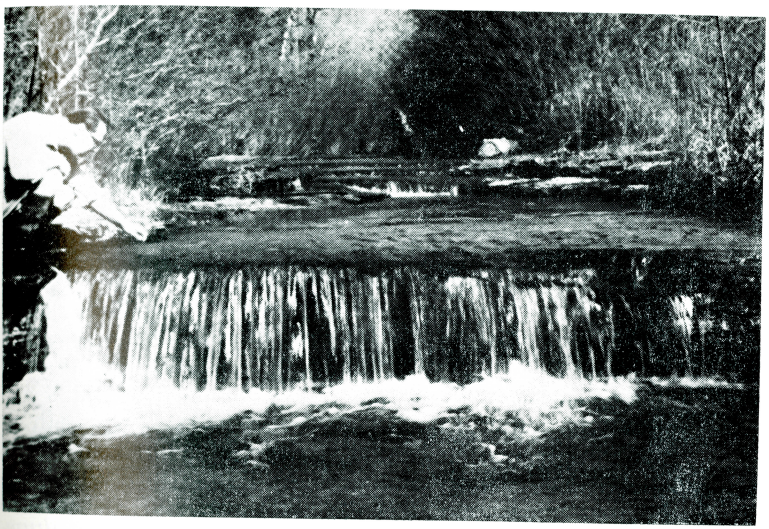

Fig. 3. Low falls on a tributary of Shoals Creek near Florence, Alabama, colonized by larvae of *S. pictipes* just above the crest (Goose Shoals, December 20, 1954).

bank of the Tennessee River just below Wheeler Dam was found to have larvae of *C. mutata, S. tuberosum,* and *S. vittatum* on trailing vines and leaves during March and early April. Larvae of the caddisflies, *Cheumatopsyche analis* (Banks) and *Chimarra* sp., were present on the rocks. A woodland tributary of Panther Creek near Waterloo, Alabama, harbored larvae of *S. tuberosum* and *Prosimulium* sp. (probably *P. magnum*) on rocks and trailing vines during the winter and spring months. Adults of the small elmid, *Limnius latiusculus* (LeC.), were present on submerged stones as were larvae of the waterpenny, *P. herricki*. A female caddisfly of the genus *Glossosoma* was reared from a pupal case collected on a rock on February 25, 1955.

At Florence, Alabama, two undescribed species (No. 7 and No. 16) placed in the *S. jenningsi* group by Dr. Stone were collected from Cypress Creek as larvae on June 15, 1956. One

of these (No. 7) is also known to be present at DeSota Falls near Ft. Payne, Alabama.

*Western Low Hilly Area*

The third study area was situated along the western edge of the Highland Rim Plateau in the low rugged hills of west Tennessee and their extensions into western Kentucky and northeastern Mississippi (fig. 1). These hills are sandy and gravelly in character, being unconsolidated material laid down along the margins of the ancient Mississippi embayment. There is a mingling of coastal plain and plateau topographies and soils along the Tennessee River system, particularly in northeastern Mississippi. These lands constitute some 6.7% of the Tennessee Valley area. The streams are generally small, shallow, gravelly, and well exposed (fig. 4). Many tend to pool out or become dry in the fall. Annual rainfall as measured at Johnsonville, Tennessee, is 51.17" with low monthly averages in September (3.46") and October (2.90"). Water temperatures in early spring (February-April) ranged from 47-53° F. and in summer (June-August) from 75-80° F.

Populations of blackflies in the small gravelly streams were sparse. As in the other portions of the Tennessee Valley, *S. tuberosum* was the species most frequently encountered. Larvae were found throughout the year, and emergence of adults appeared to be curtailed only in January and February. Both *S. venustum* and *Prosimulium* sp., probably *magnum,* were taken in the larval state in winter but were infrequent. Pupae of *S. tuberosum* and *S. venustum* were found in Morgan Creek at Sugar Tree, Tennessee, on March 31, 1955, but *Prosimulium* was present only in the larval stage at this time of year. This tendency of *Prosimulium* (*P. magnum*) to follow the vernal appearance of adult *Simulium* spp. was also noted in the upstream tributaries along the main river reservoirs. The psephenid, *P. herricki,* was collected at Sugar Tree on rocks in association with the simuliid larvae mentioned above. There was a notable scarcity of *S. jenningsi* and *S. vittatum* in the western portion of Tennessee as compared to the eastern valley and mountainous areas. One adult of the turkey gnat, *Simulium meridionale* Riley, common in the lower Mississippi Valley was captured at Sugar Tree. A single male of *Simulium verecundum* S. & J., recently described from the eastern United States, was reared from a pupa collected near Iuka, Mississippi, in a sandy-bottomed stream on June 30, 1954. This species is a member of the *Simulium venustum* complex and is scarcely distinguishable from *S. venustum* and *S. tuberosum* in the pupa, female or male, except for the genitalia. The absence of *S. pictipes* in the gravelly streams is apparently due to the lack of characteristic breeding sites on flat sedimentary rocks where swift and shallow water occurs just above the crests of small falls.

*Economic Importance*

While blackfly occurrence has not been known to be of sufficient density to involve direct loss (death) of livestock, annoyance in reservoir areas of east Tennessee, North Carolina, and northwest Georgia by *S. vittatum* has been severe enough to interrupt the milking of cattle, drive workstock to shelter, interrupt spring plowing, and interfere with power mowing operations at one dam site. Cows were bitten primarily about

Fig. 4. Typical gravel-bottomed stream near McKinnon, Tennessee, where *S. tuberosum* was the principal blackfly.

the udder while mules and horses were annoyed by flies feeding inside the ears. Workstock so affected was readily detected at a considerable distance by observing a frequent characteristic shaking of the head due to blackfly feeding. Females of *S. jenningsi, S. tuberosum, S. venustum, S. vittatum, S. pictipes,* and *P. magnum* have all been collected while feeding in the ears of horses and mules. On several occasions during the spring of 1954, mules at Surgoinsville, Tennessee, and at Murphy and Hayesville, North Carolina, were found to have as many as 100 flies feeding per ear. The disturbance caused by such feeding and subsequent headshaking not only decreases the efficiency of the work animal, but may also upset the mental equanimity of the farmer. In an effort to prevent blackflies from entering the ears of their stock while working, some farmers place a cloth "hat" or "sleeve" over each ear, while others try to repel them by placing leafy branches on the bridles. A number have

"doctored" the ears by smearing heavy applications of grease or crankcase oil in and on the ears to prevent feeding. One remedy used in west Tennessee was to rub crushed walnut leaves on the ears.

Though adult females of *S. jenningsi, S. tuberosum,* and *S. vittatum* readily flew and crawled about the head of man, the only species encountered biting man in the course of the observations were *P. hirtipes* in the eastern mountainous area and an undetermined species of the *S. jenningsi* group in north Alabama. This latter species was produced in considerable numbers from the bases of emergent *Justicia* along the margins of Cypress Creek which flows through a hilly oak-wooded area into Pickwick Reservoir at Florence, Alabama. It proved to be a serious pest to human population living in this vicinity from the latter part of March until June 1956. Bites of this blackfly about the head and ears were particularly annoying to those engaged in various outdoor activities especially during the first few hours after sunrise and in the late afternoon before sunset.

*Effects of Water Level Operations*

The incidence of impoundment has drastically affected blackfly productivity, particularly in the hilly tributary portions of the drainage systems of east Tennessee, North Carolina, and Georgia. Prior to impoundage of water by TVA in the Tennessee River Basin, blackfly production was rather continuous in the shallow, rocky, free-flowing streams. After impoundage, the deeper, more or less static water prevented further development in the immediate reservoir areas and generally limited blackfly production to tributary streams and to suitable portions of the main, free-flowing river. In Fontana, Watauga, Hiwassee, and Chatuge Reservoirs, for instance, notable blackfly populations were present above the backwater areas as well as downstream from the dams, but were not generally found in the reservoir proper. As the seasonal drawdown occurs, however, receding reservoir water permits more free-flowing conditions to prevail in the stream beds at upper contour levels. Portions of Doe Branch and Roan Creek in Watauga Reservoir covered by reservoir water in the spring become heavy producers of blackflies, *S. pictipes,* in the summer and fall when the stream bed becomes free flowing following the drawdown. On many reservoirs, however, this portion of the stream bed in the zone of normal reservoir fluctuation has become more or less silted in, and blackfly production is negligible. In Dayton Creek on Chickamauga Reservoir rocks were sufficiently cleared of silt in the fall and winter to produce an early spring series of *Prosimulium* in 1955. Of all species observed, *S. vittatum* appeared most tolerant to silt and has been found to emerge from pupal cases on twigs or rocks covered with a definite layer

of silt. It was also the most tolerant of industrial waste and effluent from sewage disposal plants.

In the recent impoundage of Fort Patrick Henry Reservoir, blackfly populations present in the main basin appear to have been eliminated in the first season of operation. Observations in the proposed reservoir basin on the Holston River prior to impoundage in the summer and fall of 1953 showed very extensive colonizations of the rocky basin by immature stages of *S. vittatum*. Overwintering larvae of this annoying species were eliminated by impoundage of the reservoir in November 1953. No larvae were detected in the following March or April (1954) and no adults were found resting either on exposed rocks or at lights in the area. Farmers reported no annoyance to livestock which until 1954 had been an annual occurrence. Downstream from Fort Patrick Henry, considerable annoyance to livestock in February and March was reported by farmers along the Holston River, especially in the vicinity of Surgoinsville and Rogersville, Tennessee. Through the summer and fall of 1954 an average fluctuation cycle of about four feet kept *S. vittatum* from reestablishing itself in the Fort Patrick Henry Reservoir. While blackflies might be expected to develop in the rocky stretch just below Boone Dam, periodic cutoff of discharge water has discouraged breeding in the area.

In another instance, blackfly control was achieved by water level management in connection with the Chatuge Reservoir spillway. Due to construction activities at the dam which prohibited drawing Chatuge Reservoir, all outflow during the summer of 1954 was over the spillway. This continuous spilling created very favorable conditions for blackfly propagation on the spillway and in the rocky channel below. By late June blackflies were beginning to be troublesome to TVA workers, residents, and livestock in the immediate area. Since it was thought that control could be achieved by temporarily drying the spillway and the rocky stream bed below, flashboards were placed on the spillway and the flow cut off for a period of four days during the first week in July. Not only were all larvae destroyed by drying, but also pupae which are moderately resistant to drying were apparently baked by the hot sun on the concrete and rocks. No adult emergence was detected. The next generation of adults, comprised principally of *S. vittatum*, *S. pictipes*, and *S. fibrinflatum*, did not mature on the spillway until six weeks later and sizable numbers of blackflies did not appear until the end of the growing season.

### *Effects of Mosquito Control Larviciding*

To supplement water level management and other biological measures, TVA applies larvicides where necessary to control *A. quadrimaculatus* populations in its reservoirs. Since this activity is confined to shorelines of the slack water lakes, no

effects from mosquito control larviciding were observed on blackfly production in the tributary streams.

*Summary*

Fifteen species of blackflies, three of them undescribed, were found during and following a two-year survey of biting Diptera initiated during the spring of 1953 in the Tennessee River Basin. Typical forms occurring in the mountainous areas of the tributary watershed were *Prosimulium hirtipes, Simulium pictipes, S. tuberosum,* and *S. vittatum.* In the limestone lowlands of north Alabama, *P. magnum, S. pictipes, S. tuberosum, S. vittatum,* and one species (undetermined) of the *S. jenningsi* group were common. Shallow streams with gravel bottoms in west Tennessee were most suitable for breeding of *S. tuberosum.*

Mating of *S. pictipes* was observed during early morning hours in October above the Chatuge Dam spillway near Hayesville, North Carolina. Male flies, apparently flying upside down about six feet above the spillway surface, engaged females in normal flight position.

Blackfly annoyance was sufficiently severe in some reservoir areas in east Tennessee, North Carolina, and northwest Georgia to interrupt milking of cattle, drive workstock to barns for shelter, interrupt spring plowing, and interfere with power mowing operations at one dam site. Females of *S. vittatum* were most pestiferous to livestock, but *S. venustum, S. tuberosum, S. jenningsi, S. pictipes,* and *P. magnum* were also collected while biting. While these species annoyed man by flying about the head, only *P. hirtipes* and an undetermined species of the *S. jenningsi* group were taken feeding on man.

Control of blackflies, *S. pictipes, S. vittatum,* and *S. fibrinflatum,* was effective for a six-week period following cut off of flow over the Chatuge Dam spillway for a period of four days in July 1954. Both blackfly larvae and pupae were destroyed when the spillway surface was dewatered.

Reservoir impoundage has eliminated breeding areas of blackflies in much of the tributary watershed, particularly in the hilly reservoir areas of east Tennessee. Blackfly larvae may still be found in small tributaries but they are unable to propagate in the reservoir proper.

The following combinations of letters have been employed in the distribution data to indicate the method or conditions pertaining to the collection: BB (biting bear); BC (biting cow); BH (biting horse); BM (biting man); BU (biting mule); C (in car); L (larva); LT (light trap); P (pupa); R [adult(s) reared from pupa(e)]; RS (collected by aspirator while resting); and S (net sweeping).

*Cnephia* (*Mallochianella*) *mutata* (Mall.)

ALABAMA: Wilson Dam, IV-3-53 (S-1f); Florence, III-4-55 (L-1); Wheeler Dam, III-17-55 (L-3).

DISTRIBUTION RECORDS

*Collections of Simuliidae Found in the Tennessee River Valley 1953 - 1956*

| Species | Females | Males | Larvae | Pupae | Taken From |
|---|---|---|---|---|---|
| *Cnephia* (*M.*) *mutata* (Mall.) | 1 | | 4 | | Ala. |
| *Prosimulium hirtipes* (Fries) | 10 | | | | Tenn. |
| *P. magnum* D. & S. | 11 | 7 | 4 | 9 | Tenn., Ala. |
| *Prosimulium* spp. | 4 | 1 | 308 | 2 | Tenn., Ala., Miss., Ga., N. C. |
| *Simulium* (*S.*) *decorum* Walk. | 4 | | 120+ | 8 | Ala., Ga., N. C. |
| *S.* (*S.*) *fibrinflatum* Twinn | 13 | 5 | 32 | 38 | Tenn., Ala., N. C. |
| *S.* (*S.*) *jenningsi* Mall. | 33 | 13 | 1 | 2 | Tenn., Ala. |
| *S.* (*S.*) sp. *jenningsi* group | 371 | 49 | | | Tenn., Ala., Miss., Ga., N. C. |
| *S.* (*S.*) *meridionale* Riley | 1 | | | 204 | Tenn. |
| *S.* (*S.*) *pictipes* Hagen | 13 | 17 | 548 | 204 | Tenn., Ala., N. C., Ga. |
| *S.* (*S.*) *tuberosum* (Lundstr.) | 98 | 93 | 226 | 16 | Tenn., Ala., Miss., Ga., N. C. |
| *S.* (*S.*) sp. *tuberosum* prob. | 24 | 4 | 83 | 6 | Tenn., Ala., Miss., Ga. |
| *S.* (*S.*) *venustum* Say | 12 | 93 | 54 | 2 | Tenn., Ala., N. C. |
| *S.* (*S.*) *venustum* group | 111 | 9 | 1 | 1 | Tenn., Ala., Miss. |
| *S.* (*S.*) *verecundum* S. & J. | | 1 | | | Miss. |
| *S.* (*N.*) *vittatum* Zett. | 454 | 143 | 260 | 35 | Tenn., Ala., Ga., N. C. |
| *S.* (*E.*) sp. No. 4 | | 1 | 8 | 1 | Tenn. |
| *S.* (*E.*) sp. No. 4 prob. | | | | 1 | Ala. |
| *S.* (*E.*) sp. | 1 | | | | Tenn. |
| *S.* (*S.*) sp. No. 7 | | | 1 | 3 | Ala. |
| *S.* (*S.*) sp. No. 16 | 12 | 15 | 34 | 5 | Ala. |
| *Simulium* (*S.*) spp. | 12 | 11 | 32+ | 1 | Tenn., Ala., N. C. |
| Total | 1,185 | 462 | 1,716+ | 334 | |

*Prosimulium hirtipes F(ries)*

TENNESSEE: Clingmans Dome, V-14-53 (S-lf), V-11-55 (BM-4f); Gatlinburg, IV-1-54 (S-2f); Newfound Gap, V-28-54 (BB-lf); Rutledge, IV-19-55 (BM-2f).

*Prosimulium magnum* D. & S.

TENNESSEE: Lobelville, IV-23-54 (BU-lf); Waverly, IV-23-54 (S-lf); Charleston, III-27-56 (R-lf, lm) (P-2). ALABAMA: Florence, IV-2-56 (R-8f, 6m) (P-7) (L-4).