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A SURVEY OF SUMMER EPHEMEROPTERA, PLECOPTERA AND TRICHOPTERA OF THE ABRAMS CREEK DRAINAGE OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK

A final report for a Discover Life in America Award to Dr. R. Edward DeWalt

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and

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Abstract.-Nine sites in the Abrams Creek drainage of western Great Smoky Mountains National Park were investigated, from 25 May through 22 July 2001, for an assemblage of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These EPT taxa were collected at up to five intervals over that time frame. Ultra-violet light trapping and several other more active methods were used to determine species composition, based on the adult lifestage, at these sites. Adult specimens examined totaled 35,895. The Abrams basin provided 163 species consisting of 36 mayflies, 35 stoneflies, and 92 caddisflies. Within the mayflies, the Heptageniidae (clinging mayflies) provided 17 species. The most speciose stonefly families were the Perlidae and Perlodidae, with ten and eight species, respectively. Speciose families of caddisflies included Hydropsychidae (net-spinners), Leptoceridae (longhorns), and Hydroptilidae (microcaddisflies), with 12, 15, and 16 species, respectively. The latter is somewhat surprising as evidence to date suggested that microcaddisfly species were few in the park. Small streams and highest elevation sites tended to support fewer species, while large streams, especially Abrams Creek at Abrams Creek Campground, were by far the most productive and diverse. Several species previously unknown from the state of Tennessee and GRSM were taken, as were specimens of undescribed caddisflies in *Agapetus* and *Goera*.

Introduction.-Abrams Creek is the western-most drainage in the Great Smoky Mountains National Park (GRSM). It is wholy contained within Blount County, Tennessee and the Blue Ridge (mountain) physiographic province. It arises from elevations near 1300 m along the Tennessee and North Carolina border and empties into Lake Chilhowee, an impoundment of the Little Tennessee River at approximately 320 m elevation. This drainage is largely pristine in its headwaters, but has been cleared of its protective treed riparian zone within its middle third, in area referred to as Cades Cove. Being an open pastureland, this region receives more sunlight than other areas, which may favor aquatic organisms that scrape algae off rocks and those that need warmer water temperatures. Some stretches of the stream here may be referred to as "losing", where porous bedrock allows water to escape the channel, only to resurface downstream. Beyond Cades Cove the stream begins a steep descent through a narrow canyon. This descent culminates at Abrams Falls, where the stream falls over a bedrock outcropping some six to eight meters in height. The stream eventually flattens near its mouth, providing long placid runs and pools, interspersed by short riffles.

Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies, hereafter collectively referred to as EPT) are common inhabitants of streams throughout much of the world. In North America, they are especially diverse in the southeastern states, where they have undergone much speciation, probably due to the relatively stable geology and climate of the area (Brigham et al., 1982). Their current status and risks to survival in the Southeast have been reviewed recently by Morse et al (1993).

EPT species have a wide range of tolerance to pollution and habitat alteration, with many species being extremely intolerant of environmental change. As an ecological indicator, the number of EPT taxa is an efficient measure of the health streams, provides a surrogate for more costly measures of ecosystem function, and has the ability to monitor habitat specific impacts (Barbour et al. 1992, Lenat and Penrose 1996, Wallace

et. al. 1996;). Ecological tolerance values have been established for many commonly encountered taxa in the Southeast (Lenat 1993).

Most of the work discussed in the previous paragraph was accomplished using the immature stages. Although many of the immatures of EPT have been associated with adults, an unspecied, significant, component remain undescribed and/or unrecognizable to species in the immature stage. Several stream locations in the Park are routinely monitored using these immature lifestages, and the identification of these stages has been facilitated using important works such as Brigham et al. (1982). Still, many identifications are, by necessity, made at the generic level due to lack of keys. Therefore, these data are insufficient to inventory the EPT species that exist in the Park. The use of permanent plots by the ATBI, with malaise traps, etc., can provide adults to augment the inventory. Small projects by scientists using more active methods have also helped to expand the number of species known. Additional, targeted, basin-wide inventories are necessary to flesh out the species of EPT that occur in the Park.

The objective of this study was to conduct an intensive inventory of the Abrams Creek drainage, the western-most drainage in the GRSM. This drainage was chosen after the authors georeferenced 600 Plecoptera records from GRSM within the Illinois Natural History Survey insect collection. This revealed a hole in coverage that included areas west and south of Cades Cove—the Abrams Creek drainage. Consultations with Chuck Parker of the USGS confirmed that study of this drainage would close a gap in information for streams in GRSM. Since this was the only major drainage flowing west from the Park, and that ridges to 1300 m to the south and east might prevent more eastern taxa from coming west and invite western taxa into the basin.

Methods.-Nine sites (see Table 1 for locations) were routinely sampled in the Abrams Creek drainage between May 25 and 22 July 2001. These locations were spread throughout the drainage (Fig. 1) and over an elevational gradient of 454 m. The highest location was Anthony Creek, while the lowest, near the northwestern corner of GRSM, was on Abrams Creek at Abrams Creek Campground.

Table 1. Streams, sites description, elevation and location information for nine routinely sampled sites in the Abrams Creek drainage of the Great Smoky Mountains National Park, summer 2001.

Stream	Site Description	Elevation (m)	Latitude	Longitude
Anthony Creek	Anthony Creek Trail at 3rd footbridge going upstream	821	35.5868	83.7516
Abrams Creek	Cades Cove Campground, 100 m upstr. park entrance	584	35.6047	83.7757
Abrams Creek	Cades Cove, Sparks Lane	553	35.6025	83.7939
Abrams Creek	100 m upstr. Abrams Falls Trailhead	532	35.5921	83.8520
Mill Creek	100 m upstream Abrams Falls trailhead	540	35.5901	83.8522
Forge Creek	Gregory Ridge Trail, Campground #12	733	35.5472	83.8321
Trib. Forge Creek	Gregory Ridge Trail, 300 m downstream Campground #12	715	35.5485	83.8349
Trib. Forge Creek	400 m up Parsons Branch Rd.	671	35.5588	83.8546
Abrams Creek	Abrams Creek Campground	367	35.6103	83.9327

Sites ranged from seepage areas (both tributaries of Forge Creek) to 4-6 m-wide fast water sites (Forge Creek, Anthony Creek) to streams of up to 10 m across (Abrams at Cades Cove, Sparks Lane, and the Abrams Falls Trailhead, and Mill Creek at the Abrams Falls Trailhead) to a 30 m-wide, relatively slowly flowing Abrams Creek at Abrams

Creek Campground. These sites were thought to contain the widest variation in stream size in the drainage. Only the addition of sites of higher elevation would have added greatly to the potential for a broader fauna.

Most sites were sampled using a Bioquip 12-volt ultraviolet light just after sunset. Effort was standardized by time (approximately one hour), by radiant surface area (a standardize reflective sheet size), and by common weather conditions. Fig. 2 demonstrates the apparatus used. Often, several sites were sampled in a single evening, necessitating the use of two DC timers that permitted timed illumination of the reflective surface. Two trays with 80% EtOH were positioned at bottom of the surface to capture insects. At sites that were attended, mayfly subimagoes (a subadult with hair-covered wings, molts to and imago) were captured and stored in a container until transformation to the imago stage. Males of perlid and perlodid stoneflies were captured and their intermittent organs extruded to facilitate species identification. Specimens from trays were stored in plastic containers until they could be sorted and identified. Geographic coordinate data was captured using a Garmin 12XL set to NAD 1983.

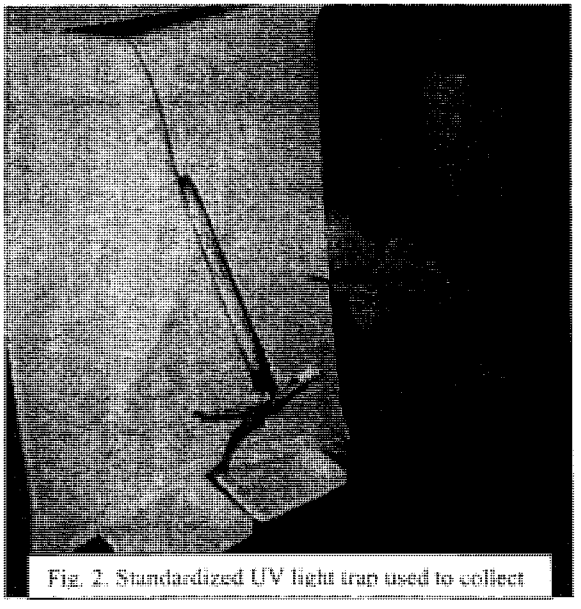

Fig. 2. Standardized UV light trap used to collect

Anthony Creek was sampled during most visits using sweep and aerial netting, with the exception of one ultraviolet event. Night sampling was avoided after park officials suggested that bear activity was higher than normal in that area. Hence, the results of this site are not strictly comparable to that of other sites.

Specimens were sorted to species and species identifications made where possible. In many cases, only the males of species have been described, so determinations were based largely on that sex. Where descriptions for females existed and where it seemed color patterns or wing veination was consistent between sexes, females were determined.

Some site/date combinations produced in excess of 5,000 specimens. These were confined to Abrams Creek at Abrams Creek Campground. Subsampling at a rate of 25% was conducted to speed sorting. Even at this rate, subsampling of hydroptilid (microcaddisflies) was necessary for the 22 July event. Only 1/16 of all microcaddisflies from an original subsample of 25% were identified. Even at this rate, 797 specimens were identified from an estimated 12,832 specimens from the original subsample. Adjusted to full sample density, the microcaddisflies along would yield an estimated 51,328 individuals. Species richness values are reflective of specimens actually inspected. No effort was made to estimate richness based on total sample densities where subsampling took place.

Identified specimens were stored in 3-dram, patent lip vials in 80% ethanol. High grade stoppers sealed these vials. Label data was captured in the INHS Insect Collection database, with each vial receiving a unique identifier label with which to track information. These specimens are housed in the INHS insect collection, and arrangements will be made to deaccession a synoptic collection of all species where duplicates are available. These will be permanently on loan to NPS collection facilities in Gatlinburg during the fall 2002 ATBI meeting. A database file will accompany all donated material.

RESULTS

Forty-six site visits were made in the Abrams Creek drainage during this project (Table 2). A total of 35,895 specimens were identified across the three orders (Appendix 1). Among the mayflies, eight families were represented, with the Heptageniidae (clinging mayflies) providing 17 species. Stoneflies provided another 35 species. Two families, the Perlidae and Perlodidae provided 10 and 8 species respectively. Caddisflies provided nearly three time the number of species that the other orders provided. Of the 92 species found, three families provided greater 10 species. The Hydroptilidae provided 16 species. It is likely this number will increase as experts currently reviewing material send word of their work. Leptoceridae and Hydropsychidae (exclusive of the Arctopsychidae) provided 15 and 12 species respectively.

Table 2. Dates that sites in Abrams Creek drainage were visited. Year is 2001. Methods for all are ultra-violet light trap, unless otherwise noted. Dates have been organized into similar periods.

Site	Dates Visited					
Anthony Creek	5/26 Sweep	5/27	6/9 Sweep	7/6 Sweep		
Abrams Creek, Cades Cove CG	5/24		6/9	6/19	7/5	7/17
Abrams Creek, Sparks Lane	5/25		6/7	6/19	7/6	7/17
Abrams Creek, Falls Trailh.	5/25		6/8	6/18	7/6	7/18
Mill Creek, Falls Trailh.			6/6	6/18	7/6	7/18
Forge Creek	5/25 Sweep	5/26	6/7	6/21	7/7	7/20
Trib. Forge Creek, Gregory Ridge Trail	5/25 Sweep	5/26	6/7	6/21	7/7	7/20
Trib. Forge Creek, Parsons Br. Rd.	5/27		6/9	6/19	7/7	7/18
Abrams Creek, Abrams CG	5/29		6/10	6/20	7/8	7/22

Though Fig. 2 shows the number of specimens examined, for most sites (excluding Abrams Creek at Abrams Creek Campground and Anthony Creek), it also provides an indication of relative catch. There is no doubt that Abrams Creek at Abrams Creek Campground far distanced all other locations in shear abundance. Of the remaining sites, elevation and stream size appears to play a role in abundance. The Forge Creek tributaries and Forge Creek mainstem provided less than 500 total individuals.

Tributary of Forge Creek at Parsons Branch provided the fewest specimens. This stream dried to a trickle by early July, which probably had some influence on abundance in the stream. The Tributary to Forge Creek along Gregory Ridge Trail maintained a one to two-meter-wide braided channel throughout the summer and it provide about double the number of specimens as the first Forge Creek tributary. Sites flowing through the flatwoods section of Cades Cove (Mill Creek and Abrams Creek at the Abrams Falls trailhead) produced and order of magnitude more specimens as the Forge Creek sites. Species richness varied greatly across sites (Appendix 1, Fig. 3). Abrams Creek at Abrams Creek Campground produced the greatest number of EPT species at 72.

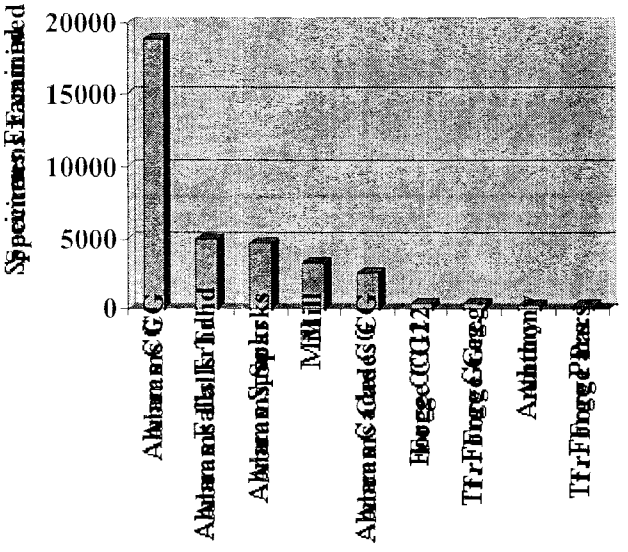

Fig. 2. Numbers of specimens examined. For all but Abrams CG and Anthony Creek, this comparison is relative. The actual number of individuals is much greater at Abrams CG.

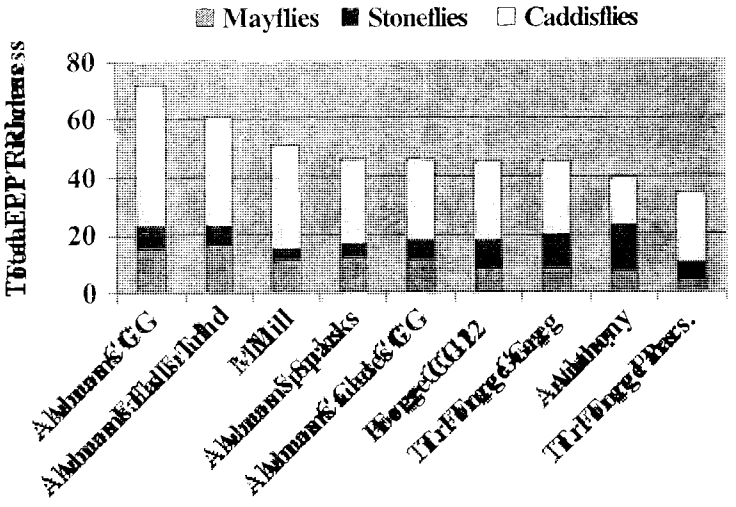

Fig. 3. EPT species richness broken down by order at sites in Abrams Creek drainage of Great Smoky Mountains National Park, summer 2001.

Streams segments in the flatwoods produced the next highest totals, these included Abrams and Mill creeks near the Abrams Fall trailhead. Abrams Creek at Sparks Lane produced fewer species yet, eventhough it was not a great distance from Abrams Falls trailhead. Smaller, higher elevation sites produced the fewest species.

Caddisflies contributed the greatest proportion of overall species richness, most often contributing twice the number of mayfly and stonefly species combined (Fig. 3). An extreme example of this is Abrams Creek at Abrams Creek Campground, where 23 species of mayflies and stoneflies occurred as compared to 49 caddisfly species. A departure from the trend also occurred at Anthony Creek, where stonefly richness and caddisfly richness were the same, 16 species. This is probably due to sweep netting being highly effective for stoneflies, while it is not so for caddisflies.

Phenology of species richness for large streams generally increased through June and leveled off during July. The last three dates at Abrams Creek at Abrams Creek trailhead demonstrate this well in that total richness values ranged from 36-39 species (Fig. 4). More than half of the species on each of these dates was contributed by caddisflies. Abrams Creek at Abrams Creek Campground reached peak richness during the 20 June sample date and then decreased slightly through the last two dates (Fig. 5). A small stream, Tributary to Forge Creek, Parsons Branch, demonstrated a very different phenology (Fig. 6). Its richness was highest during the 27 May light trap sample and decreased throughout the summer. This corresponds well with the decrease in abundance noted previously. Another Forge Creek tributary that had ample water throughout the summer peaked in richness during a 21 June sample, afterwhich it began a precipitous decline. Caddisflies were present throughout the sampling period, but stoneflies, and to a lesser extent mayflies, no longer could be collected from the site.

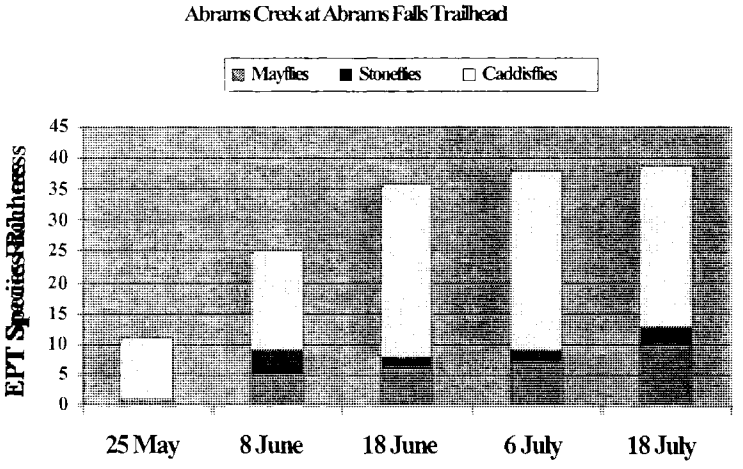

Fig. 4. Phenology of EPT species richness for Abrams Creek at Abrams Falls Trailhead, summer 2001.

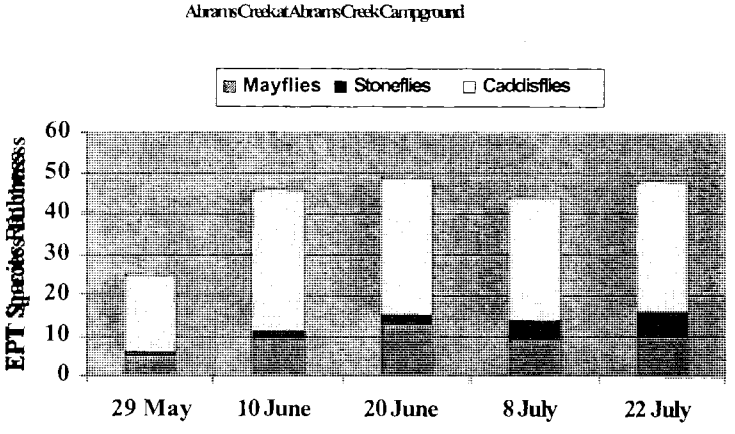

Fig. 5 Phenology of EPT species richness for Abram Creek at Abrams Creek Campground, summer 2001.

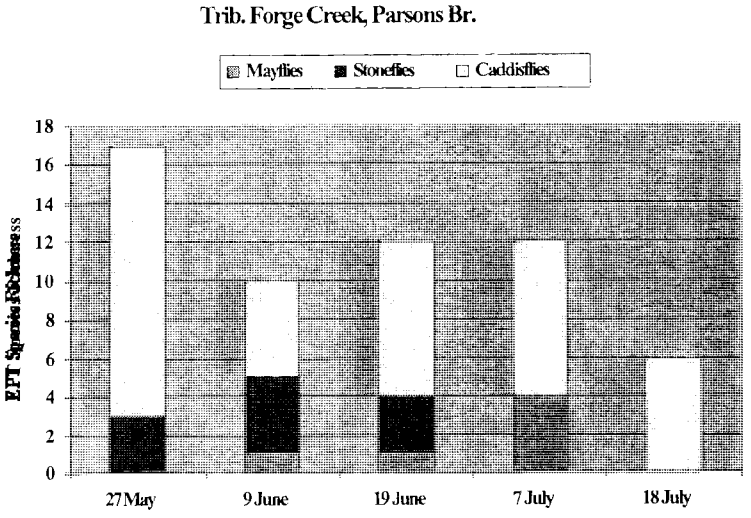

Fig. 6. Phenology of EPT species richness for Tributary to Forge Creek, Parsons Branch, summer 2001.

SIGNIFICANT FINDS

Several species collected during the project were either rare or had not previously been collected from GRSM and/or in Tennessee. A brief discussion of each of these follows.

EPHEMEROPTERA

Baetidae

Procloeon viridoculare (Berner) 1940.- A single male imago was taken at Anthony Creek on 9 June. This species has not previously been reported from GRSM or from Tennessee as far as we can tell. It is known from the Southeast, Pennsylvania, and Michigan (Randolph and McCafferty 1998).

Caenidae

Caenis anceps Traver, 1935.-A moderately large population occurs in Abrams Creek at Abrams Creek Campground. All specimens were taken on 20 June. A single specimen was taken at Abrams Creek at Abrams Falls Trailhead in Cades Cove. It has not been reported from GRSM, but is known from Campbell County, Tennessee (Provonsha 1990).

Caenis mccafferti Provonsha, 1990.-Four specimens were taken from Abram Creek at Abrams Creek Campground. This recently described species is known from the eastern United States and mountainous parts of Arkansas. Provonsha (1990) does not report it from Tennessee, but it does occur in northwestern South Carolina. This constitutes a new GRSM record.

Ephemerellidae

Ephemerella nr. *fratercula* McDunnough, 1925.-A single male was taken from a tributary of Forge Creek along Gregory Ridge Trail. This species is known from the Southeast (McCafferty's Mayfly Central: www.entm.purdue.edu/entomology/mayfly/mayfly.html) and as far north as Quebec, Canada (Needham et al. 1935). This identification requires independent confirmation. The specimen will be sent to Pat McCafferty's laboratory where Luke Jacobus is working on Ephemerella. If this determination is confirmed, this would be another state and GSRM record.

Serratella serrata (Morgan), 1911.-One male and 17 presumed females were taken at Abrams Creek at Abrams Fall Trailhead. Known from the Southeast and Northeast (Burks 1953). Locally, it is known from North Carolina. The specimens will be sent to Pat McCafferty's laboratory. Allen and Edmunds (1963) maps do not place in within the GSRM, but in close proximity. If this determination is confirmed, it would be another state and GSRM record.

Serratella serratoides (McDunnough), 1931.-This species is abundant throughout the larger streams in the drainage, especially so at Abrams Creek at Abrams Creek Campground. Its ventral abdominal surface has a arch of four small dots. Several males were taken and it was noticed that females occurred with the same pattern. We have assumed that all females with this pattern were *S. serratoides*. Allen and Edmunds (1963) provide a record for Sevierville, Tennessee. This species is not listed on the DLIA aquatic insects list for the GRSM.

Ephemeridae

Ephemera varia Eaton, 1883.-Taken at Abrams Creek, Sparks Lane and at Mill Creek. Known from Tennessee and McCafferty (1975) noted that all Southeastern records were from "high mountain areas." A GRSM park record.

Epeorus vitreus (Walker), 1853.-Found throughout the drainage, but most abundant in the larger streams. A species listed as northeastern in distribution at Mayfly Central. These specimens will require confirmation from an expert. We will inquire with Pat McCafferty about providing this service.

Leucrocuta aphrodite (McDunnough), 1926.-Found only at low elevation, large stream sites. It was especially abundant at Abrams Creek at Abrams Creek Campground. Known from the Southeast and Tennessee, but unknown from GRSM.

Leucrocuta juno (McDunnough), 1924.-The most common *Leucrocuta* in the drainage, but most abundant in the middle reaches. Known from the Southeast and Tennessee, but unknown from GRSM.

Leucrocuta thetis (Traver), 1935.-Not a GRSM record, but generally relegated to high elevation sites in Anthony and Forge Creek drainages. Displaced by *L. juno* in larger streams.

Stenonema ithaca (Clemens and Leonard), 1924.-Abundant in Abrams Creek at Abrams Creek Campground. Known from the Northeast, the Southeast, and from Tennessee (Bednarik and McCafferty 1979). Not recorded from GRSM.

Heptageniidae sp.-Four males taken at three locations. Lacking forelegs that limit identification by non-experts. Will be sent to experts for determination.

Isonychiidae
Isonychia hoffmani Kondratieff and Voshell, 1984.-One specimen taken at Abrams Creek at Abrams Falls Trailhead. Several other specimens taken in open area in vicinity of Abram Falls Trailhead. Needs confirmation, will ask Boris Kondratieff for aid with this. Currently known only from Virginia and West Virginia (Kondratieff and Voshell 1984).

Isonychia bicolor (Walker), 1853.-Fifteen males taken from three locations in the middle reaches of Abrams Creek. Not listed from GRSM, but occurs locally. Will confer with Boris Kondratieff.

Leptophlebiidae
Paraleptophlebia moerens (McDunnough), 1924.-Two specimens from the Tributary of Forge Creek along Gregory Ridge Trail. Known from the Southeast, Northeast, and far north of the continent. Will confer with Pat McCafferty. Unknown to GRSM at this time.

Siplonuridae
Siphlonurus nr. *typicus*.- One male taken at Abrams Creek at Sparks Lane in Cades Cove. Randolph and McCafferty (1998) give its range as scattered locations in the Midwest and from Quebec to Pennsylvania. This specimen too requires confirmation by an expert.

PLECOPTERA

Leuctridae
Leuctra tenella Provancher, 1876.-This species was taken from Anthony and Forge Creeks. Stewart and Stark (1988) suggest that it does not occur south of Pennsylvania. Currently, Peter Harper of the University of Montreal is conducting a revision of the entire genus. These records from areas extralimital to known ranges must be view with skepticism until his revision is complete.

Perlidae
Perlesta decipiens (Walsh), 1862.-Thirteen adults were taken from Abrams Creek at Abrams Creek Campground. It is widespread across the eastern US (Stark 1989), but had not been reported from Tennessee nor the GRSM.

Perlesta placida (Hagen), 1861.-Taken from Abrams Creek at Abrams Falls trailhead and at Abram Creek Campground. It is widespread in the mid-Atlantic and Gulf Coastal Plains states, but had not yet been reported from Tennessee (Stark 1989). A new GRSM record.
Neoperla coosa Smith and Stark, 1998.-Eleven adults taken at Abrams Creek Campground. This is a recently described species from Piedmont section of northern Alabama. It is both a new Tennessee and GRSM record.

TRICHOPTERA

Glossosomatidae
Agapetus n.sp.-A single male of this undescribed species was taken from Abrams Creek at Cades Cove Campground. Another male was taken along Anthony Creek trail, but was not associated with this project. This species is currently being studied by Chuck Parker of the USGS and his colleagues.

Goeridae
Goera n.sp.-One male and four females of this undescribed species were taken Abrams Creek at Cades Cove Campground, from Forge Creek, and from Tributary to Forge Creek at Parsons Branch Road. This species is currently being studied by Brian Armitage of Ohio State University.

Ceratopsyche macleodi (Flint), 1965.-This species was taken only at Anthony Creek, but constituted 30% of the 287 specimens taken. This is close relative of a very common *Ceratopsyche slossonae* (Banks 1965), which is uncommon in collections at this site. We believe that the female and larva of this species are still undescribed. This location provides an opportunity to do both. Many female *Ceratopsyche* were present here that matched descriptions for neither *C. sparna* (Ross 1938) nor *C. slossonae.*

Cheumatopsyche helma Ross, 1939.-Twenty-seven males and presumptive females of this species were taken at Abrams Creek at Abrams Creek Campground. It is currently known from only four locations in Tennessee, Kentucky, and North Carolina (Etnier et al. 1998).

Cheumatopsyche oxa Ross, 1938.-Populations of these were taken from adjacent Abrams and Mill Creeks at Abrams Fall Trailhead in Cades Cove. Gordon (1974) describes its distribution as being midwestern and eastern. This is a new GRSM record.

Hydropsyche simulans Ross, 1938.-This species was taken from two Abrams Creek locations, at the Abrams Fall Trailhead in Cades Cove and at Abrams Creek Campground. Several males were taken, but most were females. It occurs in Tennessee (Etnier et al. 1998), but has not yet been reported from GRSM.

Hydroptilidae

Hydroptila alabama Harris and Kelley, 1984.-Taken from Abrams Creek Campground. Known from Alabama (Harris and Kelley 1984) and from Tennessee (Etnier et al. 1998). A new GRSM record.

Hydroptila nr. *amoena* Ross, 1938. This may well be several species. Specimens were taken in middle reaches of the Abrams drainage. Steve Harris has graciously offered to confirm GRSM hydroptilid identifications.

Hydroptila armata Ross, 1938.-Several specimens were taken at the lowest elevation sites in the drainage. This species is known from middle and east Tennessee (Etnier et al. 1998). This is a new GRSM record.

Hydroptila nr. *fiskei* Blickle, 1963.-This species was taken throughout the larger streams in the basin. No published records for *H. fiskei* exist, but the existence of a species near to it in the Abrams drainage has been known for several years. It is not certain exactly what species is represented here. Steve Harris is currently reviewing these specimens and has not been able to say definitively what it is.

Hydroptila grandiosa Ross, 1938.-This was by far the most abundant hydroptilid in the Abrams Creek drainage. It was, however, restricted to the largest four stream segments. Both males and females are readily identifiable. It has been reported from GRSM at Abrams Creek Campground (Etnier et al. 1998).

Hydroptila scolops Ross, 1938. Abrams Creek at the Falls Trailhead yielded six males of this species. If the identification is correct, this represents only the second known location, other than the type locality in southern Illinois (Ross 1938). It will be sent to Steve Harris for confirmation.

Mayatrichia ayama Mosely, 1937.-A single specimen from Abrams Creek Campground was taken. A new GSRM record.

Ochrotrichia graysoni Parker and Voshell, 1980.-Two males were taken at Abrams Creek campground. This constitutes both a new state and GRSM record.

Oxyethira novasota Ross, 1944.-Two males taken at Abrams Creek Campground. It is known from Tennessee, but has not been reported from GRSM.

Oyxethira pallida (Banks), 1904.-Two males taken Abrams Creek Campground. It is known from Tennessee, but has not been reported from GRSM.

Leptoceridae

Ceraclea flava (Banks), 1904.-Males and females totally 119 individuals were taken from Abrams Creek Campground. These have been listed from middle Tennessee (Etnier et al. 1998), but have not been reported from GRSM.

Ceraclea nepha (Ross), 1944.-Single male taken from Abram Creek Campground. Occurs in eastern Tennessee, but has not been reported from GRSM.

Ceraclea transversa (Hagen), 1861.-This species is the most widely distributed *Ceraclea* in the Abrams drainage. A new GRSM record.
Leptocerus americanus (Banks), 1899.-One male specimen was taken at Abrams Creek Campground. It is known from east-central Tennessee (Etnier et al. 1998), but has not yet been reported from GRSM.

Nectopsyche exquisita (Walker), 1852. This species was found only at Abrams Creek Campground. It occurs in scattered locations across east and central Tennessee. It has also been reported as larvae from this GRSM location.

Oecetis avara (Banks), 1895.-Found at the three lowest stream sites in the drainage and was abundant at Abrams Creek campground. Present statewide (Etnier et al. 1998). Yet not reported from GRSM.

Triaenodes perna Ross, 1938.-Small populations occur at Cades Cove and Abrams Creek Campgrounds. Known from central and eastern Tennessee. Not known from GRSM.

Molannidae
Molanna ulmerina Navas, 1934.-Occurred in low numbers at the four lowest elevation sites. Known from a single east-central Tennessee location (Etnier et al. 1998). Unknown from the GRSM.

Philopotamidae
Chimarra augusta Morse 1971.-Three males found at Abrams Creek Campground. Known from a single Tennessee location (Etnier et al. 1998), unknown from GRSM.

Chimarra feria Ross 1941.-Two males found at Abrams Creek Campground. Unknown from Tennessee (Etnier et al. 1998), unknown from GRSM.

Chimarra socia Hagen, 1861.-Abundance of males found at Abrams Creek Campground. Unknown from only a few Tennessee locations (Etnier et al. 1998), unknown from GRSM.

Polycentropodidae
Nyctiophylax affinis (Banks), 1897.-Twenty-one males taken at Abrams Creek Campground. Known from middle Tennessee. Unknown from GRSM.

Nyctiophylax celta Denning, 1948.-Eighty-two males found at two locations, Tributary of Forge Creek at Parsons Branch and at Abrams Creek Campground. Known from eastern Tennessee. Unknown from GRSM, but reported from Blount County outside of park boundary.

Polycentropus crassicornis Walker, 1852. Two females taken at Abrams Creek at Sparks Lane and at Mill Creek. Known from middle Tennessee (Etnier et al. 1998), but not known from GRSM.

Rhyacophilidae
Rhyacophila vibox Milne, 1936. Two females taken at Abrams Creek at Sparks Lane and at Tributary to Forge Creek on Gregory Ridge Trail. Known from east Tennessee (Etnier et al. 1998), but not from GRSM.

This large project contributed many new GRSM records and a few state records as well. Most of the new records were recorded from Abrams Creek Campground, where Abrams Creek is wide and tame. Other such large water habitats may offer more unknowns for GRSM.

Much work remains to be done with mayflies in GRSM. Our experience here has been frustrating with most specimens being subimagoes and females. Special attention should be turned to Ephemerellidae. Perhaps some funds should go to Luke Jacobus to expand his work to include all species in the family.

Among stoneflies, new records could be found among early emerging perlodids and among the leuctrids. The latter would benefit from a revision in the works on the entire family in eastern North America. Peter Harper's work could help to clean up confused species in the genus *Leuctra*.

Among caddisflies, it seems that the hydroptilidae will provide the greatest increase in taxa. Another surprising group was the leptocerids; they provided many new records from Abrams Creek Campground.

Data associated with this project have already been electronically shipped to both Luciana Musetti and Chuck Parker. Voucher specimens will follow this fall for deposition into NPS collections. Loans to experts have been made and more will follow especially in the Ephemerellidae and Hydroptilidae.

ACKNOWLEGEMENTS

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Fig. 1. Locations sampled in Abrams Creek drainage for Ephemeroptera, Plecoptera, and Trichoptera.

Table 2. Ephemeroptera, Plecoptera, and Trichoptera from nine routinely colllected locations in the Abrams Creek drainage of the Great Smoky Mountains National Park, summer 2001.

Order Family Genus	species	Anthony Creek	Abrams Creek, Cades Cove CG	Abrams Creek, Sparks Lane	Abrams Creek, Falls Trailh.	Mill Creek, Falls Trailh	Forge Creek, CG 12	Trib. Forge Cr, Gregory Ridge Tr.	Trib. Forge, Parson Br. Rd.	Abrams Creek, Abrams Cr. CG	Total
EPHEMEROPTERA											
Baetidae	unknowns									60	60
Acentrella	turbida				2					628	630
Acerpenna	pygmaea				1						1
Baetis	flavistriga			1		28				10	39
Baetis	intercalaris									53	53
Baetis	sp.		7	1		1	2			1	12
Procloeon	viridoculare	1									1
CAENIDAE											
Caenis	anceps				1					138	139
Caenis	mccafferti									4	4
EPHEMERELLIDAE	unknowns			13	104	32				1	150
Ephemerella	dorothea						3				3
Ephemerella	nr. fratercula							1			1
Ephemerella	sp.		2	2	1	17	9				31
Serratella	serrata				18						18
Serratella	serratoides		5	6	6	6				497	520
Serratella	sp.		1							5	6
EPHEMERIDAE											
Ephemera	guttulata								1		1
Ephemera	varia			1		4					5
HEPTAGENIIDAE											
Cinygmula	subaequalis	13									13
Epeorus	dispar	2									2
Epeorus	vitreus		95	25	332	42	3	4	1	84	586
Heptagenia	marginalis									17	17
Leucrocuta	aphrodite				5	2				205	212
Leucrocuta	juno		59	968	15	312		1		3	1358
Leucrocuta	thetis	6					5	1			12
Rhithrogena	sp.					160					160
Stenacron	carolina	1			2				1		4
Stenacron	interpunctatum			1						68	69

Stenacron	pallidum		3								3
Stenacron	sp.	2	3	1		2					8
Stenonema	ithaca		1							105	106
Stenonema	meririvulanum				1						1
Stenonema	modestum		4		3					62	69
Stenonema	pudicum		10	63	5	5	1				84
Stenonema	terminatum	1							1		2
Order Family Genus	**species**	**Anthony Creek**	**Abrams Creek, Cades Cove CG**	**Abrams Creek, Sparks Lane**	**Abrams Creek, Falls Trailh.**	**Mill Creek, Falls Trailh**	**Forge Creek, CG 12**	**Trib. Forge Cr, Gregory Ridge Tr.**	**Trib. Forge, Parson Br. Rd.**	**Abrams Creek, Abrams Cr. CG**	**Total**
Stenonema	vicarium				3					92	95
Stenonema	sp.		1				2	1	2	5	11
Heptageniidae	forelegs, additional			1			1	2			4
ISONYCHIIDAE											
Isonychia	hoffmani?				1						1
Isonychia	bicolor		13	1	1						15
Isonychia subg. Prionoides	sp.				3		1	1			5
Isonychia subg. Isonychia	sp.			1		1				17	19
LEPTOPHLEBIIDAE											
Habrophlebiodes	americana		1								1
Paraleptophlebia	moerens							2			2
Paraleptophlebia	sp.	1		1			1				3
SIPHLONURIDAE											
Siphlonurus	nr. typicus			1							1
CHLOROPERLIDAE											
Alloperla	caudata			1							1
Alloperla	nanina	1					1	1			3
Alloperla	neglecta			1							1
Alloperla	usa	1									1
Alloperla	sp.	2	1	3		1	1				8
Suwallia	marginata	1									1
Sweltsa	mediana		5								5
Sweltsa	sp.	6	14				2	1		1	24
LEUCTRIDAE											
Leuctra	alexanderi	14						4	5		23
Leuctra	ferruginea		3					3	1		7
Leuctra	grandis								1		1

Leuctra	tenella	2					6				8
Leuctra	sp.	19	2				6	13	7		47
NEMOURIDAE											
Amphinemura	nigritta								1		1
Amphinemura	wui	20	2				8	8	3		41
PELTOPERLIDAE											
Tallaperla	anna							1			1
Tallaperla	laurie							6	1		7
Tallaperla	maria	2	24								26
Tallaperla	sp.	2									2
Viehoperla	ada						1				1
PERLIDAE											
Acroneuria	abnormis	5	2		3	11	16	21		47	105
Acroneuria	carolinensis				2						2
Order Family Genus	**species**	**Anthony Creek**	**Abrams Creek, Cades Cove CG**	**Abrams Creek, Sparks Lane**	**Abrams Creek, Falls Trailh.**	**Mill Creek, Falls Trailh**	**Forge Creek, CG 12**	**Trib. Forge Cr, Gregory Ridge Tr.**	**Trib. Forge, Parson Br. Rd.**	**Abrams Creek, Abrams Cr. CG**	**Total**
Acroneuria	filicis				1	1				2	4
Beloneuria	georgiana	2						1			3
Eccoptura	xanthenes						6	10			16
Neoperla	coosa									11	11
Perlesta	decipiens									13	13
Perlesta	frisoni							1			1
Perlesta	nelsoni			2	3					15	20
Perlesta	placida				4					38	42
PERLODIDAE											
Diploperla	duplicata		1								1
Isoperla	dicala									2	2
Isoperla	frisoni				5						5
Isoperla	holochlora	7		1	17	5	9	3			42
Isoperla	sp.				4			1			5
Malirekus	hastatus	1									1
Remenus	bilobatus	3		1			2				6
Yugus	arinus	1									1
Yugus	bulbosus	3					1				4
Yugus	sp.	2									2
PTERONARCYIDAE											
Pteronarcys	scotti	1									1

ARCTOPSYCHIDAE											
Arctopsyche	irrorata	2									2
Parapsyche	cardis	7					25	10	1		43
BRACHYCENTRIDAE											
Micrasema	wataga			1	526	169		1		334	1031
Micrasema	sp.		1						1		2
CALAMOCERATIDAE											
Anisocentropus	pyraloides									2	2
Heteroplectron	americanum							1			1
GLOSSOSOMATIDAE											
Agapetus	rossi				24					206	230
Agapetus	tomus		212	183	136	82				1893	2506
Agapetus	n.sp.		1								1
Agapetus	sp.			2566	1818	1093					5477
Glossosoma	nigrior		1	3	2	8	1	1			16
GOERIDAE											
Goera	calcarata		1	4	100	28				52	185
Goera	n.sp.		1				3		1		5
HELICOPSYCHIDAE											
Helicopsyche	borealis				1					71	72
HYDROPSYCHIDAE											

Order Family Genus	**species**	**Anthony Creek**	**Abrams Creek, Cades Cove CG**	**Abrams Creek, Sparks Lane**	**Abrams Creek, Falls Trailh.**	**Mill Creek, Falls Trailh**	**Forge Creek, CG 12**	**Trib. Forge Cr, Gregory Ridge Tr.**	**Trib. Forge, Parson Br. Rd.**	**Abrams Creek, Abrams Cr. CG**	**Total**
Ceratopsyche	macleadi	87									87
Ceratopsyche	morosa		2	5			1				8
Ceratopsyche	slossonae			7	209	181	9	5	16		427
Ceratopsyche	sparna	2	57	78	279	110	11	3		181	721
Ceratopsyche	sp.			2				1			3
Cheumatopsyche	nr. goera									1	1
Cheumatopsyche	harwoodi		305	236	136	511				931	2119
Cheumatopsyche	helma									27	27
Cheumatopsyche	oxa				211	60					271
Cheumatopsyche	sp.			364				1		858	1223
Diplectrona	modesta	1	111			8	213	262	123		718
Hydropsyche	betteni			4	6	6					16
Hydropsyche	depravata				11	4					15
Hydropsyche	depravata		2	16	17						35

Hydropsyche	simulans				84					16	100
Hydropsyche	sp.						13	2			15
HYDROPTILIDAE											
Hydroptila	alabama									A	
Hydroptila	amoena		16	7	1	10					34
Hydroptila	armata				4	3				15	22
Hydroptila	callia									A	
Hydroptila	delineata									19	19
Hydroptila	fiskei		1		30	3				176	210
Hydroptila	grandiosa			1	113	23				7151	7288
Hydroptila	hamata			1	40	8				748	797
Hydroptila	scolops				6						6
Hydroptila	sp.		4	1	52	7			2	197	263
Mayatrichia	ayama									1	1
Ochrotrichia	graysoni									2	2
Ochrotrichia	sp.					1				7	8
Oxyethira	novasota									2	2
Oxyethira	pallida									2	2
Oxyethira	sp.					1				3	4
Palaeagapetus	celsus						3				3
Stactobiella	delira		1								1
Stactobiella	martynovi		4	1		1					6
Stactobiella	sp.		15		1				1		17
LEPIDOSTOMATIDAE											
Lepidostoma	lydia	1									1
Lepidostoma	group		2								2
Lepidostoma	ontario								4	1	5
Lepidostoma	pictile						3	1			4
Order Family Genus	**species**	**Anthony Creek**	**Abrams Creek, Cades Cove CG**	**Abrams Creek, Sparks Lane**	**Abrams Creek, Falls Trailh.**	**Mill Creek, Falls Trailh**	**Forge Creek, CG 12**	**Trib. Forge Cr, Gregory Ridge Tr.**	**Trib. Forge, Parson Br. Rd.**	**Abrams Creek, Abrams Cr. CG**	**Total**
Lepidostoma	tibiale				1					17	18
Lepidostoma	togatum									4	4
Lepidostoma (Mormomyia)	sp.	1	2	1			4	5	7		20
LEPTOCERIDAE											
Ceraclea	cancellata			1						5	6
Ceraclea	flava									119	119
Ceraclea	nepha									1	1

Ceraclea	tarsipunctata			1	1					16	18
Ceraclea	transversa		8	8	5	6	4	1	5	8	45
Ceraclea	sp.			7					1	2	10
Leptocerus	americanus									1	1
Mystacides	sepulchralis				5					3	8
Nectopsyche	exquisita									57	57
Oecetis	avara				32	1				318	351
Oecetis	inconspicua		5	2	2	1				804	814
Oecetis	persimilis			1	26	5				139	171
Setodes	stehri				92	3				1455	1550
Triaenodes	ignitus		4	2	12	31				2	51
Triaenodes	perna		1							9	10
Triaenodes	taenius					1	2				3
LIMNEPHILIDAE											
Pseudostenophylax	uniformis	1					1		3		5
MOLANNIDAE											
Molanna	blenda				1						1
Molanna	ulmerina			1	1	1				6	9
ODONTOCERIDAE											
Psilotreta	amera								3		3
Psilotreta	sp.							1			1
PHILOPOTAMIDAE											
Chimarra	augusta									3	3
Chimarra	feria									2	2
Chimarra	socia									193	193
Chimarra	sp.									129	129
Dolophilodes	distinctus		6	19	5	10	8	4	6		58
Dolophilodes	major	1					11	7	1		20
Dolophilodes	sp.		16		3	16	7		3		45
Wormaldia	moesta		1				2		4		7
Wormaldia	sp.						2	2	1		5
PHRYGANEIDAE											
Ptilostomis	ocellifera							1			1
POLYCENTROPODIDAE											
Nyctiophylax	affinis									21	21
Order Family Genus	**species**	**Anthony Creek**	**Abrams Creek, Cades Cove CG**	**Abrams Creek, Sparks Lane**	**Abrams Creek, Falls Trailh.**	**Mill Creek, Falls Trailh**	**Forge Creek, CG 12**	**Trib. Forge Cr, Gregory Ridge Tr.**	**Trib. Forge, Parson Br. Rd.**	**Abrams Creek, Abrams Cr. CG**	**Total**

Nyctiophylax	banksi									1	1
Nyctiophylax	celta								1	81	82
Nyctiophylax	nephophilus		4		1	3	3		1		12
Nyctiophylax	sp.		39		11	2	3	2		320	377
Plectronemia	crassicornis			1		1					2
Polycentropus	cinereus		37	5	3	21	16	18	2	3	105
Polycentropus	confusus		6	16	3	8		2	3	13	51
Polycentropus	maculatus						1				1
Polycentropus	sp.			4		1	3	1		2	11
PSYCHOMYIIDAE											
Lype	diversa	26	20	1	5	11	7	2	5	1	78
Psychomyia	flavida		1446	47	419	260	1		18	17	2208
RHYACOPHILIDAE											
Rhyacophila	atrata	1									1
Rhyacophila	carolina	3	2	1		1	1	3	2	1	14
Rhyacophila	carpenteri							2	2		4
Rhyacophila	fuscula		7		11	15	11		1	5	50
Rhyacophila	glaberrima	4						1			5
Rhyacophila	nigrita	24					4				28
Rhyacophila	teddyi	2					1				3
Rhyacophila	torva	2									2
Rhyacophila	vibox			1				1			2
Rhyacophila	sp.			5				1	1		7
SERICOSTOMATIDAE											
Fattigia	pele						2				2
Site Totals		287	2600	4700	4989	3345	463	429	244	18838	35895
Ephemeroptera Richness		7	11	12	16	11	8	8	4	15	36
Plecoptera Richness		16	7	5	7	4	10	12	6	8	35
Trichoptera Richness		16	28	29	38	36	27	25	24	51	92
EPT Total Richness		39	46	46	61	51	45	45	34	72	163

A=Notified by Dr. Steve Harris that Hydroptila nr. fiskei specimens sent to him provided these additional species.