

# Emergence of Aquatic Insects During March-April 1993 from Streams in the Chiricahua National Monument

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**Abstract.**—Two emergence traps covering approximately four square meters of water surface were placed over Bonita Creek and East Whitetail Creek in the Chiricahua National Monument during the time when surface flow of water was present. Twenty collections were made periodically between 9 March and 15 April, 1993. From these samples 28 taxa have been identified from 800 specimens collected.

The most abundant groups were midges (Chironomidae, Diptera) and stoneflies (Capniidae, Plecoptera). Over seventy-five stoneflies emerged consisting of two species; *Mesocapnia arizonensis* and *Capnia californica*. Twenty-five mayflies (Baetidae, Ephemeroptera) emerged during this period with the very common North American species *Baetis tricaudatus* present as well as the uncommon species *Falceon quilleri*. Immature blackflies (Simuliidae, Diptera) were observed in the streams in large numbers but were infrequently collected in the emergence traps. *Prosimulium imposter* was the most common blackfly present. Future research should be directed at determining how these insects cope with the long dry periods when no surface water is present. It may be that subsurface flow is maintaining these insects.

## METHODS

Emergence traps constructed of shade cloth (Lumite special screen #5103200 from Chicopee Mfg. Co.) with a mesh size of 0.5 mm covered 4m<sup>2</sup> of water surface. Two traps were placed on Bonita Creek and East Whitetail Creek in the Chiricahua National Monument (32\_01'18"N, 109\_20'19"W and 32\_01'15"N, 109\_18'44"W). These two streams were at 1627m and 1853m elevation respectively. The site on Bonita Creek is known as the Shake Spring. A seonc site on Bonita Creek was used after the East Whitetail Creek flow stopped on 31 March. The precipitation and stream flow (Table 1) indicate the paucity of water available for this aquatic habitat. Twenty samples were taken between 9 March, 1993 and 15 April 1993. Specimens were aspirated from the inside of the trap and preserved in 70% ethanol. The samples were then returned to Penn State in Erie, PA for sorting and identification. Merritt & Cummins, 1984; Stewart

et al. 1974) Representative specimens have been deposited at the Chiricahua National Monument.

The Chiricahua National Monument is located in the Southeast corner of Arizona on a tract of 11,985 acres. It was created out of ash from a volcanic explosion some 27 million years ago. The Chiricahua mountains stand at the crossroads of the southern Rocky mountains, the northern Sierra Madre, the Chihuahuan Desert to the east and the Sonoran Desert to the west. Surrounded by deserts and grasslands this "sky island" is the repository of plant and animal species that have retreated to their highlands in the face of gradual climatic change. It is home to plant and animal species more commonly found in Mexico and Central America.

## RESULTS AND DISCUSSION

Biotic inventories have not been done for numerous groups and especially aquatic insects. (Stohlgren & Quinn, 1992) Aquatic organisms lead a precarious existence in this habitat and often

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have unique adaptations. The riparian zone may be barren land or in some desert areas composed of tamarisk, willows, cottonwoods, rabbitbrush, sagebrush, mesquite and a variety of low-lying shrubs. Stress of this environment include fluctuating water temperatures, shifting stream substrates, stream bank instability, flash flooding, low water quality and severe, periodic drying up of the water resource or habitat.

One behavioral mechanism for survival is that organisms burrow into the substrate and down into the groundwater areas during periods of surface dewatering. Long slender gills of some organisms add to the interface keeping gills free while burrowing through the sand allowing organisms to obtain oxygen from the water in this habitat and not smoother. Some organisms have strong spines on the head and strong shortened legs which act as tools for breaking up the plating of the benthos and substrate.

Eighteen families of aquatic insects from six orders including 28 taxa were present in approximately 800 specimens collected. (Table 2) Several species collected were uncommon. The life histories of most of these insects are potentially quite unique due to the lack of flowing water for an extended period. Descriptions of the various orders collected follows.

**PLECOPTERA (STONEFLIES)** emerge as adults in the winter during annual periods of little rainfall and during a time when scouring flash

Table 1.—PRECIPITATION in inches measured at the Visitors Center in 1992.

Jan	1.32	Jul	4.14
Feb	0.88	Aug	4.83
Mar	1.14	Sep	1.63
Apr	0.44	Oct	0.76
May	0.18	Nov	0.89
Jun	0.68	Dec	1.31

**STREAM FLOW** measured in Bonita Creek

1989	- No flow this calendar year.
1990	- Some flow but the amount not recorded, probably minimal.
1991	- 3.0 cm flow 6 Jan.
	4.0 cm flow 4 April
	Some flow last 2 weeks of Dec. but not recorded.
1992	- Flow during the whole month of January but not recorded.
	4.0 cm flow 5 Feb.
	0.5 cm flow 25 Aug.
	0.5 cm flow 2 Sept.
1993	- 5.5 cm flow 8 Jan.
	9.5 cm flow 11 Jan.
	6.5 cm flow 22 Jan.
	10.0 cm flow 29 Jan.
	6.0 cm flow 5 Feb.
	6.5 cm flow 11 Feb.
	5.0 cm flow 19 Feb.
	9.1 cm flow 24 Feb.
	6.1 cm, flow 3 Mar.

Table 2.—Aquatic Insects of Chiricahua National Monument Spring 1993.

<b>DIPTERA</b>
Chironomidae
<i>Cricotopus</i> sp.
<i>Orthocladus</i> sp.
Ceratopogonidae
Dixidae
Empididae
<i>Neoplecta</i> sp.?
Psychodidae
Simuliidae
<i>Prosimulium</i> <i>imposter</i> Peterson
<i>Simulium</i> <i>beoti</i> Vargas, Martínez-Palacio & Díazmajera
Bibionidae
Ephydriidae
Sciadidae
Dolichopodidae
Tipulidae
<i>Dicranota</i> ( <i>Rhaphidolabis</i> ) sp. 1
<i>Dicranota</i> ( <i>Rhaphidolabis</i> ) sp. 2
<b>EPHEMEROPTERA</b>
Baetidae
<i>Fallax</i> ( <i>Baetis</i> ) <i>quilleri</i> (Dodds)
<i>Baetis</i> sp.
<i>Baetis</i> <i>tricaudatus</i> Dodds
<i>Cellibaetis</i> sp. <i>americanus</i> or <i>pictus</i>
<b>MEGALOPTERA</b>
Corydalidae
<i>Neohelms</i> sp.
<b>ODONATA</b>
Coenagrionidae
<i>Argia</i> sp.
<b>PLECOPTERA</b>
Capniidae
<i>Mesocapnia arizonensis</i> (Baumann & Gaurin)
<i>Capnia californica</i> Claassen
<b>HEMIPTERA</b>
Gerridae
<i>Aquarius remigis</i> (Say)
Belostomatidae
<i>Belostoma</i> sp. or <i>Abedus</i> sp.
Veliidae
<i>Microvelia beameri</i> McKinstry
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floods do not occur. Mature nymphs crawl up on the edge of the bank, shed their exuviae, and the adult winged form emerges. Adults mate and lay eggs. Eggs hatch before spring run-off and the nymphs burrow down into the sand and are not seen in stream samples until the following winter. (Sagent et al. 1991)

In this study the stoneflies were one of the most abundant insects collected and all from the family Capniidae. *Mesocapnia arizonensis* had 18 males and 33 females at Bonita Creek while at East Whitetail Creek 5 females were collected.

*Capnia californica* had 4 males and 7 females at Bonita Creek and 9 males and 9 females were collected at East Whitetail Creek. *Mesocapnia arizonensis* is known only from Arizona at elevations of 2000-5000 feet occurring in intermittent streams which dry up during the summer months. Baumann and Gauffin (1970) state that this species emerges in the spring from February to April. Sargent et al. (1991) refer to the genus *Mesocapnia* as tolerant of high mountain streams to lowland streams that are still relatively unperturbed. It may, in this habitat have a fast univoltine life cycle with a summer diapause. *Capnia* is probably similar in its life cycle. The Capniidae function as shredder-detritivores.

**EPHEMEROPTERA (MAYFLIES)** are common in streams subjected to temporary stress periods. Following a period of stress, small mayfly nymphs tend to reinhabit a stressed area by free-floating downstream from calmer water areas upstream from stress. They have an extremely high reproductive potential. The Baetidae function as collector-gatherers and scrapers feeding on detritus and diatoms in the nymphal stage.

In this study at least 3 species were present. All 25 specimens were collected from the Shake Spring area of Bonita Creek. *Baetis tricaudatus* adults emerge throughout the year. Females crawl under water collapsing the wings onto or alongside the abdomen. Time required for nymphs to mature varies with the area and species. Subimago stage lasts from 7-12 hours. Mating flights take place 6-15 feet over the stream bank in late afternoon or early evening. **CHIRONOMIDAE (midges) DIPTERA**, drift away from a stressed area and reinhabit new areas downstream. Larvae of some species tend to burrow down into the sand and may even spin silken linings to the their burrows.

In this study over 700 adult midges were collected from Bonita Creek with only 33 collected from East Whitetail Creek. At present all specimens appear to be in two genera, *Cricotopus* spp. and *Orthocladius* spp. These species are Orthoclaudiini with the first genus functioning as a shredder, collector-gatherer as does the latter genus feeding on detritus and algae. **SIMULIIDAE (blackflies) DIPTERA**, may also be present in large numbers, usually on stable substrate such as rock outcrops, fallen logs or vegetation in the streambed. Larvae spin a small net on an object in the direct stream current. Only 3 adults were collected during this study but large numbers of larvae were observed in the stream. Blackflies function as collector-filterers.

**TIPULIDAE (craneflies) DIPTERA** were collected only at Shake Spring of Bonita Creek with 11 specimens all females. The genus *Dicranota* is in the subfamily Limoniinae and functions as a predator. These craneflies have a brief egg stage and 4 larval stages and a pupal stage that lasts 5-12 days. The entire life cycle may be as short as 6 weeks or as long as 5 years. It would be of interest to know what type of life cycle exists in this habitat.

**OTHER DIPTERA (CERATOPOGONIDAE, DIXIDAE, EMPIDIDAE, SCIARIDAE, DOLICHOPODIDAE, BIBIONIDAE, EPHYDRIDAE & PSYCHODIDAE)**. The biting midges (Ceratopogonidae) were collected only at Bonita Creek, as were the Dixids, dance flies, dark-winged fungus gnats, long-legged flies, March flies, shoreflies, and moth flies. The Ceratopogonidae, Dolichopodidae, and Empididae function as predators. The Dixidae and Psychodidae are collector-gatherers. The Ephydriidae may be a shredder. The Bibionidae were an interesting part of the fauna that have been reported to feed on decaying vegetable matter and their presence in an aquatic situation should be further studied. Sciaridae probably are feeding on decaying plant material. **MEGALOPTERA (dobsonflies)**, of the genus *Corydalis* can live successfully in a desert habitat. The life cycle may take 2-3 years to complete. Larvae are hardy and robust so they withstand considerable environmental buffeting and avoid stress by burrowing into substrate and may crawl into pools or under rocks. I believe that the genus *Neohermes* collected during this study has similar features. This genus functions as a predator.

**HEMIPTERA (WATER STRIDERS, GIANT WATER BUGS & BROAD-SHOULDERED WATER STRIDERS)** Water striders (Gerridae) burrow in the mud or under stones or hibernate when the streams dry up. These insects are unspecialized predators feeding primarily on other insects. The giant water bugs (Belostomatidae) have raptorial front legs that function very effectively as predators. The broad-shouldered water striders also function as predators feeding on both live and dead arthropods.

**ODONATA (ZYGOPTERA-damselflies), COENAGRIONIDAE** were common at the Shake Spring site on Bonita Creek. *Argia*, the genus present is a predator.

**TRICHOPTERA (caddisflies)** were not collected as adults but larval cases were observed in the stream. It is surprising that no adult specimens were collected.

At present I am not aware of what happens to these insects during the approximately 9 months when no surface water is present, but there could be subsurface water available. Some of these insects undoubtedly have long periods of dormant stages but it is not apparent at what stage in their life cycle this occurs. Future studies should include sampling of the subsurface areas and periodic sampling to determine the presence of the various life stages throughout the year. Fisher and Gray (1983) reported that most aquatic insects of Sycamore Creek and other Sonoran Desert streams are multivoltine, producing several generations annually.

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#### LITERATURE CITED

- Baumann, R.W. & A.R. Gaufin. 1970. The *Capnia projecta* complex of Western North America (Plecoptera: Capniidae). *Trans. Amer. Entomol. Soc.* 96:435-468.
- Fisher, S.G. & L. J. Gray. 1983. Secondary production and organic matter processing by collector macroinvertebrates in a desert stream. *Ecology* 64(5): 1217-1224.
- Merritt, R.W. & K. W. Cummins. 1984. An introduction to the Aquatic Insects of North America. Kendall/Hunt. 722pp.
- Sargent, B.J., R. W. Baumann & B. C. Kondratieff. 1991. Zoogeographic affinities of the Nearctic stonefly (Plecoptera) fauna of Mexico. *Southwestern Naturalist*. 36(3):323-331.
- Stewart, K. W., R. W. Baumann, & B. P. Stark. 1974. The distribution and past dispersal of Southwestern United States Plecoptera. *Trans. Amer. Entomol.* 99: 507-546.
- Stohlgren, T. J. & J. F. Quinn. 1992. An assessment of biotic inventories in Western U. S. National Parks. *Natural Areas J.* 12 (3):145-154.



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