PHORETIC RELATIONSHIPS BETWEEN CHIRONOMIDAE (DIPTERA) AND BENTHIC MACROINVERTEBRATES[1,2]

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ABSTRACT: Seven streams in the Piedmont and Coastal Plain regions of South Carolina were sampled to determine the frequency and composition of aquatic phoretic relationships. In one stream, as many as 71.4% of the Odonata collected hosted phoretic midges. *Stenonema smithae* Traver (Ephemeroptera: Heptageniidae) and *Nectopsyche exquisita* (Walker) (Trichoptera: Leptoceridae) also were found with phoretic Chironomidae. In a population of snails at Wildcat Creek, 80.0% were phoretic symbionts. Aquatic phoretic relationships were concluded to be relatively common in the regions studied, probably due in part to the prevalence of sand-bottomed streams.

In recent years there has been increased interest in and documentation of phoretic associations between aquatic organisms. Phoresy is defined (Steffan 1967) as a partnership in which one organism transports the other, either permanently or as a characteristic and essential element in the life cycle. Steffan (1967) reported Chironomidae to be associated phoretically with Trichoptera, Diptera, Ephemeroptera, and Plecoptera. Roback (1977) found *Eukiefferiella* sp. living on a naucorid (Hemiptera). Rosenberg (1972) reported finding one libellulid (Odonata) nymph supporting a *Paratanytarsus* sp. larva, after examining several hundred libellulid nymphs. White and Fox (1979) discovered *Rheotanytarsus exiguus* Johannsen on a *Macromia georgina* Selys (Odonata: Macromiidae) nymph. They also discovered pupae of *Oxyethira azteca* (Mosely) (Trichoptera: Hydroptilidae) on the same odonate.

Parasitic relationships have been reported fairly frequently by chironomids on bivalves (Forsyth and McCallum 1978, Hynes 1976). However, Mancini (1979) was the first to show phoretic relationships between chironomids (*Rheotanytarsus* sp.) and snails.

The consensus of most aquatic phoresy research is that for chironomids this phenonemon is relatively uncommon. In opposition, Roback (1977) felt that phoretic relationships are fairly common. In an attempt to document the frequency of aquatic phoretic relationships. collections of aquatic macroinvertebrates were made in the Piedmont and Costal Plain

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[1]Received March 14, 1980

[2]Published by permission of Director, South Carolina Agricultural Experiment Station, Technical Contribution No. 1771.

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regions of South Carolina.

Methods

Collections were made from Pickens County: Wildcat Creek; Anderson County: Big Garvin Creek, Little Garvin Creek, Watermelon Creek, Browns Creek, and Rock Creek; Horry County: Simpson Creek, all from March through July 1979. Specimens were preserved in 80% ETOH, and then examined under a microscope for phoretic associations. Chironomids were mounted on slides and determined by appropriate taxonomic specialists. At Wildcat Creek, 45 snails (*Elimia acutocarinata* (Lea)) were collected randomly, and the number of chironomid larvae/snail was ascertained. Rocks upon which the snails were attached were searched carefully, and all chironomids on the rocks were preserved.

Results and Conclusions

All seven streams collected in this study yielded specimens exhibiting phoretic relationships. Mayflies, caddisflies, dragonflies and damselflies were found bearing chironomid larvae (Table 1). Of all dragonflies (Anisoptera) collected, only *Boyeria vinosa* (Say) (Aeshnidae) and *Macromia* spp. (Macromiidae) were found with phoretic midges. Both of these genera are sprawlers and wait motionless for prey to come within reach before attacking. These long waiting periods evidently allow the chironomids time to build their cases on the nymphs. Midges also were

Table 1. Hosts, phoretic chironomids, biogeographical regions and localities.

Host	Chironomidae species	# of larvae	Biogeographical Region	Locality
Boyeria vinosa (Say)	*Rheotanytarsus* sp.	2	Piedmont	Watermelon Creek
B. vinosa	*Rheotanytarsus* sp.	2	Piedmont	Browns Creek
B. vinosa	*Rheotanytarsus* sp.	3	Piedmont	Rock Creek
B. vinosa	*Rheotanytarsus* sp.	1	Piedmont	Rock Creek
B. vinosa	*Rheotanytarsus* sp.	4	Piedmont	Rock Creek
B. vinosa	*Rheotanytarsus* sp.	1	Piedmont	Rock Creek
B. vinosa	*Rheotanytarsus* sp.	2	Piedmont	Rock Creek
B. vinosa	*Rheotanytarsus* sp.	4	Piedmont	Little Garvin Creek
Calopteryx maculata (Beauvois)	*Rheotanytarsus* sp.	4	Coastal Plain	Simpson Creek
Nectopsyche exquisita (Walker)	*Rheotanytarsus* sp.	1	Coastal Plain	Simpson Creek
Stenonema smithae Traver	*Rheotanytarsus* sp.	1	Coastal Plain	Simpson Creek
S. smithae	*Rheotanytarsus* sp.	1	Coastal Plain	Simpson Creek
Macromia sp.	*Rheotanytarsus* sp.	4	Coastal Plain	Simpson Creek
Macromia sp.	*Rheotanytarsus* sp.	1		
	Tanytarsus sp.	1	Piedmont	Big Garvin Creek
Macromia georgina Selys	*Tanytarsus* sp.	3	Piedmont	Big Garvin Creek
B. vinosa	Chironomini	2	Piedmont	Watermelon Creek

found on *Stenonema smithae* Traver (Ephemeroptera: Heptageniidae), *Nectopsyche exquisita* (Walker) (Trichoptera: Leptoceridae), and *Calopteryx maculata* (Beauvois) (Odonata: Calopterygidae) which also may remain in one place for long periods.

For the Odonata, tabulation of the location of the phoretic midges on the nymphs showed that 21 chironomid larvae built cases on the legs of the nymphs, 11 larvae on the thorax and wing pads, and 2 larvae built a case on the dragonfly head. No Odonata were found with chironomid cases on the abdomen or the venter of the body. The lack of chironomid cases on the venter is not surprising, for the nymphs are sprawlers which allows no access to the venter by the chironomids. The absence of phoretic chironomids on the abdomen may be due to the continuous expansion and contraction of the abdominal segments. This movement probably would tend to detach a chironomid case over time. The head, thorax, wing pads, and legs are relatively immobile and appear to make a good site for permanent attachment.

Stenomena smithae in one instance demonstrated phoretic attachment on the thorax. However, the other, early instar specimen had the chironomid case attached to the cerci (Figure 1). It would seem that the cerci would be a precarious attachment position.

Frequency of phoretic occurrence varied greatly among streams. Browns and Little Garvin Creeks each yielded 1 phoretic relationship, Big

Figure 1. *Rheotanytarsus* sp. larva in phoretic association on *Stenonema smithae* Traver.

Garvin and Watermelon Creeks 2 relationships each, and Simpson and Rock Creeks 5 relationships each. In Rock Creek there were only 7 odonates collected, and 5 of these specimens had phoretic chironomids (71.4%).

Many case-building chironomids build their cases on rocks and other objects. Little Garvin and Browns Creeks have a few rocks dispersed throughout the stream bed. Rock Creek is predominantly and Simpson Creek is entirely sand-bottomed. Thus, as the percentage of rocks, detritus, etc. decreases in a stream, phoresy by chironomids on aquatic insects increases.

Three taxa of larval Chironomidae were found to be phoretically associated in this study: *Rheotanytarsus* sp., *Tanytarsus* sp. and unidentifiable Chironomini. *Rheotanytarsus* sp. was the most common phoretic midge, occurring on 87.5% of all hosts. One *Macromia* sp. nymph yielded one *Tanytarsus* sp. and one *Rheotanytarsus* sp. larva. This was the only example of two phoretic species on one host in this study. *Tanytarsus* sp. occurred on two hosts, and unidentified Chironomini on one host. This predominance of Chironominae is not surprising, for the larvae of many of the species of this subfamily build cases.

Wildcat Creek, a rocky-bottomed stream, yielded no phoretic chironomids on aquatic insects. However, of the 45 specimens of *Elimia acutocarinata* (Lea) collected at Wildcat Creek, 36 (80.0%) yielded phoretic midges (*Rheotanytarsus* sp.) (Figure 2). The majority of host snails supported 2 *Rheotanytarsus* sp. larvae, but the number of phoretic relationships ranged from 0 to 4.

The location of the chironomid cases on the snail shells was random, and occurred in every direction (Figure 3). This is in opposition to observations by Mancini (1979) who found that *Rheotanytarsus* sp. had 3 preferred attachment positions on *Goniobasis semicarinata* (Say) in Indiana. Careful examination showed no damage to any of the fleshy portions of the snail, which supports the conclusion that the chironomid larvae were not feeding on the snails.

Chironomid larvae collected from rocks where the snails also were collected included *Rheotanytarsus* sp., but the numbers for this species were no higher than those of other midge taxa. The snail shells therefore must be a preferred site for *Rheotanytarsus* sp. larvae at Wildcat Creek although the reason for this preference is unknown. Perhaps the smooth surface of the snail shell is an easier attachment site than the rough surface of the rock.

Phoretic relationships are indeed relatively common in the Piedmont and Coastal Plain regions of South Carolina. This may be due in part to the predominance of sand-bottomed streams in these regions.

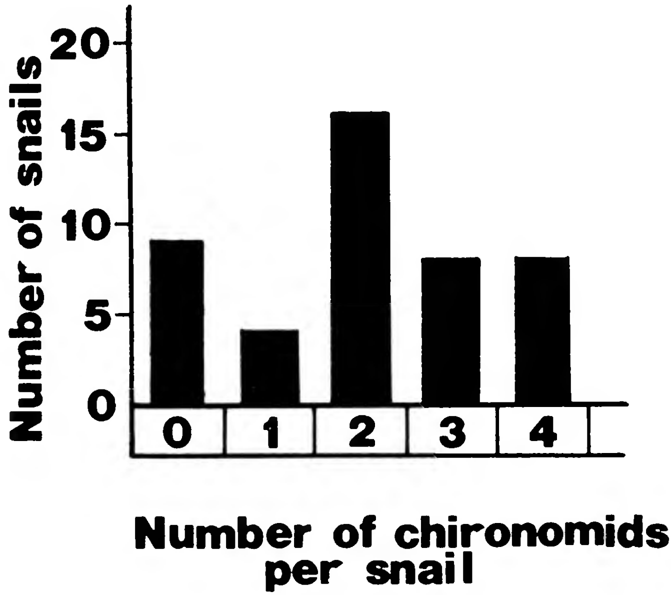

Figure 2. Number of snails collected and number of phoretic midges/snail.

Figure 3. Location of phoretic midges on *Elimia acutocarinata* (Lea).

ACKNOWLEDGEMENTS

Our sincere thanks are extended to the following individuals for their invaluable assistance: Dr. Gerald Carner, photography; Dr. Manuel Pescador, Ephemeroptera determinations; Mr. William M. Beck, Jr., Chironomidae determinations; and Dr. J.B. Burch and Mr. John Suloway, Mollusca determinations.

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Glenn E. Wixom, a member of the American Entomological Society, was born on August 9, 1909 in Oroville, California and died there on June 3, 1979. He attended Butte College and was employed by the postal department at Oroville for 33 years. He was active in scouting and developed his interest in entomology and natural history from his youth.

In 1966 he published privately, through the Appelman Press, Oroville, the first of some 14 Technical Bulletins entitled "Orthoptera of Western North America subfamily Acridinae." These works contain keys, descriptions and distributional data of acridine grasshoppers. No new taxa were described. These papers were distributed widely to museums, universities and specialists alike. In the mid 1970s he took a collecting trip to South America and presented his collection of very well preserved Orthoptera to the California Academy of Sciences and University of Idaho.