

Mating Flights of *Isonychia* May-flies (Ephemeroptera).

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Relatively few accurate observations have been made on the mating flights of mayflies. Morgan writes, "Actual mating has been observed but a few times. The most satisfactory observation was made (May, 1911) upon a swarm of *Baetis*. Murphy's² observations on the mating behavior of *Baetis posticus* supported Morgan's statements. In a more recent account of the order of mayflies, Needham and associates³ remark, "And for many mayflies the swarming habits are quite unknown."

In a previous paper⁴ the writer has recorded an observation on the mating flights of *Stenonema vicarium*. Opportunity has been afforded to extend this observation to species of *Isonychia*.

The temperatures at which eggs of mayflies hatched have been recorded by writers in several scattered papers. However, data on the temperature for nymphal emergence and that for adult behavior in nature have been greatly restricted. The most available information on the latter two activities may be found in the work by Clemens and by Murphy.

In an ecological study of mayflies Clemens⁵ found that temperature had a very marked effect on the length of subimaginal period. Murphy² recorded a monthly average of temperature in her study of *Baetis posticus*. From May to October inclusive, she found that the average temperature for

¹Morgan, Ann. H. 1913. Contribution to the Biology of Mayflies. Ann. Soc. Amer. 6: p. 392.

²Murphy, Helen. 1922. Notes on the Biology of Mayflies Genus *Baetis* Bull. Lloyd Library Ent. Ser. 2.

³Needham, J. G., Traver, Jay R. and Hsu, Yin-Chí. 1935. The Biology of the Mayflies, p. 10.

⁴Cooke, Herman G. Jan., 1940. Observations on Mating Flights of Mayflies *Stenonema vicarium* Ent. News 51.

⁵Clemens, W. A. 1917. An Ecological Study of the Mayfly Chironetes. University of Toronto Studies Biol. Ser. 17.

nymphal emergence (of brood four) was 62.2° F., for each month.

The writer also has observed that temperature is quite a factor as regards the behavior of mayflies. He has been able to secure the temperature and date of nymphal emergence and of adult behavior in nature as here noted. All temperatures were counter-checked by a thermometer employed on date of observations. It was found that the nymphs failed to emerge from the water as sub-imagoes when the temperature registered below 65° F. No doubt, the chief difference between the former and latter figures may be attributed to difference in species or environmental conditions or probably both.

The present study began on August 24, 1940, when a lone male was observed descending over the banks of Darby Creek from a large company of imagoes which swarmed high up among the branches of trees beneath a mid-day sun. The location was almost two miles up stream from Oakview, Pennsylvania. Neither copulation nor the movements that usually characterize actual mating took place; nevertheless, the incident occurring at a height of forty or fifty feet served not only as a clue toward further investigations, but also as a confirmation of a report by Needham³. In a paragraph on the swarming of *Callibaetis* that author writes, "Other mayflies fly at a higher altitude in swarming; some so high as to be observed with difficulty from the ground."

At 1:30 p. m., on the above date the atmospheric pressure registered 30.23 inches while the temperature was 69° F.⁶

The summer of the following year (1941) was uneventful in this field until September 26 and 27. At 3:30 p. m., both days, a small company of *Isonychia christina* (tentative identification of species) was seen rising and falling in deep rhythmic undulations over an evaporated pond-bed twenty yards from the west bank of the creek. The scene of this flight was approximately one hundred yards up stream from the location

⁶ Records of atmospheric pressure and temperature were obtained from the Weather Bureau at Philadelphia, Pa. The times given are in Eastern War Time, one hour earlier than Eastern Standard Time.

of the male observed in 1940. At times the individuals soared to a height of about fifty feet while at frequent intervals they descended to within five feet of the ground. When the lower level was reached they quickly mounted upward as if the descended distance had been plotted by measurement. The vibratory body motion so effectively displayed by these insects during flight was more highly perfected by the males than by the females.

On September 26, 1941, at 1:30 p. m., the atmospheric pressure was 30 inches and at 4 P. M. the temperature was 78° F. The following day, at the same hours, the atmospheric pressure was 30.21 inches while the temperature fell to 73° F. The weather reports for the three above mentioned dates, suggest a fairly constant range of atmospheric pressure and temperature for the flights of *Isonychia*.

It was of particular interest to note a female entering the group of males attempting, in her sluggish manner, to participate in the rhythmic performance. Up to this point her role had been negligible, but she was soon spotted and attacked by a male as if he had been watchfully awaiting her arrival. The pair remained united during their flight for a distance of nearly thirty yards and then suddenly separated and vanished among the trees. Two other females passed unmolested beneath the swarm of males and continued on their journey. Shortly after this, at intervals of about ten minutes, two additional couples were seen in copulation. Each couple showed a tendency to be borne slightly downward as it proceeded along its course. Otherwise, copulation was conducted in a manner similar to that observed for *Stenonema vicarium*.

One of the most striking features exhibited during these flights was the trend displayed toward net shyness, (i.e., from the swinging of an insect net), a tendency probably carried over from the nymphal stage, as nymphs of this species are among the most wary and are difficult to capture. When the swarm was continuously disturbed it either withdrew to a more distant region, or its members became scattered and disappeared. However, after a few minutes interval they usually returned

to resume their performance in increasing numbers and with renewed vigor. Needham³ also reported similar scattering in the genus *Callibaetis* that he observed: "—— suddenly vanishing ghostlike from view."

In order to capture *Isonychia* imagoes, it was necessary to lie in wait in the grass beneath the swarm until descending members had reached a lower level. Normally, these flights remained in progress for about thirty-five minutes. During prolonged interference, by the collector, the duration could not be accurately estimated. However, in either case, activity ceased long before sun-down.

The writer wishes to express his gratitude and appreciation to Dr. P. P. Calvert for his stimulating interest freely shown throughout this investigation, and to Dr. H. T. Spieth for having aided in the classification of this as well as several other species of mayflies. Thanks are due also to Dr. D. H. Wenrich, Dr R. G. Schmieder and Mr. E. T. Cresson, Jr., for helpful suggestions.

The Carry-over of Jungle Fever Virus. Continued investigation of jungle yellow fever in Colombia brought added evidence that, in certain areas at least, a *Haemagogus* mosquito is the chief villain in the tragedy. One of the puzzling aspects of this problem has been the complete disappearance of this mosquito at certain periods, especially during the dry season, while at the same time the disease has continued among both animals and men. This problem was resolved by the discovery that *Haemagogus* is characteristically an inhabitant of the tree tops and may be found there when it is absent in catches made at ground level. The investigators were forced to develop techniques new to yellow fever work, and as one of them expressed it, it became necessary "to associate with the monkeys in the interlacing branches high above the jungle floor." With this knowledge available it was possible to capture haemagogus mosquitoes throughout the entire dry season of 1941, and the yellow fever virus was found repeatedly in the mosquitoes caught in the tree tops.—Rockefeller Foundation, Annual Rept. 1941, p. 15.