

THE ECOLOGY AND LIFE HISTORY OF *BAETISCA ROGERSI* BERNER  
(EPHEMEROPTERA : BAETISCIDAE)

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ABSTRACT

The life history, ecology, and seasonal distribution of *Baetisca rogersi* were investigated under laboratory and field conditions in 1968 and 1969. Field studies were conducted at Rocky Comfort Creek and Bear Creek, Gadsden County, Florida. Eggs hatched in 20-31 days (averaging 22.8 days) under laboratory conditions. Fertilized eggs hatched in an average of 21 days. *B. rogersi* can be parthenogenetic, but unfertilized eggs required a longer average hatching period of 26.6 days. Twelve instars were found, taking approximately four months to develop in the laboratory. Field data was quite different. Young nymphs were not found until September and continued in the study streams through June. Emergence occurred from March to early July, with the majority of imagos emerging in April. Distribution of the imagos was strictly seasonal, permitting only one generation a year. It appears that other factors, such as temperature and oxygen, have an influence on the rate of egg maturation and nymphal development. Early instars in both study streams were found in thick growths of water moss (*Leptodictyum riparium*) and algae (*Spirogyra* sp.). More mature nymphs in Rocky Comfort Creek were found in shallow areas of gravel and coarse sand. In Bear Creek, which has a sand bottom, nymphs were found on submerged logs, trailing vegetation, and also on the sand bottom. Twelfth instar nymphs in both streams moved out of the current into shallow sandy or swampy areas of the stream prior to emergence. Nymphs of *B. rogersi* are herbivorous, feeding on detritus, diatoms, and filamentous algae in all instars. Emerging subimagos were observed in the laboratory between 10 : 30 a.m. and 8 : 30 p.m. with the peak emergence occurring between 12 : 00 p. m. and 3 : 00 p. m. In the study areas, subimagos emerged between 8 : 00 a. m. and 2 : 30 p. m. with the peak emergence occurring between 8 : 00 a. m. and 10 : 30 a. m. The duration of the subimaginal stage varied between 12 and 30 hours, averaging 20-24 hours. Temperature appears to influence the duration of the adult stages. Female imagos produced 1,500 to 2,727 eggs, with an average of 2,168 eggs.

SOMMAIRE

Ecologie et cycle de vie de *Baetisca rogersi* BERNER  
(Ephéméroptères : Baetiscidae)

L'écologie, le cycle et la distribution saisonnière de *Baetisca rogersi* ont fait l'objet de recherches dans des conditions de laboratoire et naturelles en 1968 et 1969. Les recherches sur le terrain ont été menées à Rocky Comfort Creek et à Bear Creek, Gadsden County, Floride. Dans des conditions de laboratoire les œufs éclosent après 20-31 jours (en moyenne 22.8 jours). Les œufs fertilisés éclosent après en moyenne 21 jours. *B. rogersi* peut être parthénogénétique,

mais les œufs non fertilisés demandent une plus longue période, en moyenne de 26.6 jours avant d'éclore. Douze instars ont été trouvés, nécessitant à peu près quatre mois pour leur développement en laboratoire. Dans des conditions naturelles les choses sont toutes différentes. Aucune jeune larve n'a été trouvée avant septembre, elles ont persisté jusqu'en juin dans la rivière étudiée. Les émergences se font de mars jusqu'au début de juillet, avec la plupart des imagos émergeant en avril. La distribution des imagos est strictement saisonnière, permettant seulement une génération par an. On constate que d'autres facteurs, tels que la température et l'oxygène, ont une influence sur la vitesse de maturation des œufs et le développement larvaire. Les premiers instars, dans les deux rivières étudiées, ont été trouvés parmi une végétation dense constituée par *Leptodictyum riparium* et *Spirogyra* sp. Des larves plus matures ont été trouvées sur des fonds peu profonds de gravier et de sable grossier. À Bear Creek, qui présente un fond sableux, des larves ont été trouvées sur des bûches submergées, accrochées à la végétation, et aussi sur le fond sableux. Les larves du douzième instar, dans les deux rivières, évitent le courant et se retirent, avant leur émergence, dans des zones de fond sableux peu profond ou marécageuses. Les larves de *B. rogersi* sont herbivores, se nourrissant de détritiques, de diatomées et d'algues filamenteuses chez tous les instars. L'émergence des subimagos a été observée au laboratoire entre 10h30 et 20h30, avec un pic entre 12h et 15h. Dans la région que nous avons étudiée, les subimagos émergeaient entre 8h et 14h30, avec un pic entre 8 et 10h30. La durée du stade subimago varie entre 12 et 30 heures, en moyenne 20-24 heures. La durée du stade imago varie de 8 1/2 à 29 heures, en moyenne 20-24 heures, dans des conditions normales. La température semble influencer la durée du stade adulte. Les imagos femelles produisent 1500 à 2727 œufs, avec en moyenne 2168 œufs.

#### AUSZUG

#### Die Ökologie und Lebensgeschichte von *Baetisca rogersi* BERNER (Ephemeroptera : Baetiscidae)

Die Lebensgeschichte, Ökologie und jahreszeitliche Verteilung von *Baetisca rogersi* waren unter Laboratorium- und Feldbedingungen in 1968 und 1969 untersucht worden. Feldstudien wurden am Rocky Comfort Bach und Bear Bach, Gadsden Bezirk, Florida gemacht. Eier schlüpften in 20-31 Tagen (durchschnittlich 22,8 Tage) unter Laboratoriumsbedingungen aus. Befruchtete Eier schlüpften durchschnittlich in 21 Tagen aus. *B. rogersi* kann partheongenetisch sein, aber unbefruchtete Eier brauchten eine längere, durchschnittliche Ausschlüpfungszeit von 26,6 Tagen. Zwölf Instars, welche im Laboratorium ungefähr vier Monate zur Entwicklung brauchten, wurden gefunden. Felddaten waren ganz anders. Junge Nymphen wurden nicht vor September gefunden, und kamen weiter in den Studienflüssen bis zum Juni vor. Das Erscheinen fand vom März bis zum frühen Juli statt, mit der Mehrzahl der Imagos im April erscheinend. Verteilung der Imagos war strikt jahreszeitlich, welches nur eine Generation im Jahr erlaubte. Es scheint, dass andere Faktoren, wie Temperatur und Sauerstoff, einen Einfluss an der Geschwindigkeit von Eierreifung und Nymphenentwicklung haben. Frühe Instars in beiden Studienflüssen wurden im dicken Gewächs von dem Wassermoss, *Leptodictyum riparium* und der Alge *Spirogyra* sp. gefunden. Mehr erwachsene Nymphen im Rocky Comfort Bach wurden im seichten Gebieten von Kies und groben Sand gefunden. Im Bear Bach, welcher Sandboden hat, wurden Nymphen an überschwemmtem Holz, hängender Vegetation und auch am Sandboden gefunden. Zwölfte Instar-Nymphen in beiden Flüssen zogen aus der Strömung in seichte, sandige oder sumpfige Gegenden des Flusses vor dem Erscheinen.

Nymphen von *B. rogersi* sind pflanzenfressend und fressen Detritus, Diatomen, und fadenförmigen Algen in allen Instars. Erscheinende Subimagos wurden im Laboratorium zwischen 10h30 und 20h30 beobachtet, mit der Höchsterscheinung zwischen 12h und 15h. In den Studien-gegenenden erschienen Subimagos zwischen 8h und 14h30, und gipfelten zwischen 8h und 10h30. Die Dauer des Subimagos-Stadiums schwankte zwischen 12 und 30 Stunden, durchschnittlich 20-24 Stunden. Die Dauer des Imagos-Stadiums schwankte von 8 1/2 bis 29 Stunden, durchschnittlich zirka 20-24 Stunden unter normalen Bedingungen. Die Temperatur scheint die Dauer des Erwachsenen-Stadiums zu beeinflussen. Weibliche Imagos produzierten 1500 bis 2727 Eier, mit einem Durchschnitt von 2169 Eiern.

## DISCUSSION

R. ALLEN : What is the approximate length of the adult life ?

M. PESCADOR : The average life span of the adult is 21 hours and 46 minutes.

D. LEHMKUHL : Under what conditions did you determine this ? Was it in the laboratory ?

M. PESCADOR : Yes, in the laboratory.

D. LEHMKUHL : Can't these things be extremely variable ?

M. PESCADOR : They can.

D. LEHMKUHL : I think that, in some places, mayflies wait until conditions are right for oviposition. On the West Coast of the United States, where there is often misty or rainy weather for several days, they remain as subimagos until it gets warm: then they transform. You can then find mating flights, but often you won't find them for several days at a time.

M. PESCADOR : Dr. CLEMENS claims that humidity also affects the duration of the subimagos.

D. LEHMKUHL : You can manipulate them and do just about anything you want — such as photograph them. All you have to do is manipulate the temperature or the humidity.

R. KOSS : Do you know anything about the swarm behavior of *B. rogersi* ?

M. PESCADOR : I tried, but it was a failure. I was able to observe the flight of the subimagos because the nymphs of *Baetisca* emerge out of the water. The nymphs usually climb two to three inches above the water level and emerge. You can then observe the flight pattern of the subimagos, which is very unique. All the subimagos I have observed emerging first dive into the water and then they fly into the air vertically and I don't see them again.

R. KOSS : Did you ever look for swarms in the morning ?

M. PESCADOR : During the emerging period, I went as early as 7 a.m. and I didn't see any swarms.

L. BERNER : One of the problems I have always experienced is getting the subimagos to transform to the adult stage. Were you able to solve this problem ? I would like some good clues on how to get them to transform successfully.

G. EDMUNDS : May I offer you and many others who might have some difficulty with subimagos a good hint. For some species it is essential that the subimagos be put in some sort of cage that is large enough for them to fly around first. Some of the Siphonuridae will not make the transformation from subimagos to imagos until they have flown. So you just have to have yourself a good sized cage with the right humidity and the right temperature to bring your material through successfully. On the other hand, for many species — I think many of you are familiar with the glass topped boxes that Mr. RIEK first introduced to me. These are marvelous for most subimagos in the field. It is usually easy to get subimagos into the container.

R. ALLEN : A California company makes little cages about twice the size of a cup for grass-

hoppers. They are \$0.75 apiece and I bought about 30 of them. I carry them in my camper when I am in the field. When I catch subimagos, I just put them in these cages. If it is warm and I am going through the desert I put them in my icebox which has a temperature of 38° or 39° F. I have had good luck securing imagos. The cages are of screen wire with a tin top, and have an artificial plant inside for the subimagos to sit on.

D. LEHMKUHL : I have been able to rear subimagos, including a lot of very sensitive mountain cool stream species. The critical things are the temperature and the humidity. I have a large jar which I put over the top of cages similar to those that Dr. ALLEN mentioned. Then I take a paper cup, fill it with water, and put in a paper towel for a wick. If the subimagos die, then I usually put them in a cooler temperature, although sometimes I have to wait a week for them to transform.

R. KOSS : I have used these cages that Dr. EDMUNDS mentioned in Arizona and Mexico and I can't get subimagos to come through so easily. Maybe the cardboard in the box causes subimagos to dry out. I even put pieces of plants and water drops in them and still the greatest percentage of subimagos dry out in these boxes.

S. JENSEN : I noticed in your growth charts that you show the nymphs appearing in December, and the adults appear approximately in June. It seems to me that when I was here two years ago in September we were collecting fully mature nymphs. Am I correct?

M. PESCADOR : No, that was another species.

B. BURKS : Were you able to determine the sex of the parthenogenetic offspring?

M. PESCADOR : Those that hatched in the laboratory from eggs were not reared beyond the third instar.

E. RIEK : What about field collection data? Could you give any indication whether they always were fertilized females?

M. PESCADOR : I wasn't able to observe the mating flight of the species in the field.

E. RIEK : Do you think there necessarily is a swarming flight, because with some of our Australian mayflies we have individual matings? You might have a swarm of a half dozen males and just one female coming into the swarm, but never these mass flights.

M. PESCADOR : It is possible.

E. RIEK : These little glass topped boxes do tend to dry in hotter climates. They are very efficient in cooler and more humid areas. The main attraction of them, in my opinion, is that you have a surface on which the subimagos can bury their tarsal claws so they have a better chance of emerging properly and completely. But under dry conditions I always put a little bit of plant material for humidity, to make sure that they hatch.

C. FREMLING : I have noticed that *Hexagenia* can never complete the subimaginal moult if they are in something that they cannot grasp onto readily. The insect has to have something large or a screen that it can really dig its tarsal claws into. Maybe for smaller species you need smaller meshes.

W. PETERS : In reference to Mr. JENSEN's question, the species which he collected on the Blackwater River was *Baetisca escambiensis* which was described by Dr. BERBER. Mr. RIEK and various other people in my laboratory have seen swarming *Baetisca escambiensis* on the Blackwater River in November. These adults swarm over the water at a fairly low elevation — probably 8 to 10 feet above the water surface — in companies large enough so that they are recognizable. I can remember when we got out of our car on the Blackwater River and somebody looked at the river some distance away and said, "There are mayflies swarming." It is rather strange that *B. escambiensis* can be observed swarming anytime as long as they are in season,

but for all the looking we have done, morning, noon and night, for *B. rogersi*, we haven't seen one yet.

J. JONES : Did you ever try to dissect the genitalia of the early instars below the sixth instar to determine the sex ?

M. PESCADOR : The size of the nymphs is too small for dissection.

G. EDMUNDS : The thing that bothers us in a number of species of mayflies is finding where they swarm. We know that some species like *Ephemerella coloradensis* in Utah swarm about 200 feet in the air and you can watch them with a pair of binoculars and wonder how you can get them. This last summer I was on an entirely different type of work and decided to drive to the top of a small hill in a dry area of the state of Washington. The nearest river was a full 2 miles away and right behind a pine tree on the top of this hill I ran into a swarm of *Baetis*. Now, don't ask me why this was chosen for a swarming sight, but it would be an unlikely place for me to look for it. Of the many species of *Ameletus* that occur in the Western United States, I have yet to see a swarm of *Ameletus* males or even a single individual male in mating flight.

L. BERNER : There are advantages of being in the right place at the right time. For years I have thought that *Baetisca rogersi* was an extremely rare species. Then Mr. PESCADOR tells me that it is one of the commonest species in this area. I find it hard to believe because I made many trips to this section of Florida looking for it and not finding anything. It was a surprise when he told me it was common.

E. RIEK : Many Australian mayflies swarm well away from the water. I know one patch on one road where you can get mass swarms of *Caenis*, or the Australian equivalent, almost every fishing season. You drive through this place early in the morning and you will have mayflies on your screen, not just once, but on many occasions in the exact spot.