

## LIFE HISTORY AND LABORATORY REARING OF *EMESAYA B. BREVIPENNIS* (HETEROPTERA: REDUVIIDAE) IN SOUTHERN ILLINOIS

A. M. HAGERTY, J. E. MCPHERSON AND J. D. BRADSHAW

Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901

### ABSTRACT

The life history of *Emesaya b. brevipennis* (Say) was studied in southern Illinois from April to December 1998. The bug also was reared in the laboratory on *Drosophila* sp. at  $26 \pm 3.0^\circ\text{C}$  under a 16:8 (L:D) photoperiod. This bivoltine species apparently overwintered as eggs. First instars were found primarily from early to late May and mid-July to mid-August, second instars from late May to early June and from late July to mid-August, third instars from late May to mid-June and during August, fourth instars primarily from early June to early July and early to late August, fifth instars primarily from mid-June to mid-September, and adults from late June to early December. In the laboratory, the incubation period averaged 33.91 d. The five nymphal stadia averaged 11.27, 7.84, 8.85, 11.14, and 16.75 d, respectively. Total developmental time averaged 89.76 d.

Key Words: Bivoltine, copulation, spider webs

### RESUMEN

El historial de vida de *Emesaya b. brevipennis* fue estudiado en el sur de Illinois desde Abril a Diciembre del 1998. El insecto también fue criado en el laboratorio en *Drosophila* esp. a  $26 \pm 3.0^\circ$  bajo un fotoperíodo de 16:8 (L:O). Esta especie bivoltina aparentemente sobrevivió el invierno como huevos. Los primeros instares fueron encontrados principalmente del comienzo al final de mayo y mitad de julio a mitad de agosto, los segundos instares de tarde en mayo a temprano en junio y de finales de julio a medio agosto, terceros instares de finales de mayo a mitad de junio y durante agosto, cuarto instares principalmente desde el comienzo de junio al comienzo de julio y todo el mes de agosto, quinto instares principalmente de mediados de junio a mediados de septiembre, y adultos desde el fin de junio al comienzo de diciembre. En el laboratorio, el periodo de incubación fue un promedio de 33.91 d. El tiempo de desarrollo total fue 89.76 d.

*Emesaya brevipennis* (Say) is one of the emesine reduviids, a cosmopolitan group of bugs characterized by markedly slender bodies and appendages (Wygodzinsky 1966). This New World species is divided into three subspecies, *E. b. australis* McAtee & Malloch, *E. b. occidentalis* McAtee & Malloch, and *E. b. brevipennis* (Say) (Froeschner 1988), all of which occur in America north of Mexico. *E. b. brevipennis*, which is the most widely distributed of the three subspecies, occurs from New York and Massachusetts south to Florida and west to Iowa, Kansas, Texas, and California (Froeschner 1988). It occurs throughout Illinois (JEM, unpublished data).

*Emesaya b. brevipennis* has received much attention over the years, probably due, in part, to its large size (33.0-37.0 mm [Blatchley 1926]) and wide distribution. Published information on its biology has consisted mainly of scattered notes. It has been collected under bridges (e.g., Gates & Peters 1962); in sheds, barns, and outbuildings (e.g., Banks 1909; Blatchley 1926; Froeschner 1944; Gates & Peters 1962; Howes 1919; Readio 1926, 1927; Torre-Bueno 1923, 1925; Uhler 1884; Wickham 1910); from vegetation (e.g., Banks

1909; Blatchley 1926; Froeschner 1944; Gates & Peters 1962; Torre-Bueno 1923, 1925; Uhler 1884), flood debris, Spanish moss (Elkins 1951), screens (Brown & Lollis 1963); and in association with spider webs (Banks 1909; Brown & Lollis 1963; Howes 1919; Readio 1926, 1927; Usinger 1941; Wickham 1910).

Based on the literature, this subspecies apparently is univoltine (Banks 1909; Readio 1927) and overwinters as eggs (Howes 1919; Readio 1927). Nymphs occur in the spring and much of the summer (Brown & Lollis 1963; Readio 1927; Uhler 1884; Wickham 1910), and adults can be found during the summer and early fall (Brown & Lollis 1963; McAtee & Malloch 1925; McPherson 1992; Readio 1927; Uhler 1884; Wickham 1910). The eggs are oviposited in the summer and early fall (Brown & Lollis 1963; Howes 1919; Readio 1927) and are attached to spider webs (Brown & Lollis 1963; Readio 1926, 1927), rafters of wooden structures (Howes 1919; Readio 1926, 1927), and twigs of bushes and trees (Uhler 1884).

This paper presents information on the field life history and biology of *E. b. brevipennis* in southern Illinois.

MATERIALS AND METHODS

Field Life History

During summer 1997, a population of *E. b. brevipennis* was discovered near Bluff Lake, Union Co., IL. The numbers observed and accessibility of the site suggested a life history study was possible. Therefore, a study was conducted from April to December 1998, before and after the active season, respectively.

The study site is located in the Jonesboro quadrangle 7.5' topographic (T13S, R2W, NW1/4, NE1/4, Sec. 20), 4 miles east of state highway 3. It consists of a Bailey limestone rock face (Nelson & Devera 1995) covered by vines of *Campsis radicans* (L.) and *Rhus radicans* L. The rock face is approximately 18.5 m high and parallels the east side of township road 235N for 160.9 m. The site is surrounded by a forested area containing *Acer barbatum* Michaux, *Carpinus caroliniana* Walter, *Carya glabra* (Miller), *Carya ovalis* (Wangenheim), *Celtis occidentalis* L., *Fagus grandifolia* Ehrhart, *Quercus rubra* L., and *Ulmus rubra* Muhlenberg. The bugs were observed on webbing of the araneid spider *Anelosimus studiosus* (Hentz), which enclosed the vines on the rock face.

Samples of up to 20 adults and nymphs, and notes on the bugs' activities, were taken weekly from early May to early December. Sampling was by hand picking and confined to an approximately 11.0 m long and 6.0 m high section of the rock face. Nymphs large enough to be identified to instar and adults were not collected. Younger nymphs were preserved in 70% ethanol and taken to the laboratory for closer examination. Plant material, webbing, and the rock face were examined in the field for eggs.

Laboratory Rearing

Eggs were collected at Bluff Lake on 13 February (n = 163) and 6 March (n = 75) 1999, brought to the laboratory, placed on moistened filter paper in the bottoms of petri dishes (approximately 9 cm diam., 2.0 cm deep) and covered with the lids. Approximately 4-6 drops of distilled water were added every 1-2 d to keep the filter paper moist.

The resulting nymphs were placed in 1-pt (approximately 0.47 liter) Mason jars with a disc of moistened filter paper on the bottom. Each jar was closed with a disc of paper toweling and wire screening and secured with the band of the 2-piece Mason jar lid. A strip of paper toweling,

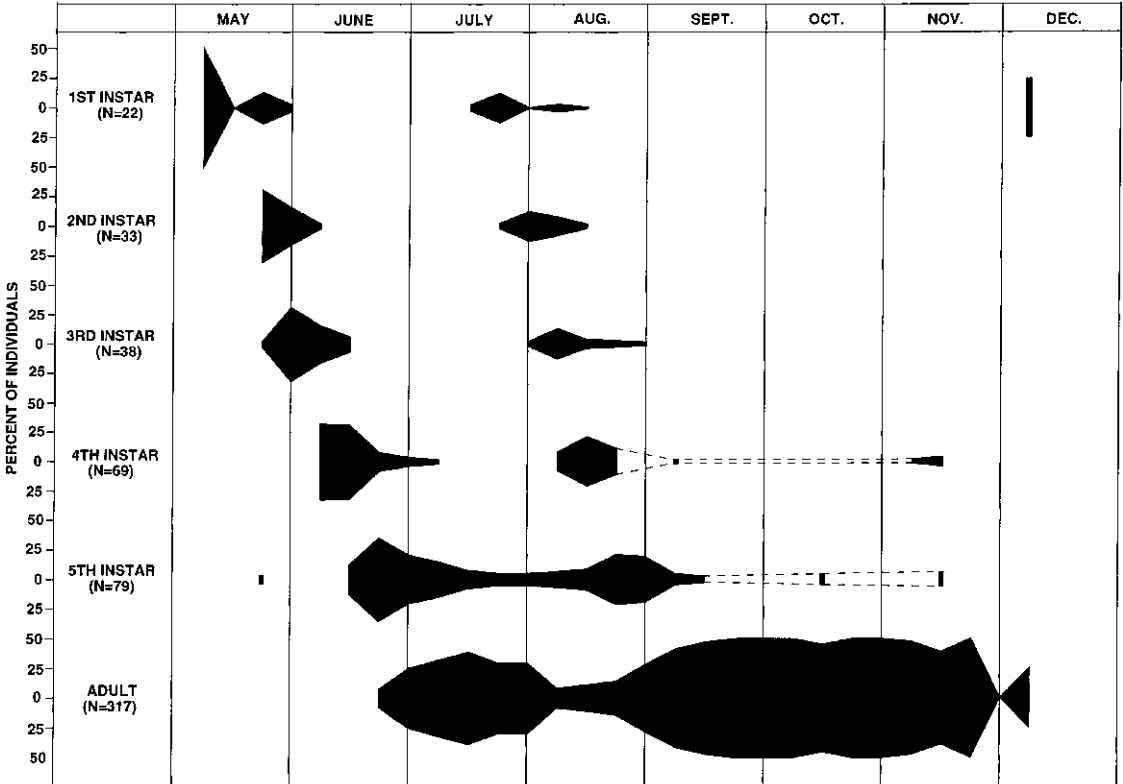


Figure 1. Percent of individuals in each stage per sample of *Emesaya b. brevipennis* collected at Bluff Lake, Union Co., IL, during 1998.

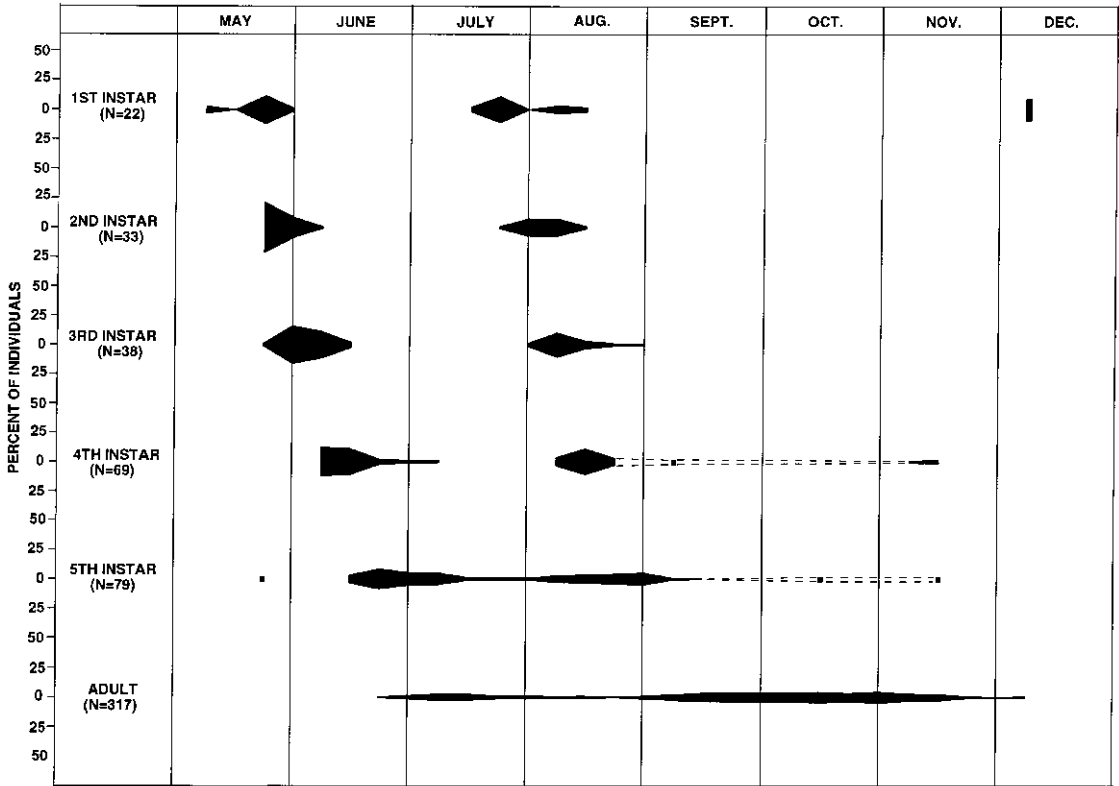


Figure 2. Percent in each sample of total individuals of same stage of *Emesaya b. brevipennis* collected at Bluff Lake, Union Co., IL, during 1998.

folded longitudinally (to prevent the strip from rolling up when damp), was suspended inside the jar from the lid and secured at the upper end between the discs of wire screen and paper toweling. This strip increased surface area for walking and absorption of excrement. The filter paper was moistened with 8-10 drops of distilled water per day. The bugs were fed five *Drosophila* sp. adults per day for this and subsequent instars.

To determine if eggs could develop without an intervening cold period (i.e., without passing through cold winter temperatures), three adult females were collected at Bluff Lake on 22 October 1998, brought to the laboratory, and placed in a 1-qt (approximately 0.95 liter) Mason jar prepared similarly to the 1-pt jars for nymphs. The strip served a third function in addition to those for nymphs, that of an ovipositional site. As with nymphs, the filter paper was moistened with 8-10 drops of distilled water daily, and the bugs were fed five *Drosophila* sp. adults per day. The resulting eggs also provided incubation data, not possible with the 1999 field-collected eggs, which were laid at unknown times.

Eggs were removed, placed on moistened filter paper in the bottoms of petri dishes, and treated

similarly to the field-collected eggs discussed above.

The bugs were kept in incubators maintained at  $26 \pm 3.0^\circ\text{C}$  and a photoperiod of 16:8 (L:D) (approximately 2,800 lux).

### RESULTS AND DISCUSSION

#### Field Life History

*Emesaya b. brevipennis* is bivoltine in southern Illinois (Figs. 1 and 2) based on peaks in abundance of adults and nymphs.

This species apparently overwintered as eggs, which were glued lengthwise to the vines, webs, and rock surface. We could not distinguish fertile eggs in the field because the eggs are dark and durable, even if not fertile. Of the 238 eggs collected in February and March for the laboratory-rearing study, 121 (50.8%) hatched. We assumed all had been oviposited the previous fall.

First instars were found primarily from early to late May and mid-July to mid-August, second instars from late May to early June and from late July to mid-August, third instars from late May to mid-June and during August, fourth instars

TABLE 1. COMPARISON OF MONTHLY TEMPERATURES (°C) FROM 1961 TO 1990 WITH THOSE OF 1998.

Month	Year					
	1961-1990 <sup>1</sup>			1998 <sup>2</sup>		
	Max	Min	Avg	Max	Min	Avg
January	4.8	-5.2	-0.2	7.1	-1.6	2.8
February	7.7	-3.1	4.5	10.7	0.8	5.8
March	13.9	2.4	8.1	12.8	2.7	7.7
April	20.0	7.9	14.0	19.8	7.2	13.5
May	25.0	12.6	18.8	27.0	14.8	20.9
June	29.7	17.2	23.4	29.7	16.7	23.2
July	31.4	19.4	25.4	30.6	18.5	24.6
August	30.5	18.3	24.4	32.8	18.8	25.8
September	26.8	14.6	20.7	30.9	15.7	23.3
October	21.1	8.1	14.6	23.2	8.7	15.9
November	13.9	3.2	8.5	15.7	3.4	9.5
December	7.0	-2.5	2.2	8.9	-0.7	4.1

<sup>1</sup>At Anna, Illinois (COOPID. 110187, Midwestern Regional Climate Center, Champaign, IL).

<sup>2</sup>At Anna, Illinois (COOPID. 110187, National Climatic Data Center, Asheville, NC).

primarily from early June to early July and early to late August, fifth instars primarily from mid-June to mid-September, and adults from late June to early December (Figs. 1 and 2).

A few nymphs were found outside the primary times of occurrence in the field of their respective instars (Figs. 1 and 2), including four firsts (3 December), four fourths (6 September, n = 1; 5-13 November, n = 3), and seven fifths (20 May, n = 1; 11 October, n = 3; 13 November, n = 3). We believe that this was atypical and the result of unusually mild temperatures during the spring and fall (Table 1; note average temperatures for 1961-1990 and 1998).

Copulation was observed in late September (6 pairs) and early October (8 pairs). Interestingly, on 5 November 1998, a male was seen in copulo with an apparently dead female.

#### Laboratory Rearing

Eggs were glued singly and lengthwise to the paper toweling, screening, filter paper, and sides of the jar. Each egg was dark brown to black with longitudinal rows of thin, toothlike projections and capped by a cephalic operculum with a central tubercle, as described by McAtee & Malloch (1925). The incubation period averaged 33.91 days (Table 2).

The first instar emerged through the cephalic end of the egg, pushing aside the operculum. It was whitish, almost transparent, but became more visible after feeding.

The first through fifth stadia averaged 11.27, 7.84, 8.85, 11.14, and 16.75 d, respectively (Table 2). The total developmental period averaged 89.76 d. Most nymphs died during the fifth stadium, which resulted from incomplete ecdysis.

TABLE 2. DURATION (IN DAYS) OF EACH IMMATURE STAGE OF *EMESAYA B. BREVIPENNIS* UNDER LABORATORY CONDITIONS.

Stage	No. Completing		Mean ± SE	Cumulative mean age (d)
	Stadium	Range		
Egg <sup>1</sup>	34	30-38	33.91 ± 0.39	33.91
Nymph <sup>2</sup>				
1st instar	52	7-19	11.27 ± 0.30	45.18
2nd instar	49	6-14	7.84 ± 0.20	53.02
3rd instar	47	6-16	8.85 ± 0.30	61.87
4th instar	43	7-20	11.14 ± 0.41	73.01
5th instar	20	14-22	16.75 ± 0.53	89.76

<sup>1</sup>35 eggs, all of which laid in laboratory, used for incubation determination.

<sup>2</sup>Nymphs hatched from field-collected eggs.

Brown & Lollis (1962) suggested that females have a sixth instar; however, none was found.

In conclusion, *E. b. brevipennis* is bivoltine, at least in southern Illinois, and overwinters as eggs. It will feed on *Drosophila* adults in captivity. Interestingly, this apparently is not true of *Emesaya brevicoxa* (Banks). Several specimens of this reduviid found in cobwebs beneath the eaves of a cabin were kept alive in a "breeding cage" for 5 months on various species of spiders. Although supplied miscellaneous insects, they never were observed to feed on them (Usinger 1941).

#### ACKNOWLEDGMENTS

We thank the following individuals of Southern Illinois University at Carbondale: J. A. Beatty (Department of Zoology) for identification of spiders, Beth Burke (Department of Zoology) for the laboratory culture of *Drosophila* sp., and Mike A. Mibb (Department of Plant Biology) for identification of plants. We also thank Tudi P. Smith (USDA Forest Service, Missoula, MT; formerly Murphysboro, IL) for her assistance in providing geological information and maps of the study site. Finally, we are grateful to the USDA Forest Service for granting permission to collect in the Shawnee National Forest and to Ray G. Smith (USDA Forest Service, Missoula, MT; formerly Vienna, IL), for his help in obtaining the collecting permit.

#### REFERENCES CITED

- BANKS, N. 1909. Notes on our species of Emesidae. *Psyche* 16: 43-48.
- BLATCHLEY, W. S. 1926. Heteroptera or true bugs of eastern North America with especial reference to the faunas of Indiana and Florida. Nature Pub. Co., Indianapolis, IN. 1116 pp.
- BROWN, H. P., AND D. W. LOLLIS. 1963. Observations on the life history and behavior of the thread-legged bug *Emesaya b. brevipennis* (Say), (Hemiptera: Ploiariidae). *Proc. Oklahoma Acad. Sci.* 43: 88-90.
- ELKINS, J. C. 1951. The Reduviidae of Texas. *Texas J. Sci.* 3: 407-412.
- FROESCHNER, R. C. 1944. Contributions to a synopsis of the Hemiptera of Missouri, Pt. III. Lygaeidae, Pyrrhocoridae, Piesmididae, Tingididae, Enicocephalidae, Phymatidae, Ploiariidae, Reduviidae, Nabidae. *Am. Midland Nat.* 31: 638-683.
- FROESCHNER, R. C. 1988. Family Reduviidae Latreille, 1807. The assassin bugs, pp. 616-651 in T. J. Henry and R. C. Froeschner (eds.). *Catalog of the Heteroptera, or true bugs, of Canada and the continental United States.* E. J. Brill, New York. 958 pp.
- GATES, D. E., AND L. L. PETERS. 1962. Insects in Kansas. *Kansas State Univ. Ext. Serv. B-94:* 1-307.
- HOWES, P. G. 1919. *Insect behavior.* Richard G. Badger, Gorham Press, Boston, MA. 176 pp.
- MCCATEE, W. L., AND J. R. MALLOCH. 1925. Revision of the American bugs of the reduviid subfamily Ploiariinae. *Proc. U. S. Natl. Mus.* 67(1): 1-153 (inc. 9 plates).
- MCPHERSON, J. E. 1992. The assassin bugs of Michigan (Heteroptera: Reduviidae). *Great Lakes Entomol.* 25: 25-31.
- NELSON, W. J., AND J. A. DEVERA. 1995. Geologic map of the Jonesboro and Ware quadrangles. Union County, Illinois. Illinois State Geological Survey, Map IGQ-14. 1 p. (oversized).
- READIO, P. A. 1926. Studies on the eggs of some Reduviidae (Heteroptera). *Univ. Kansas Sci. Bull.* 16: 157-179.
- READIO, P. A. 1927. Studies on the biology of the Reduviidae of America north of Mexico. *Univ. Kansas Sci. Bull.* 17: 5-291.
- TORRE-BUENO, J. R. de la. 1923. Family Reduviidae, pp. 677-692 in W. E. Britton (ed.). *Guide to the insects of Connecticut. Part IV. The Hemiptera or sucking insects of Connecticut.* Connecticut State Geol. Nat. Hist. Surv. Bull. 34: 1-807.
- TORRE-BUENO, J. R. de la. 1925. Methods of collecting, mounting and preserving Hemiptera. *Canadian Entomol.* 57: 6-10, 27-32, 53-57.
- UHLER, P. R. 1884. Order VI.--Hemiptera, pp. 204-296 in J. S. Kingsley (ed.). *The standard natural history. Vol. II. Crustacea and insects.* S. E. Cassino & Co., Boston, MA. 555 pp.
- USINGER, R. L. 1941. Rediscovery of *Emesaya brevicoxa* and its occurrence in the webs of spiders (Hemiptera, Reduviidae). *Bull. Brooklyn Entomol. Soc.* 36: 206-208.
- WICKHAM, H. F. 1910. A note on *Emesa longipes*. *Entomol. News* 21: 27-30.
- WYGODZINSKY, P. W. 1966. A monograph of the Emesinae (Reduviidae, Hemiptera). *Bull. Am. Mus. Nat. Hist.* 133: 1-614.