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Aspects of the Dragonfly and Damselfly (Odonata) Community of Buck Creek, Pulaski County, Kentucky

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Abstract

Buck Creek is a fifth-order tributary of the upper Cumberland River, in southcentral Kentucky. Thirty two species of Odonata were found to inhabit this stream. Ecological data, particularly seasonality, of 31 species are presented, along with behavioral observations. Published flight seasons were extended for 5 species of Anisoptera and 6 species of Zygoptera for Kentucky. Seasonal life histories are potentially important in understanding the dynamics involved in niche segregation of a diverse community of general predators.

Introduction

A review of the literature concerning the Odonata of Kentucky revealed a paucity of ecological data. Resner (1) presented the latest distributional list with seasonality data for most species. The literature review showed that the geographical area of this study had been given little attention in surveys of Odonata (1). Additionally, few seasonality studies of communities of lotic Odonata have been published (2–4).

We undertook this study to characterize the community of Odonata of Buck Creek, Pulaski County, Kentucky. Because of the desire to observe as many species as possible and offer a complete documentation of seasonality, 2 flight seasons were incorporated in this study (1991 and 1992). Specifically, we wanted to (1) determine the odonate community composition; (2) document specific flight seasons; (3) make ecological observations; and (4) observe behavior. In this paper, data are presented for 31 of the 32 species (5) known to inhabit Buck Creek.

Study Area

Buck Creek, a fifth-order tributary of the upper Cumberland River, flows southward for 107.2 km, draining 767 km^2. This stream is located in southcentral Kentucky (37°10′N, 84°30′W) and flows primarily within the Eastern Highland Rim subsection of the Interior Low Plateaus Physiographic Province (6). The surface geology is composed principally of Mississippian age limestone (7).

The lower 19% of Buck Creek is inundated by the back waters of Lake Cumberland. This occurred with the completion of Wolf Creek Dam on the Cumberland River in 1951. Buck Creek averaged less than 20 m wide and 2 m deep, but had a maximum width of 150 m and a maximum depth greater than 25 m near its mouth (8). Its gradient was 1.25 m/km (8) with an estimated mean flow of 11.7 km^3/m (9).

Methods

Six collecting sites (5) were chosen on the mainstem of Buck Creek. Two sites were visited per week, and a collecting circuit of all sites was completed every 3 weeks. Adult collections began in June and continued through October 1991, and from April to mid-September 1992. At each site, extensive searches for and observations of adults were made by wading upstream and downstream several 100 m. Physical and biological characteristics of each collection and observation site were made.

Results

Figures 1 and 2 show the flight seasons of 31 of 32 species of Anisoptera and Zygoptera, respectively. The dragonfly species not included here, *Somatochlora linearis*, was collected as a larva. The Anisoptera flight season began in mid-April with *Basiaeschna janata* and concluded by end of October with *Boyeria vinosa* (Fig. 1). However, the Zygoptera flight season began in early May with *Calopteryx maculata* and concluded with *Hetaerina americana* and *Argia translata* in October (Fig. 2). Thus, the

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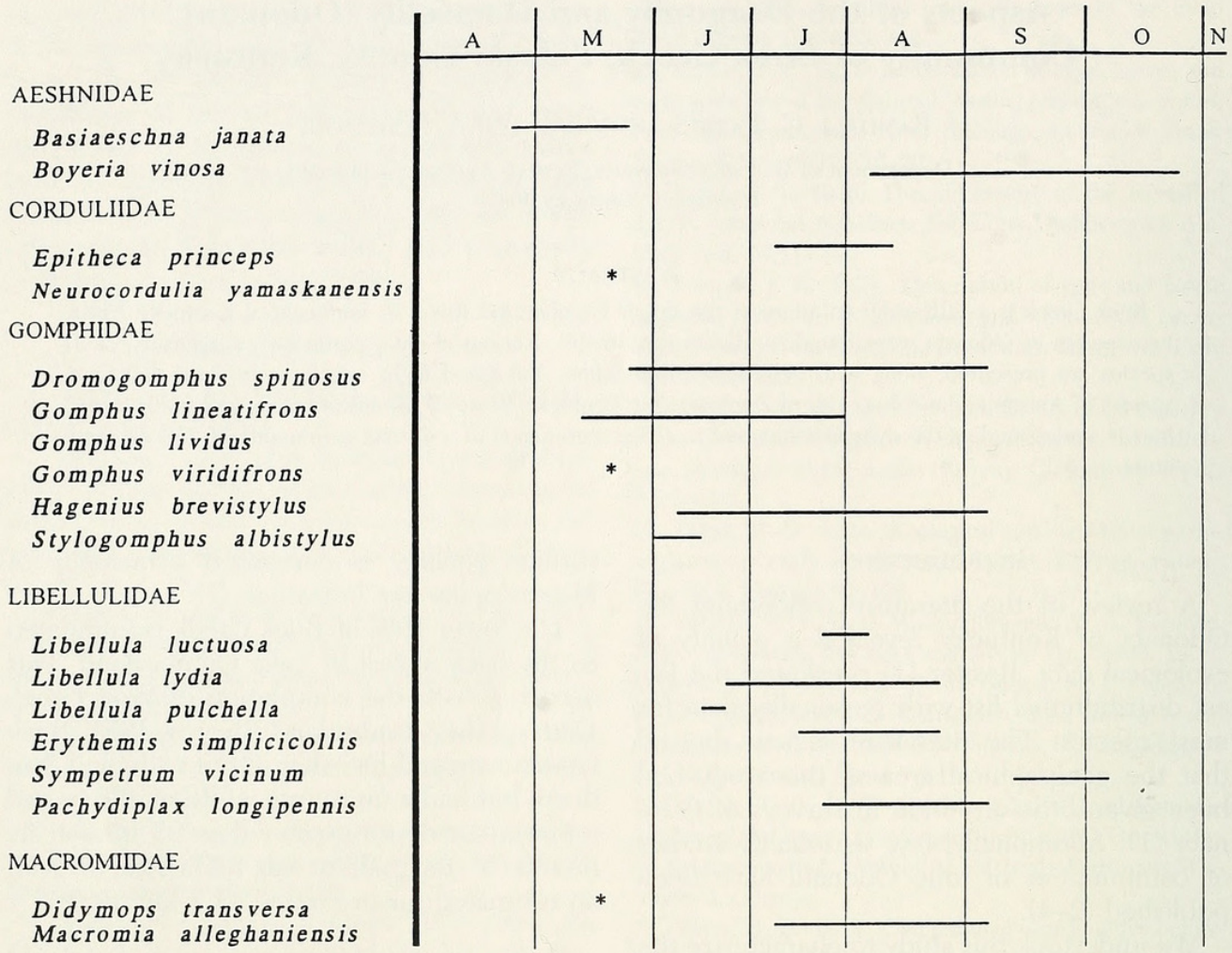

FIG. 1. Adult flight seasons of Anisoptera collected and observed (June–November 1991; April–mid-September 1992) at Buck Creek, Pulaski County, Kentucky. Asterisks (*) indicate single date record.

adult odonate flight season persisted for 190 known days (Tables 1 and 2). Of the 2 suborders, anisopterans had a shorter flight season (Figs. 1, 2). Student's t test was employed to compare the flight season between the 2 suborders (excluding those with less than 7 days recorded flight period). To compute the value of t, the flight season of each species was determined by taking the 2 seasons and averaging their flight period. This resulted in a statistically significant ($P < 0.05$) difference in flight season length. Kentucky flight season range extensions were recorded for 5 species of Anisoptera (Table 1) and 6 species of Zygoptera (Table 2).

DISCUSSION

Flight season in this study began with the first observation or collection of a reproductively mature adult. Corbet (10) reported that most reproductively mature Zygoptera live approximately 1 to 2 weeks and may extend to 5 to 8 weeks. Reproductively mature Anisoptera live 2 to 3 weeks and may extend to 3 to 6 weeks (10). Thus, synchrony of emergence was applied to those species with a flight season of approximately 6 weeks or less.

Most species collected were typical of lotic habitats; however, the Libellulidae characteristically breed in lentic waters. Westfall (11) reported the large genus *Libellula* and *Pachydiplax* from lotic waters. The upper one-half of Buck Creek had many braids that became isolated and thus lentic for a significant amount of time during both years of this study. This type of environment was previously reported in Buck Creek (7, 12). *Pachydiplax longipennis* was observed in large numbers at the most upstream site (State Route 70) (5); *Libellula lydia*, *L. pulchella* and *L. luctuosa* also were associated with the ponded water at this site. Of the 2 major isolated braids here, *P.*

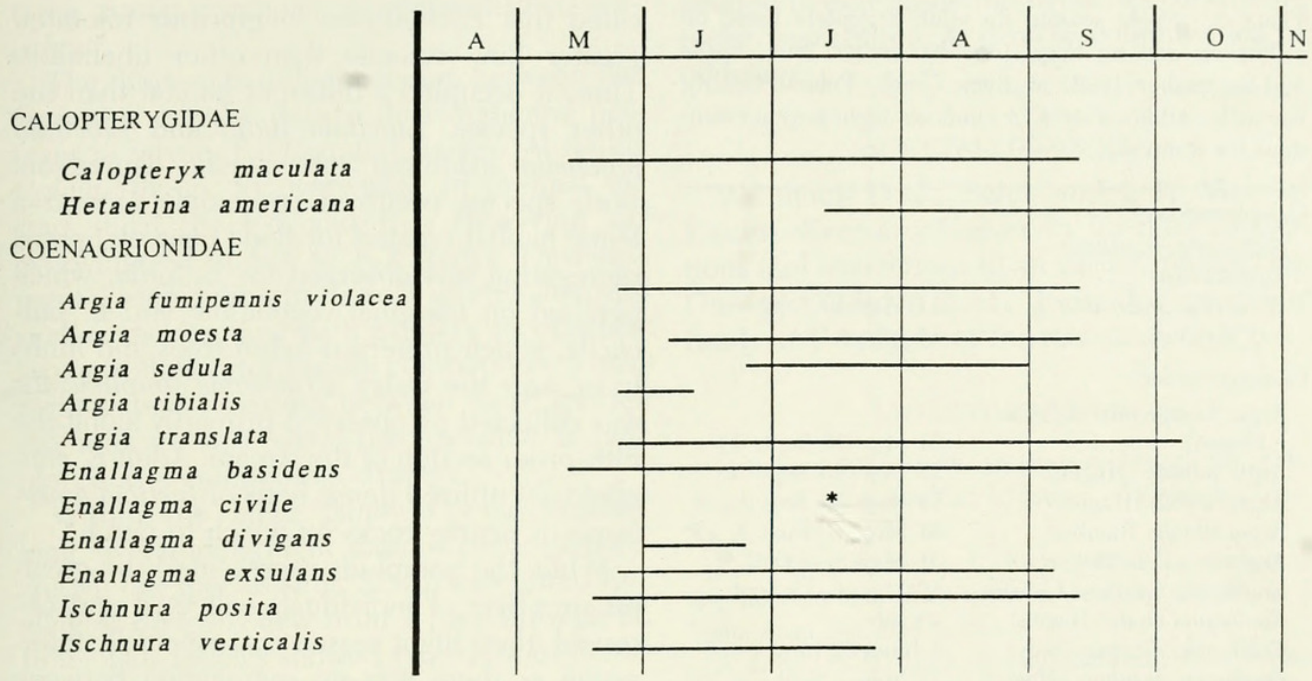

FIG. 2. Adult flight seasons of Zygoptera collected and observed (June–November 1991; April–mid-September 1992) at Buck Creek, Pulaski County, Kentucky. Asterisk (*) indicates single date record.

TABLE 1. Flight seasons for adult Anisoptera based on collections and sightings (June–November 1991; April–mid-September 1992) at Buck Creek, Pulaski County, Kentucky. Addition signs (+) indicate flight season extensions for Kentucky.

Aeshnidae	
Basiaeschna janata (Say)	20 April +–18 May +
Boyeria vinosa (Say)	3 Aug.–26 Oct.
Corduliidae	
Epitheca princeps (Hagen)	5 July–10 Aug.
Neurocordulia yamaskanensis Provancher	18 May
Gomphidae	
Dromogomphus spinosus Selys	31 May–1 Sept.
Gomphus (Arigomphus) lentulus Needham	1 June +
Gomphus (Gomphurus) lineatifrons Calvert	12 May–31 July
Gomphus (Hylogomphus) viridifrons Hine	18 May
Hagenius brevistylus Selys	9 June–7 Sept. +
Stylogomphus albistylus (Hagen)	1 June–9 June
Libellulidae	
Libellula luctuosa Burmeister	19 July–3 Aug.
Libellula lydia (Drury)	22 June–21 Aug.
Libellula pulchella Drury	21 June–22 June
Erythemis simplicicollis (Say)	14 July–31 Aug.
Sympetrum vicinum (Hagen)	13 Sept.–4 Oct.
Pachydiplax longipennis (Burmeister)	19 July–7 Sept.
Macromiidae	
Didymops transversa (Say)	18 May +
Macromia alleghaniensis (Williamson)	5 July–7 Sept. +

TABLE 2. Flight seasons for adult Zygoptera based on collections and sightings (June–November 1991; April–mid-September 1992) at Buck Creek, Pulaski County, Kentucky. Addition signs (+) indicate flight season extensions for Kentucky.

Calopterygidae	
Calopteryx maculata (Beauvois)	11 May–13 Sept. +
Hetaerina americana (Fabricius)	12 July–4 Oct.
Coenagrionidae	
Argia fumipennis violacea Hagen)	31 May–13 Sept. +
Argia moesta (Hagen)	21 June–13 Sept. +
Argia sedula (Hagen)	21 June–31 Aug.
Argia tibialis Rambur	31 May–7 June
Argia translata Hagen	31 May +–4 Oct. +
Enallagma basidens Calvert	12 May +–13 Sept.
Enallagma civile (Hagen)	13 July
Enallagma divagans Selys	1 June–22 June
Enallagma exsulans (Hagen)	18 May–1 Sept.
Ischnura posita (Hagen)	11 May–13 Sept. +
Ischnura verticalis (Say)	12 May–14 July

longipennis was associated with the smaller one that flowed during high-water conditions.

The aeshnids, *Basiaeschna janata* and *Boyeria vinosa*, had dramatically different flight seasons (Fig. 1). Thus, these 2 similarly adapted predators demonstrated temporal segregation in this study. Paulson and Jenner (4) also found *B. janata* to be synchronized "spring" species (13), while *B. vinosa* was asynchronous and overwintered in many instars.

There was a marked segregation of seasonality among the 2 species of Macromiidae, *Didymops transversa* and *Macromia alleghaniensis* (Fig. 1). Although *D. transversa* was collected on one date only in this study (Table 1), it is known to be a synchronous spring flyer (1, 4). *Macromia alleghaniensis* had an asynchronous emergence and flew from mid- to late summer (Fig. 1). Both these species were found in the lower two-thirds of the stream, becoming more common downstream.

The family Libellulidae was represented by 6 species; 3 were congeneric (Table 1). While *Libellula lydia* and *Erythemis simplicicollis* were collected along most of Buck Creek, the other species had more restricted distributions. Only *Sympetrum vicinum* had a segregated flight season from other libellulids (Fig. 1). Boehms (14) studied the ecology and development of this species. Observations indicated that *Pachydiplax longipennis* tolerated greater flow velocity than other libellulids. Thus, it occupied a different habitat than the other species. *Libellula lydia* and *Libellula pulchella* exhibited interspecific aggression. Both species occurred commonly around a lentic habitat created for flood control. Spatial segregation was observed for *L. lydia*, which perched on marginal vegetation, and *L. pulchella*, which preferred fallen trees and limbs in or near the water. *Erythemis simplicicollis* was collected or observed primarily along the fifth-order section of the stream. Adult *E. simplicicollis* utilized dense beds of *Justicia americana* or nearby rocks on which to perch.

While the gomphids represented the greatest numbers of individuals collected and observed, their flight season was especially interesting as there was no segregation between species (Fig. 1). Most members of this family were primarily stream dwellers and relatively little was known concerning the factors governing niche segregation. With many species exhibiting asynchronous emergence, larvae exhibited a great spread of instars. The mechanism(s) controlling their niche segregation must occur during the larval life history. Morphological variations in the design of their labium may serve significantly in niche segregation (15). Also, as sprawlers in leafmats and burrowers, this group occupied the majority of available habitat in the stream (horizontal distribution). Another strategy allowing these cryptic, sedentary odonates to withstand niche overlap may result from slow development which requires long generation times (16).

The family Calopterygidae had 2 representatives at Buck Creek, *Calopteryx maculata* and *Hetaerina americana*. *Calopteryx maculata* had the earliest flight season of the 2 species (Table 2). This species demonstrated asynchronous emergence, as evidenced by its long flight season (Fig. 2). *Calopteryx maculata* preferred the more heavily forested sections of the stream, utilizing the dense forest for perches. *Hetaerina americana* emerged 2 months later and flew until early October (Table 2). The latter species also emerged asynchronously; however, it was observed to occupy a different habitat, principally boulders and exposed gravel associated with riffles. These damselflies were always observed in

open, sunny situations, as opposed to *C. maculata*.

The difference in flight season between the 2 species may be due to developmental patterns as larvae. Paulson and Jenner (4) found *Calopteryx* sp. to overwinter in prefinal instars, final (F) F-2 and F-1; *Hetaerina* sp. overwintered in F-4 to F-2 stages. Developmental segregation in these 2 morphologically similar species may be a primary mechanism in controlling interspecific competition. Thus, flight-season variations between these species did indicate that larval-size variation is employed as a competitive strategy.

Within the large family Coenagrionidae, long, overlapping flight seasons predominated among the species (Fig. 2). An exception, *Enallagma divigans* flew from 1 June through 22 June. This species showed synchronous emergence associated with "spring" species (13). Very similar flight-season observations for this species have been previously demonstrated (4, 17). Paulson and Jenner (4) found *E. divigans* larvae to overwinter predominantly in F-1 stages in North Carolina.

Many studies have reported diverse odonate communities coexisting in relatively small geographic areas (2, 17–19). As general predators, odonates must avoid niche overlap by some mechanism(s). It has been suggested that the seasonal segregation of odonates is an important mechanism to reduce niche overlap of similarly adapted species (15, 16, 20). Van Noordwijk (20) also found spatial separation between 7 genera of an 8-species zygopteran community. Michiels and Dhondt (21) demonstrated that 3 species of *Sympetrum* distinctly partitioned resources both spatially and temporally. Interestingly, Zygoptera had a statistically significant longer flight season than Anisoptera. However, the placement of the longer flight season was not expected. Anisoptera began flight in early spring, while Zygoptera did not begin flight until mid-spring. One might expect a competitive advantage gained by damselflies if they had a flight season prior to dragonflies because of fewer potential large predators and the large emergences of potential prey (Chironomidae). This pattern of flight season had been reported by other studies (17, 22).

Detailed life-history studies are needed for many odonates. In addition, more studies are needed to determine the dynamics controlling niche segregation in diverse communities of odonates.

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LITERATURE CITED

1. Resner, P. L. 1970. An annotated check list of the dragonflies and damselflies (Odonata) of Kentucky. Trans. Ky. Acad. Sci. 31:32–44.

2. Bick, G. H. and J. C. Bick. 1958. The ecology of the Odonata at a small creek in southern Oklahoma. J. Tenn. Acad. Sci. 33:240–251.

3. Cross, W. H. 1955. Anisopteran Odonata of the Savannah River Plant, South Carolina. J. Elisha Mitchell Sci. Soc. 71:9–17.

4. Paulson, K. R. and C. E. Jenner. 1971. Population structure in overwintering larval Odonata in North Carolina in relation to adult flight season. Ecology 52:96–107.

5. Payne, R. G. and G. A. Schuster. 1993. The dragonflies and damselflies (Odonata) of Buck Creek, Pulaski County, Kentucky. Ent. News 104:165–170.

6. Quarterman, E. and R. L. Powell. 1978. Potential ecological/geographical natural landmarks on the Interior Low Plateau. U.S. Dept. Interior, Washington, D.C.

7. Schuster, G. A., R. S. Butler, and D. H. Stansbery. 1989. A survey of the unionids (Bivalvia: Unionidae) of Buck Creek, Pulaski County, Kentucky. Trans. Ky. Acad. Sci. 50:79–85.

8. Cicerello, R. R. and R. S. Butler. 1985. Fishes of Buck Creek, Cumberland River drainage, Kentucky. Brimleyana 11:133–159.

9. USACE. 1976. Water quality conditions in Lake Cumberland. U.S. Army Corps of Engineers, Nashville District, Nashville. 106 pp.

10. Corbet, P. S. 1980. Biology of Odonata. Ann. Rev. Entomol. 25:189–217.

11. Westfall, M. J., Jr. 1984. Odonata. Pp. 126–176. In R. W. Merritt and K. W. Cummins (eds.) An introduction to the aquatic insects of North America, 2nd ed. Kendell/Hunt Publishing Company, Dubuque, Iowa.

12. Floyd, M. A. and G. A. Schuster. 1990. The caddisflies (Insecta: Trichoptera) of the Buck Creek System, Pulaski County, Kentucky. Trans. Ky. Acad. Sci. 51:127–134.

13. Corbet, P. S. 1954. Seasonal regulation in British dragonflies. Nature 174:655.

14. Boehms, C. N. 1971. The influence of temperature upon embryonic diapause and seasonal regulation in *Sympetrum vicinum* (Hagen) (Odonata: Libellulidae). Ph.D. Dissertation. Univ. North Carolina, Chapel Hill.

15. Corbet, P. S. 1962. A biology of dragonflies. Witherby Ltd., London.

16. Johnson, D. M. and P. H. Crowley. 1980. Odonata "hide-and-seek": habitat specific rules? Pp. 569–579. In W. C. Kerfoot (ed.) The evolution and ecology of Zooplankton populations. Special Symposium 3. American Society of Limnology and Oceanography. Univ. Press of New England, Hanover, New Hampshire.

17. Johnson, D. M., C. C. Coney, and M. J. Westfall, Jr. 1980. The Odonata of Bays Mountain Park, Sullivan County, Tennessee. J. Tenn. Acad. Sci. 55:73–76.

18. Benke, A. C. and S. S. Benke. 1975. Comparative dynamics and life histories of coexisting dragonfly populations. Ecology 56:302–317.

19. Kormondy, E. J. and J. L. Gower. 1965 Life history variations in an association of Odonata. Ecology 46: 882–886.

20. Van Noordwijk, M. 1978. A mark–recapture study of coexisting zygopteran populations. Odonatologica 7: 353–374.

21. Michiels, N. K. and A. A. Dhondt. 1987. Coexistence of three *Sympetrum* species at Den Diel Mol, Belgium (Anisoptera: Libellulidae). Odonatologica 16:347–360.

22. Johannsson, O. E. 1978. Co-existence of larval Zygoptera common to the Norfolk Broads (U.K.) I. Temporal and spatial separation. Oecologia 32:303–321.