The Distribution of Stoneflies (Insecta: Plecoptera) of the Salt River, Kentucky[1,2]

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Abstract

As part of a preimpoundment study for Taylorsville Lake in the Salt River, Kentucky, 2,932 adult and 1,375 nymphal stoneflies were collected from August 1970 to July 1971. Annotations are given for the 12 species that represent 5 families and 8 genera. Special emphasis was placed on a study of the life history for *Isoperla burksi*, including stomach analysis and fecundity.

Introduction

To understand the stream ecosystem, the combinations of organisms and the interactions of all communities must be examined as to the roles they play (Krumholz and Neff 1970). Among the benthic forms, the stoneflies constitute a major component of the food web, and an accurate list of the species, their abundance, distribution, and life histories is essential to interpreting the results of any changes that might occur in a stream ecosystem. In conjunction with a preimpoundment study for Taylorsville Lake in the Salt River Basin (Krumholz 1971, Krumholz and Neff 1972, Neff and Krumholz 1973) the benthic fauna of the area was surveyed from 1968 through 1972. As part of that survey, Woodling (1971, unpublished master's thesis, University of Louisville, Louisville, Kentucky) studied the benthic fauna and water quality of Brashears Creek, a major tributary to the Salt River, during 1969 and 1970. The present paper is a summary of our information on the plecopterans of both the Salt River and Brashears Creek during the study period.

Many aspects of the life histories of the stoneflies found in the Salt River Basin have been reported by Needham and Claassen (1925), Claassen (1931), Frison (1929, 1935, 1942), and Harden and Mickel (1952). An exception is *Isoperla burksi* Frison, which is quite common throughout the stream system. Thus, special attention has been given to food habits and fecundity for that species.

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The Study Area

The study area, in central Kentucky, extends 94 miles on the Salt River and 22 miles on Brashears Creek (Fig. 1) and has been described in detail by Krumholz (1971), Krumholz and Neff (1972), and Neff and Krumholz (1973). Station numbers used in this paper correspond to those listed by Krumholz (1971), Krumholz and Neff (1972), and Neff and Krumholz (1973) that were sampled regularly for benthos and other materials.

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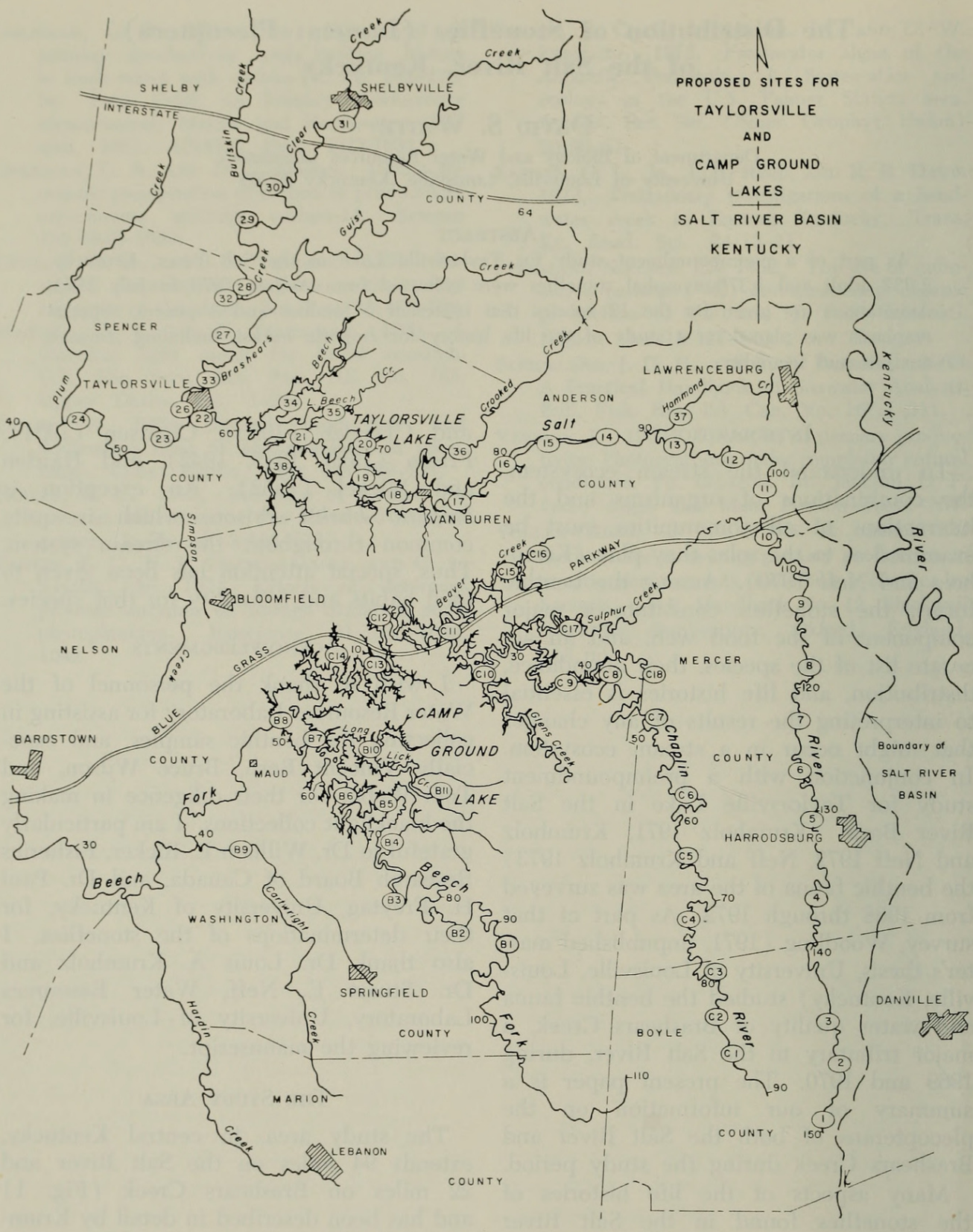

FIG. 1. Map of portions of the Salt River and Beech Fork showing the areas to be impounded and the locations of the permanent collecting stations. (From Neff and Krumholz 1973).

Upstream from Station 13, the Salt River will remain much as it is today and will not be flooded by impoundment for Taylorsville Lake. The bottom materials at these stations are primarily mud on limestone bedrock with scattered areas of sand, gravel, and rubble supporting some emergent vegetation. Stations 15 through

21 will be inundated permanently, and Station 14 is likely to be flooded at least part of each year. Bottom materials at those stations consist of bedrock, sand, gravel, and larger stones, and there are extensive beds of water willow *Justicia americana* (L.) Vahl from late spring through fall. Stations 22 and 23 are below the damsite and the bottom materials are similar to those upstream.

Brashears Creek enters the Salt River below the proposed damsite approximately 0.5 mile above Station 23. The bottom of Brashears Creek is much like that in the Salt River and also supports large stands of water willow. An intermittent tributary, Station T, that enters Brashears Creek from the west between Stations 26 and 33, was sampled when water was present. There, the streambed is similar to that in Brashears Creek.

The beds of water willow were an important physical feature of the study area, and particular attention was given to sampling those areas. During the summer, their growth effectively channelized many parts of the stream, giving it a braided appearance. The massive root systems limited shifting of the sand and gravel bars during periods of high water especially in the winter and spring months. The submerged root masses have been shown to provide an excellent winter refuge for many of the nymphs and larvae of the various aquatic insects (Woodling, unpublished master's thesis).

METHODS

Several hundred collections of nymphs were made using a Surber square-foot sampler and a 1-m wide "qualitative seine" made of nylon bobbinet (#0 grit cloth). The Surber sampler was used primarily in the riffle areas while the qualitative seine facilitated collection in the peripheral areas such as mudbanks and emergent vegetation.

Adults were collected through extensive weekly blacklighting from March through October 1971. Examination of tree trunks,

TABLE 1.—OCCURRENCE OF STONEFLIES AT 16 DIFFERENT STATIONS IN THE SALT RIVER AND BRASHEARS CREEK, KENTUCKY (SEE FIG. 1 FOR STATION LOCATIONS)

	Salt River Stations										Brashears Creek Stations						Nymphs	Adults
	2	3	4	7	13	14	16	17	22	23	T	26	33	28	29	30		
Nemoura nigritta						×	×	×	×	×						×	70	5
Allocapnia vivipara	×					×					×		×	×	×	×	242	274
Allocapnia forbesi		×	×	×								×	×				0	3
Brachyptera fasciata												×		×		×	6	2
Taeniopteryx burksi									×	×					×	×	7	9
Taeniopteryx parvula										×							6	1
Isoperla burksi					×	×	×	×	×	×			×	×	×	×	320	48
Isoperla clio						×			×	×			×	×	×	×	22	9
Isoperla nana				×		×			×	×						×	51	3
Acroneuria arida						×	×	×	×	×			×	×	×	×	219	356
Perlesta placida			×	×	×	×	×	×	×	×		×	×	×	×	×	308	2,189
Neoperla clymene					×				×	×				×	×	×	124	33
Totals	1	1	2	3	3	7	4	4	8	9	2	4	7	7	7	10	1,375	2,932

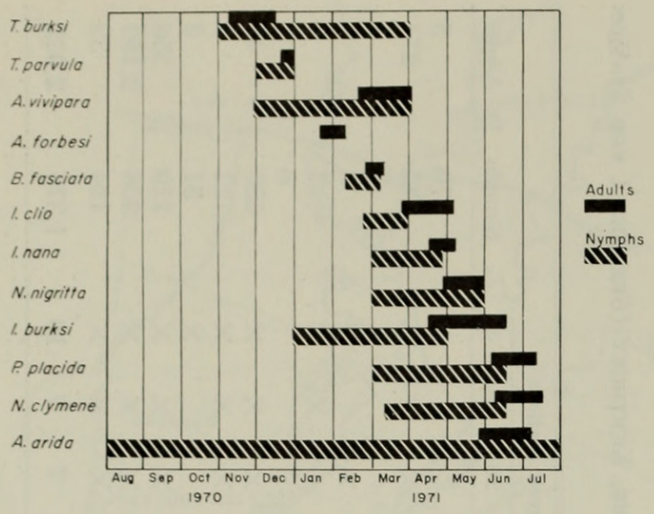

FIG. 2. Seasonal distribution of nymphs and adults of 12 species of stoneflies in the Salt River and Brashears Creek, Kentucky.

rocks, and bridge abutments yielded many adult specimens, and sweeping emergent and littoral vegetation proved effective, especially in collecting the winter and early spring forms. Where possible, nymphs and adults were identified and sexed using the guides of Needham and Claassen (1925), Claassen (1931), and Frison (1935, 1942).

THE STONEFLIES

During the study period, 1,375 nymphal and 2,932 adult stoneflies were collected from the 16 stations, and represented 5 families, 8 genera, and 12 species (Table 1). The seasonal distribution of nymphs and adults in those collections is shown in Fig. 2.

NEMOURIDAE

Nemoura nigritta group.—Seventy nymphs of this group were collected from March through May in the deeper, slower riffles from 5 stations in the lower Salt River and from a single station at the source of Brashears Creek just below the confluence of Bullskin and Clear creeks (Table 1, Fig. 2). Most were found on the larger stones though some were taken from the submerged water willow roots.

The adults, 1 male and 4 females, were found under the bark of fallen trees near the water's edge. The emergence period was very short; it began in early March and probably did not extend beyond 10 June.

CAPNIIDAE

Allocapnia vivipara (Claassen).—*A. vivipara* was the most abundant winter stonefly and the third most abundant stonefly in our collections; 242 nymphs were collected from 5 of the upper 6 stations in the Salt River and from all 6 stations in Brashears Creek (Table 1). Nymphs and adults were taken in and near the slow, shallow riffles in the Salt River and along the entire length of Brashears Creek. The greatest abundance of *A. vivipara* in Brashears Creek, however, was in the uppermost 3 stations and in the intermittent tributary.

Adults were present from late February to early April (Fig. 2). The sex ratio was very close to 1:1. The males, however, began emerging about 2 weeks before the females and were taken on tree trunks as far as 50 m from the shore. The females, though mainly macropterous, usually were not far from the stream's edge.

Allocapnia forbesi Frison.—*A. forbesi* was represented only by 3 adult males, and was the least abundant of any stonefly in these collections. All were taken in early February at Stations 26 and 33, near the mouth of Brashears Creek (Table 1, Fig. 2).

TAENIOPTERYGIDAE

Brachyptera fasciata (Burmeister).—Six large nymphs were taken in late February from riffles at 3 stations in Brashears Creek where the water was deep and fairly slow (Table 1). Both adult females were collected on a gravel bar at Station 33 in early March (Fig. 2).

Taeniopteryx burksi Ricker and Ross.—*T. burksi* was the earliest of the winter fauna and appeared in the riffles in mid-November. Though not abundant, it was present throughout the winter in the lower stations of the Salt River and in the upper reaches of Brashears Creek (Table 1). As with *Brachyptera*, the nymphs were found in the deeper, slower areas of the

riffles especially near the beds of water willow.

Adults, 7 males and 2 females, were taken under stones along the streambeds, and were collected only in November and December; however, they probably were present through early April (Fig. 2).

Taeniopteryx parvula Banks.—Six large nymphs were taken in December from the root masses of the water willows only at Station 23 in the Salt River just downstream from the mouth of Brashears Creek (Table 1). A single adult was taken on a sandbar at the same station.

Perlodidae

Isoperla burksi Frison.—*Isoperla burksi* was the fourth most abundant stonefly in our collections. Nymphs of *I. burksi* were more abundant than any other nymphs in the collections and were collected at 10 stations, especially in the riffles of the lower Salt River and throughout Brashears Creek from January to April (Table 1, Fig. 2). Of the 5 instars noted, the first 2 were found mainly among the roots of water willow. The larger individuals were most abundant in the open areas of the riffles. A measurable difference in size between males and females was noted in the 3 larger instars with the females becoming progressively larger until the difference in size was no greater than 0.2 mm prior to emergence. Nymphal females outnumbered males slightly more than 2:1.

Stomach analysis of 21 nymphs of different sizes showed *I. burksi* to be both carnivorous and cannibalistic, as are many other members of the genus. No nymph examined contained more than 1 organism in its stomach. All prey was consumed whole with no preference as to whether they were ingested headfirst or tailfirst. Of the 21 stomachs, 7 were empty, 8 contained chironomid larvae, 4 contained ephemeropteran nymphs, 1 contained a *Perlesta* nymph, and 1 an *I. burksi* nymph.

Adults began emerging in very late April and were present until the middle of June. They showed virtually no attraction to the blacklight, and only 1 was taken by that method during the entire emergence period. In late April and early May, adults were found under pieces of driftwood and bark scattered along the shore. Adults in late May and June were taken by sweeping the emergent water willow. The females collected in that manner outnumbered the males by slightly more than 2:1, the same sex ratio exhibited among the nymphs in our collections.

As indicated by the results of sweeping, mating and egg deposition took place during the day. Even though egg deposition was not observed, several females taken from the water willow deposited egg masses on the sides of the collecting jars. Egg counts from 10 newly emerged females ranged from 257 to 409 with an average of 358.

Isoperla clio (Newman).—A few large nymphs were taken in February and March from 3 stations in the Salt River and 4 stations in Brashears Creek (Table 1, Fig. 2). No more than 1 or 2 were collected in each sample indicating that the species was widespread but not abundant. Adults were taken from late March through early May by sweeping emergent vegetation.

Isoperla nana (Walsh).—Nymphs were collected from the riffles in early March through the end of April from 4 stations in the Salt River and 1 in Brashears Creek (Table 1, Fig. 2); but two adult males were taken in early May from a sandbar at that station, and a third was taken in late April as it drifted into the bottom sampler.

Perlidae

Acroneuria arida (Hagen).—*A. arida* was the second most abundant stonefly in our collections. With a 2-year life cycle, *A. arida* was the only nymph present in the riffles throughout the year (Fig. 2), and was collected at 5 stations in the Salt River and 4 stations in Brashears Creek (Table 1). First-year nymphs began appearing in the riffles during April and were abundant

until October. Since only a few specimens were taken from December through March, it was assumed that the nymphs either entered the submerged beds of water willow roots or were buried in the bottom sediments. In late March, nymphs reappeared at all of the lower Salt River stations and throughout much of Brashears Creek.

Emergence began in late May and continued through early July. *A. arida* was attracted to blacklight in large numbers.

Perlesta placida (Hagen).—*P. placida* was the most abundant plecopteran taken and made up more than half the total number of stoneflies in the collections. Also, it was taken at all but 2 of the stations sampled, those being in the extreme upper reaches of the Salt River, where the only stonefly taken was *Allocapnia vivipara.* Nymphs were present in the riffles from March through the middle of June (Fig. 2), and their numbers in the collections were exceeded only by those of *Isoperla burksi.*

Adults of *P. placida* were present from the second week in June through the second week in July, and the individuals of this species made up nearly three-fourths of all adult stoneflies in the collections.

Neoperla clymene (Newman).—Nymphs were found at 4 stations in Brashears Creek and at 3 stations in the Salt River (Table 1). They first appeared in the riffles in early March and were present until the second week in July. *N. clymene* was the fifth most abundant stonefly in the collections.

Emergence began in early June and extended through the middle of July. A few specimens were attracted to the blacklight but most were collected on stones near the stream's edge and by sweeping littoral vegetation.

Discussion

Of the species collected, all except *Acroneuria arida* appeared to be univoltine, producing a single generation per year. The life cycle of *A. arida,* as has been noted for other *Acroneuria* (Claassen 1931, and Harden and Mickel 1952), requires 2 years. All 12 species would be classified nonactive first instar or intermediate (Hynes 1961).

Of the 12 species in the collections, no more than 10 were collected at any station (Station 30 at the source of Brashears Creek), and at Stations 2 and 3 in the upper Salt River, only a single species was collected (Table 1). Nine species were collected at Station 23, 8 were present in the collections from Station 22, and there were 7 species in the collections from each of 4 stations, Station 14 in the Salt River and Stations 28, 29, and 33 in Brashears Creek. No more than 4 species were taken in the collections from the other 9 stations.

No species was taken at all 16 stations (Table 1), but specimens of *Perlesta placida* were collected at 14 stations, specimens of *Allocapnia vivipara* were taken at 11 stations, *Isoperla burksi* at 10 stations, *Acroneuria arida* at 9 stations, *Isoperla clio* and *Neoperla clymene* at 7 stations, and the *Nemoura nigritta* group at 6 stations. None of the others was taken at more than a third of the stations, and *Taeinopteryx parvula* was collected only at Station 23 just below the confluence of Brashears Creek and the Salt River.

With the exception of *Perlesta placida* and *Allocapnia vivipara,* all species were collected only at stations containing substantial beds of water willow. The water willow affords protection for the long inactive stages and for the smaller instars which were often collected by sampling in and around the root beds. Water willow provides a site for mating and egg deposition by adults of the late spring and summer such as the *Nemoura nigritta* group, *Taeniopteryx burksi,* and *Isoperla burksi.* Water willow is not necessary for *Perlesta placida,* but where this vegetation is present, it is used as a site for mating and egg deposition. *Allocapnia vivipara* is an inhabitant of small and intermittent streams, as often is *P. placida* (Frison 1929, 1935), and was found only in Brashears Creek and the portions of the

Salt River upstream from the proposed Taylorsville Lake.

Since the majority of the species were collected within or near the beds of water willow, any changes in the distribution of that vegetation brought about by the impoundment of Taylorsville Lake might have a direct effect on the abundance and distribution of these species in the Salt River.

As pointed out earlier, nymphs of *Acroneuria arida* were the only larvae present throughout the year (Fig. 2), since that species was the only one in our collections that had a 2-year life cycle. Nymphs of all other species were collected at different times from early November through mid-June (Fig. 2). Nymphs of *Taeniopteryx burksi* and *Isoperla burksi* were taken over periods of 6 months and the periods of collecting nymphs of other species ranged down to 2 months for *Brachyptera fasciata*, *Isoperla clio*, and *I. nana*. The only species for which nymphs were not collected was *Allocapnia forbesi*.

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