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# A Taxonomic & Physiographic Survey of Scirpus in Kentucky with Problem Species Complex Analysis

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Arnold,  
Sally Curb

1979

A TAXONOMIC AND PHYSIOGRAPHIC SURVEY  
OF SCIRPUS IN KENTUCKY  
WITH PROBLEM SPECIES COMPLEX ANALYSIS

Recommended April 13, 1977  
(Date)

Ernest B. Beal

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(Date)

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Dean of the Graduate College

A TAXONOMIC AND PHYSIOGRAPHIC SURVEY  
OF SCIRPUS IN KENTUCKY  
WITH PROBLEM SPECIES COMPLEX ANALYSIS

A Thesis  
Presented to  
the Faculty of the Department of Biology

Western Kentucky University  
Bowling Green, Kentucky

In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science

by  
Sally Curb Arnold

May, 1979

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A TAXONOMIC AND PHYSIOGRAPHIC SURVEY OF SCIRPUS IN KENTUCKY  
WITH PROBLEM SPECIES COMPLEX ANALYSIS

Sally Curb Arnold

May, 1979

44 pages

Directed by: E. O. Beal, K. W. Nicely, G. E. Dillard,  
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The genus Scirpus was analyzed according to species occurrence and physiographic distribution in the State of Kentucky. The morphology of three taxonomic problem complexes, Scirpus atrovirens-georgianus, Scirpus validus-acutus, and Scirpus cyperinus-eriophorum-pelius-pedicellatus was evaluated to determine whether or not their components are distinct among the Kentucky specimens. Remaining taxa were likewise evaluated and identified. A key to Scirpus in Kentucky and a taxonomic treatment are presented.



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## INTRODUCTION

The genus Scirpus consists of many species several of which present taxonomic difficulties. Representatives in

~~Species Com-~~  
plexes, there is considerable taxonomic ambiguity. Examination of specimens of Scirpus from Kentucky reveals the presence of three problem complexes in the State. There are: Scirpus atrovirens-georgianus, Scirpus validus-acutus, and Scirpus cyperinus-eriphorum-pelius-pedicellatus.<sup>1</sup> In the case of Scirpus lineatus and S. pendulus the specific epithets have often been erroneously applied (Schuyler, 1966). The remaining taxa presented no problems in identification.

Although the vascular plant flora of the State of Kentucky is generally poorly known, certain portions of the State have been collected extensively by Raymond Athey, Mary Wharton, and others. The western and mountain areas have been particularly well collected in regard to Scirpus.

Schuyler (1967) has recently studied Scirpus on a broad geographic scale in his treatment of North American species, and Koyama (1962) has treated Scirpus on a world-wide scale. In view of these works, this study was conducted within the more restricted boundaries of Kentucky and has been undertaken

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<sup>1</sup> Author citations for taxa will be covered in full in the taxonomic treatment. Author citations for those taxa not treated in the taxonomic treatment are included in the text.

to determine which species of Scirpus are present in the State as well as in which physiographic regions and counties they occur. Kentucky data are subjected to an analysis of species complexes which traditionally present classification problems to determine the appropriate ~~category~~ for their ~~components~~ to the taxa and a taxonomic treatment are derived from data on the Kentucky specimens examined.

Field collections were made, and specimens of Kentucky species of Scirpus were obtained on loan from several herbaria.<sup>2</sup>

#### A. General

Using a dissecting microscope, standard measurements of scale, achene, and spikelet lengths were taken for each of the problem groups according to the recommendations by Schuyler (1964). These measurements were also taken for several of the other taxa when appropriate. Particular morphological features of each group were observed and noted. Scale length representing an individual specimen is the mean length of five scales from the middle area of the spikelet. Achene length is the mean length of five mature achenes. Spikelet length and width are the mean values of five spikelet measurements.

Published diagnostic features for all the taxa were listed and consulted throughout specimen evaluation. Keys used in identification were Beal (1977), Clapham et al. (1962), Correll and Correll (1972), Gleason and Cronquist (1963), Fassett (1957), Fernald (1950), Polunin (1969), Radford et al. (1968), and Schuyler (1963, 1967). Any deviations from

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2DHL, KY, MUR, SIU, KNK, (Stafleu, 1974), Morehead State University, Memphis State University, Eastern Kentucky University, and Western Kentucky University.

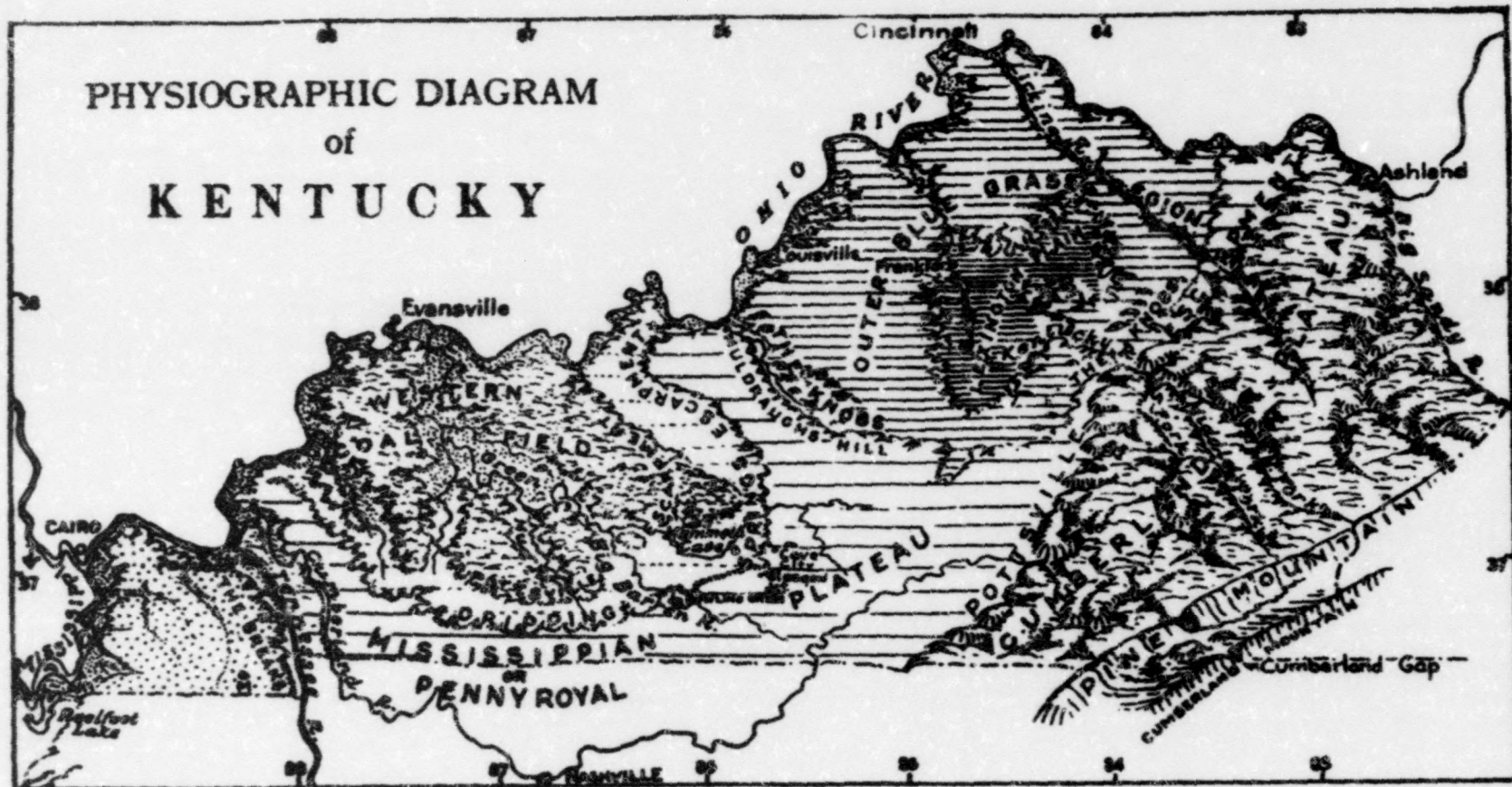
published data were noted as were secondary data. General geographic locations of collection sites were based on Figure 1.

#### B. Scirpus atrovirens-georgianus Complex

In addition to standard measurements, presence or absence of bristles, presence or absence of bristle barbs, bristle lengths relative to the achene, nature of the style, and number of leaves were observed and noted. Collection dates of immature and mature specimens were recorded to establish a general time range of maturation in Kentucky. The distribution of S. atrovirens-georgianus types was plotted geographically for comparison to the physiography of the State.

Achene length and scale length were determined by Schuyler (1967) to be potential distinguishing features in the S. atrovirens-georgianus complex. Data from the Kentucky specimens were plotted on an ordinate-abscissa graph in an attempt to demonstrate any correlations of these features with the taxa involved. Scale length (mm) was also charted against bristle length relative to the achene. Bristle length categories were defined (according to Schuyler, 1967) as much shorter than the achene, including absence of bristles, to those having bristles one half as long as the achene. These plots provided an estimate of overlap and separation based upon morphological features traditionally used in delineation.

Figure 1. Physiographic diagram of Kentucky. The Geographical Press, C. S. Hammond and Co. Maplewood, N.J. (from A. K. Lobek, 1932).





C. Scirpus validus-acuteus Complex

Dabbs (1971) stressed the significance of primary, secondary, and tertiary ray elongation as well as spikelet length to the separation of Scirpus validus and S. acuteus. Ray elongation patterns and mean spikelet length were plotted to depict any correlation between these two features. Additionally, ten morphological features characteristic of S. acuteus were phenotypically rated with ten corresponding features of S. validus according to the double index method of Klekowski and Beal (1965).

D. Scirpus cyperinus-eriphorum-pelius-pedicellatus Complex

The Scirpus cyperinus-eriphorum-pelius-pedicellatus complex presented a problem in that apparently red-brown or blackish color of involucels and bases of involucre bracts and the number of pedicelled spikelets are the only morphological features used to separate the taxa (Schuyler, 1963). Therefore, these two features together with appearance of the bristles and standard measurements were applied to classification in this group. Specimens were grouped according to their apparent morphology and examined. Geographical distribution maps were plotted and collection dates of mature and immature specimens were noted.

E. Scirpus lineatus and Scirpus pendulus

Criteria used to distinguish between Scirpus lineatus Michx. and S. pendulus are the following: number of lateral

inflorescences, if present, presence or absence of axillary bulblets and, when possible to determine from dried specimens, the relative rigidity of the culms (Schuyler, 1966). Standard measurements were taken, and the appearance of bristles was analyzed and compared within these two taxa and to other Scirpus species.

F. Remaining Taxa

Specimens of Scirpus americanus, S. expansus, S. fluviatilis, S. heterochaetus, S. holoschoenus, S. koilolepsis, S. polyphyllus, and S. smithii were also examined. These species are individually distinct, and characteristics observed were compared to published descriptions. Any discrepancies or inaccuracies were noted.

## RESULTS AND DISCUSSION

Three hundred eight Kentucky specimens of Scirpus were received on loan and examined. Based on the literature and specimens at hand, fifteen separate species were expected, but only twelve of these proved to be distinct. Of the Scirpus specimens examined, seven were identified as S. americanus, thirty-five as S. atrovirens var. atrovirens, fifty as S. atrovirens var. georgianus, fifty-one as being in the S. cyperinus-eriphorum-pelius-pedicellatus complex, nineteen as S. koilolepsis, forty-three as S. pendulus, twenty-six as S. polyphyllus, and sixty-four as S. validus or intermediates between S. validus and S. acutus. Two individuals of S. fluviatilis were identified, and S. expansus, S. heterochaetus, S. holoschoenus, and S. smithii were represented by one specimen each. After close examination, a total of six specimens was found to be too immature for positive identification.

### A. Scirpus atrovirens-georgianus Complex

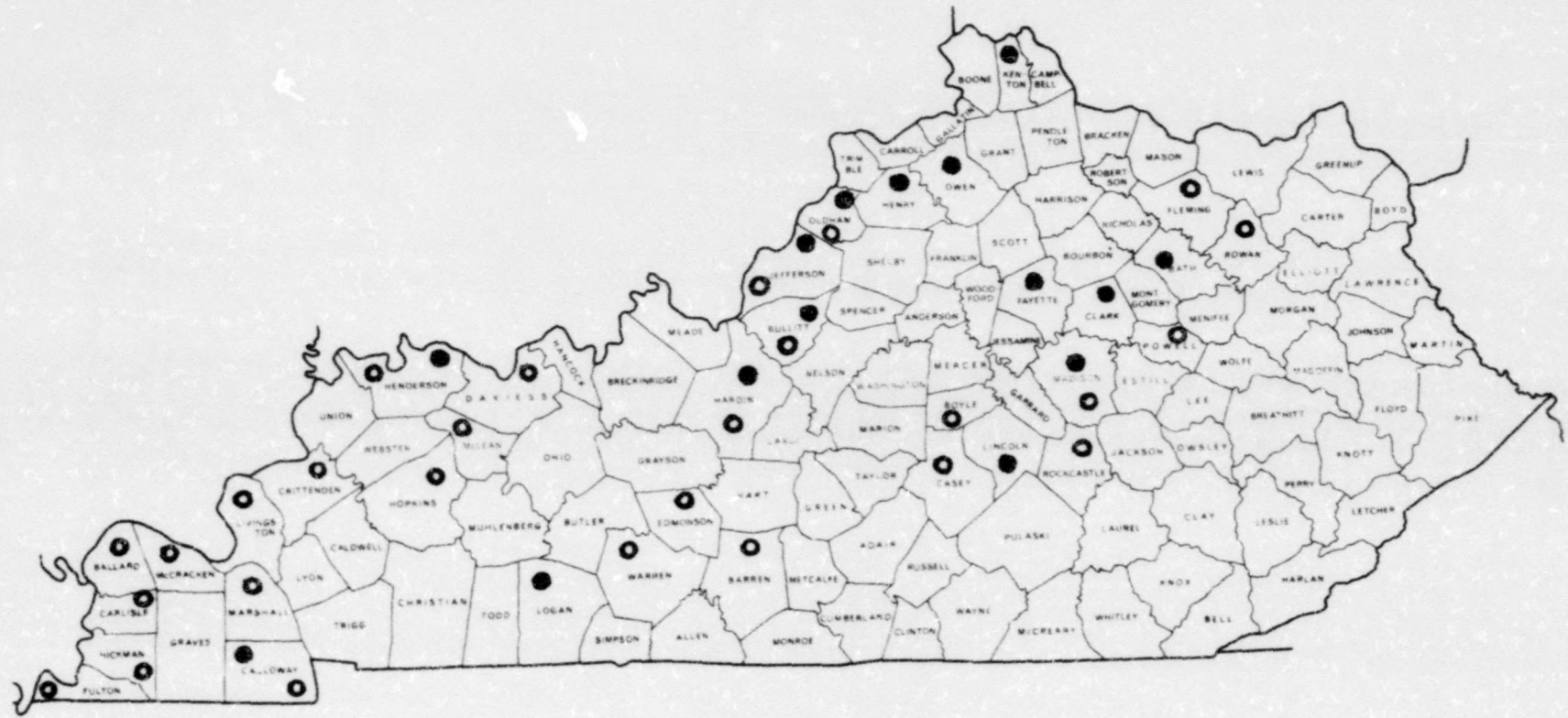
Eighty-five specimens of the Scirpus atrovirens-georgianus complex were examined. The taxa, S. atrovirens and S. georgianus, although kept separate by some authors (Schuyler, 1967; Correll and Correll, 1972), are frequently combined within S. atrovirens at the varietal level. Data presented in this paper suggest S. atrovirens is represented in Kentucky by the two varieties, atrovirens and georgianus.

Standard measurements taken on S. atrovirens var. atrovirens revealed an average achene length of 1.0-1.3 mm, an average scale length of 1.3-2.0 mm, and an average spikelet length of 2.5-4.0 mm. Average spikelet widths ranged from 1.2-1.8 mm. Bristles were found to number 4-6, and bristle length ranged from slightly shorter to slightly longer than the achene. They were not contorted and were always retrorsely barbed, at least on the distal one-third of the bristle. Scirpus atrovirens var. atrovirens occurred primarily within the Blue Grass Region of the State, although far fewer collections have been made west of this area (Fig. 2).

Standard measurements of S. atrovirens var. georgianus varied slightly from those of S. atrovirens var. atrovirens. Average achene length was 0.8-1.1 mm, and average scale length fell within the range of 1.1-1.7 mm. Spikelet length ranged from 1.9-3.9 mm. Mean spikelet width was usually 1.1-1.9 mm. One specimen (Hannan, 7-15-76, EKU 04552), although fully mature, exhibited exceptionally shorter standard measurements. These were: achene length, 0.7 mm; scale length, 1.1 mm; and spikelet length, 1.7 mm. Mean spikelet width for this specimen was 0.9 mm. Scirpus atrovirens var. georgianus occurred primarily outside of the Blue Grass Region in the northern portion of the State (Fig. 2).

Attempts to delineate the S. atrovirens complex into two distinct species failed to show a clear distinction between S. atrovirens and S. georgianus. Standard measurements of the S. atrovirens-georgianus complex compared

Figure 2. Distribution of Kentucky specimens of Scirpus atrovirens. Filled circles represent S. atrovirens var. atrovirens, and open circles represent S. atrovirens var. georgianus.



favorably with those of Schuyler (1967) as did the description of bristles. Although morphological extremes are evident, there was considerable overlap; thus, the data suggest that distinction of S. georgianus from S. atrovirens at the species level in Kentucky is hardly possible. These two taxa are supposedly distinguishable on the basis of scale length, achene length, and bristle length (Schuyler, 1967). When one compares scale and achene lengths, an obvious transition between the two morphological extremes appears (Fig. 3). Plotting spikelet length-width ratios against scale length also reveals morphological extremes, but overlap is again considerable (Fig. 4). An attempt to correlate scale length to bristle length relative to the achene also shows much overlap and does not separate S. atrovirens from S. georgianus on the basis of these features (Fig. 5).

The only apparent positive correlations are the bristle lengths relative to achene lengths. These, too, prove to overlap considerably (Fig. 6) and do not corroborate separation of these taxa above the varietal level.

Close examination of physiographic distributions revealed significant overlap in occurrence of S. atrovirens var. atrovirens and S. atrovirens var. georgianus (Fig. 2), which further supports the consolidation of these two types as varieties of S. atrovirens. On the basis of achene length versus bristle length, there is apparent justification in separation of these taxa as varieties even though there is

Figure 3. Scatter diagram showing scale length (mm) versus achene length (mm) within the Kentucky Scirpus atrovirens-georgianus complex. Filled circles represent S. atrovirens var. georgianus and empty circles represent S. atrovirens var. atrovirens. Enlarged filled circles represent more than one specimen of S. atrovirens var. georgianus falling at the same level. Enlarged empty circles represent both S. atrovirens var. atrovirens and S. atrovirens var. georgianus falling at the same level.



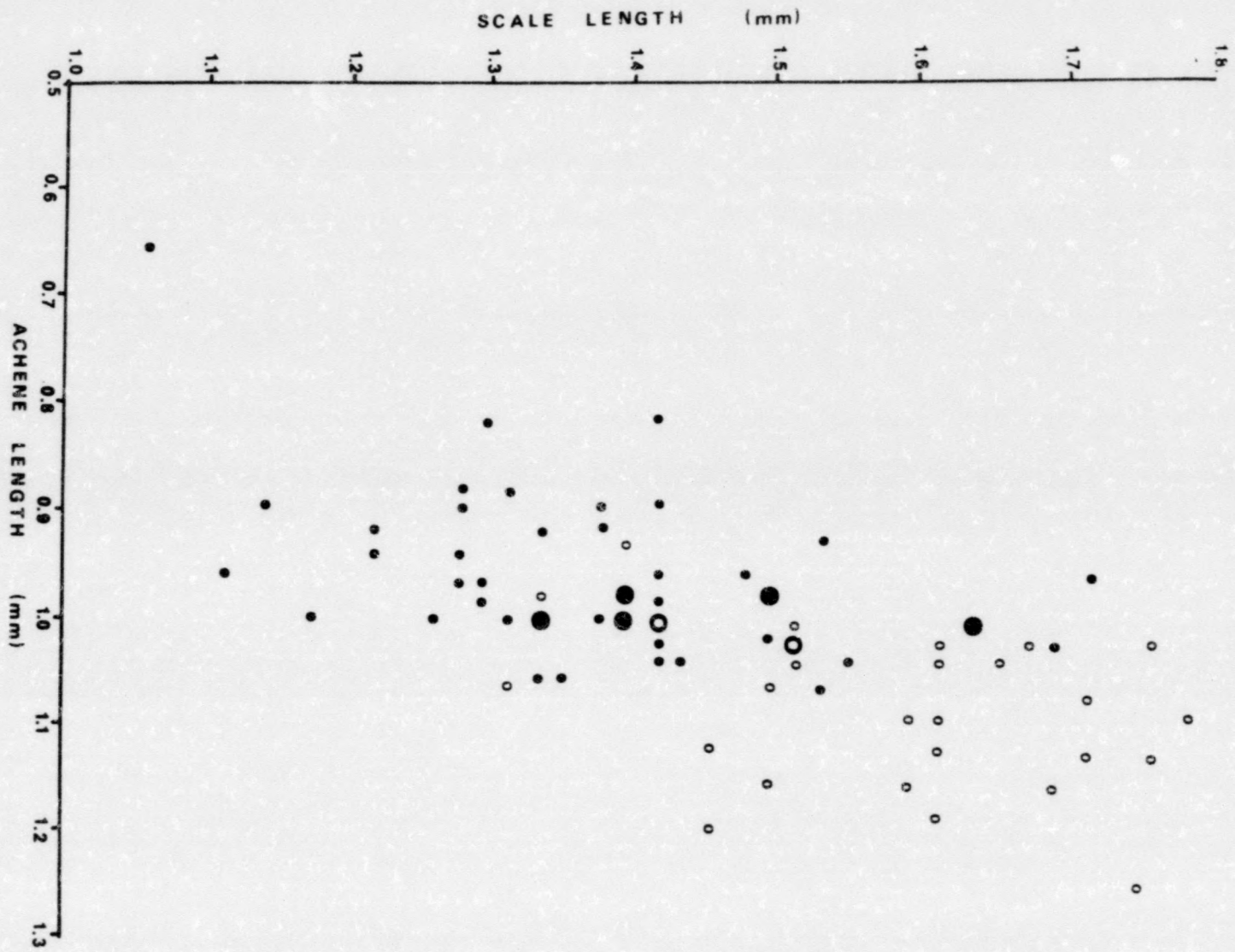


Figure 4. Scatter diagram showing correlation of spikelet length/width and scale lengths within the Kentucky Scirpus atrovirens-georgianus complex. Filled circles represent S. atrovirens var. georgianus and open circles represent S. atrovirens var. atrovirens.

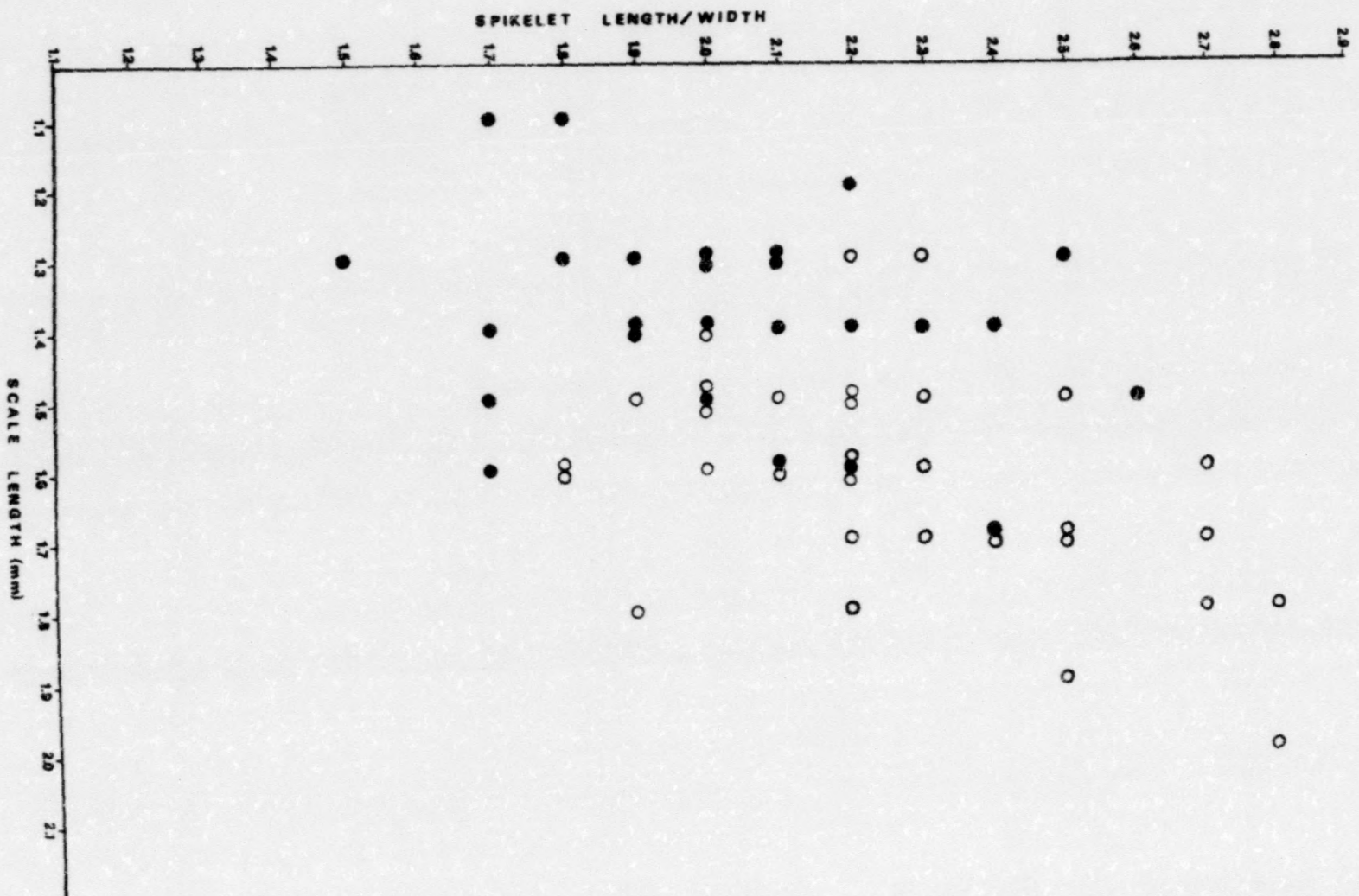


Figure 5. Relationship of scale length to bristle length relative to the achene within the Scirpus atrovirens-georgianus complex in Kentucky. Dots indicate the number of specimens falling at each level.

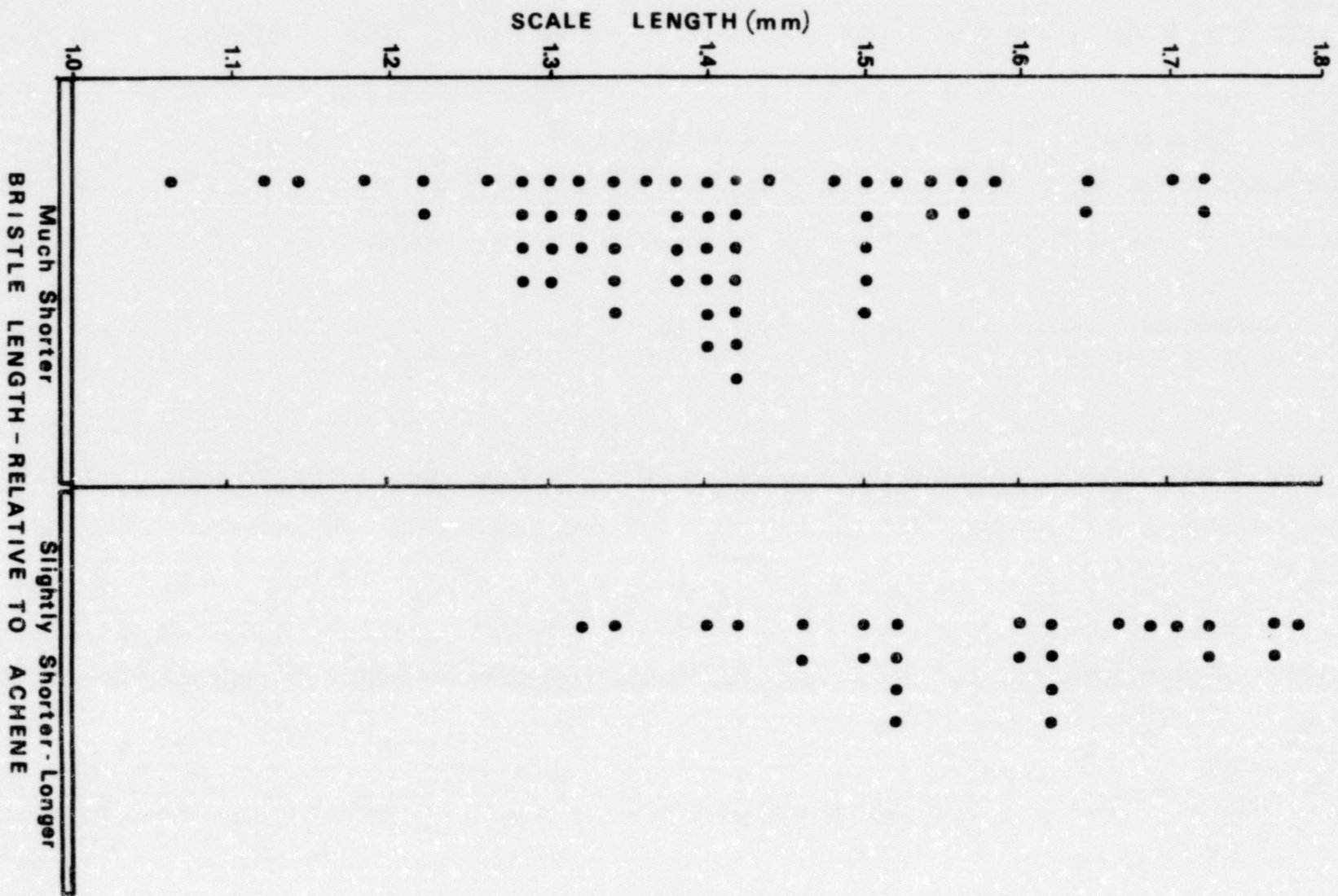
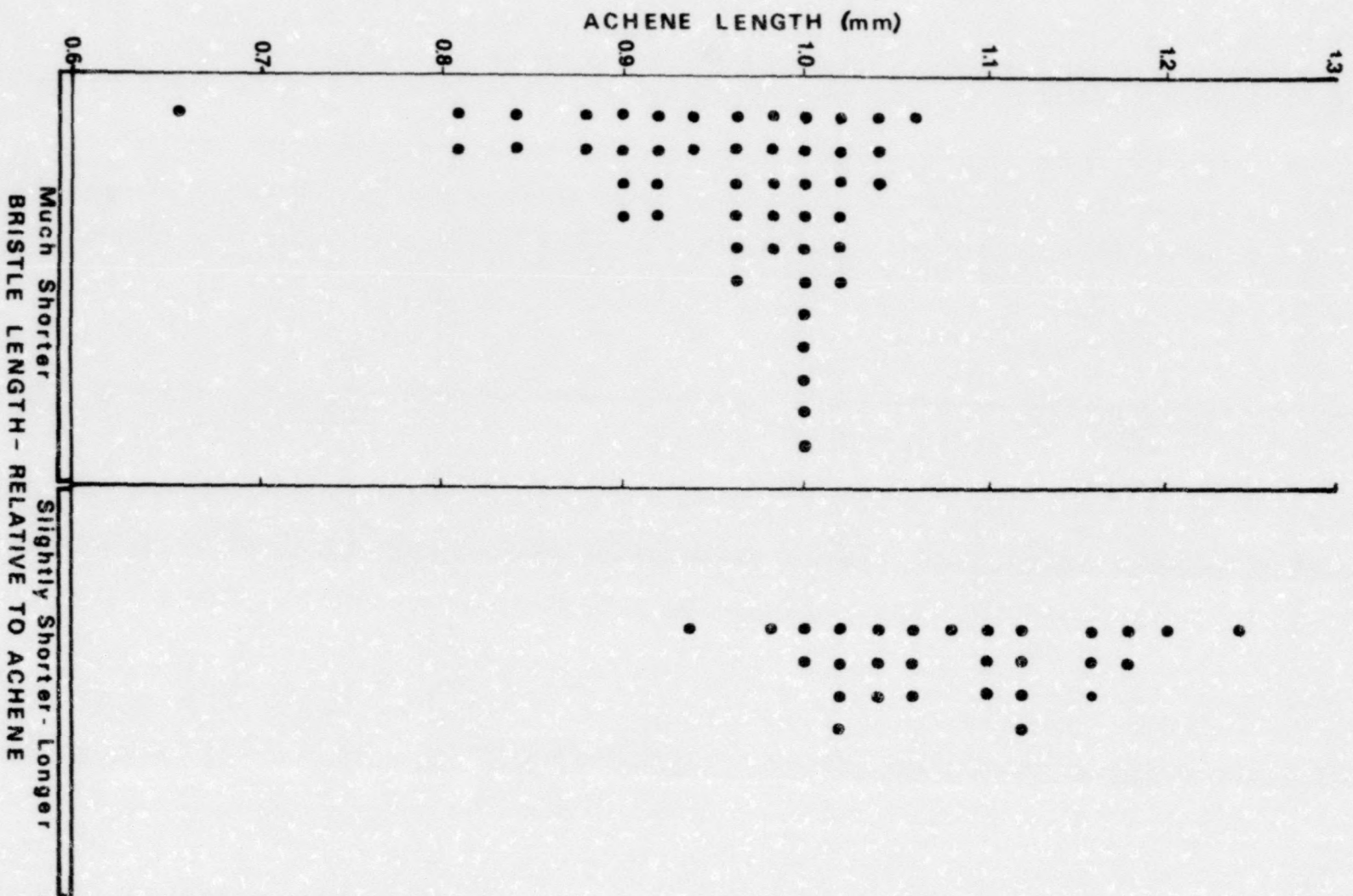


Figure 6. Relationship of achene length to bristle length relative to the achene within the Kentucky Scirpus atrovirens-georgianus complex. Dots indicate the number of specimens falling at each level.



some overlap (Fig. 6). As these are commonly treated as varieties in the literature, they are similarly maintained as varieties in this work.

B. Scirpus validus-acuteus Complex

Standard measurements of sixty-four specimens of the Scirpus validus-acuteus complex revealed a mean achene length of 1.6-2.5 mm, mean scale length of 2.2-3.8 mm, and a spikelet length ranging from 3.7-11.2 mm. Two specimens (Lassetter, 6-14-73, ECU 02244; Theiret, 8-5-78, KNK 50644) had achene lengths of 1.2 mm, which is considerably below the published achene length for this complex (Radford, 1968; Correll and Correll, 1972). Spikelet color varied with each specimen from brown-red brown to brown-grey brown. Spikelet scales also exhibited mucronate and awned midribs which included a spectrum of intermediates between these two extremes. The same gradation between extremes was apparent regarding ciliate and lacerate scale margins. Correll and Correll (1972) indicated degree of scale margin laceration to be diagnostic in discriminating between S. validus and S. acuteus. Kentucky specimens exhibited a high degree of variability of this characteristic. Of sixty-four specimens examined, thirty-three were decidedly ciliate, thirteen were lacerate, and fourteen were either intermediates or showed both features on the same plant. Thus it appears little discriminatory diagnostic value regarding these morphological traits can be applied within the S. validus-acuteus complex in Kentucky. Resinous scale glands, although noted, also provided



no consistent basis for classification in this complex. Studies by Dabbs (1971) substantiate this finding. Resinous scale glands changed in abundance with each specimens and were totally absent in eleven specimens. They were occasionally found to be absent from some scales but present on other scales from the same spikelet. They were usually brick red in color, but white glands were also observed. Resinous glands occurred frequently, but not always, along the midrib vein.

Seven S. validus-acuteus plants showed tertiary ray elongation, a feature Dabbs (1971) used to recognize S. validus; four showed primary elongation only, a characteristic he ascribed to S. acuteus. Thus secondary ray elongation itself is an example of continuity rather than discontinuity within the complex. A comparison of spikelet length and ray elongation showed considerable overlap between the diagnostic extremes of S. validus and S. acuteus (Fig. 7). Herbarium specimens (Athey, 8-14-73, SIU 2480; Athey, 8-14-73, Memphis State University 6590) previously labelled S. acuteus fell well within the expected range of S. validus. This is not surprising, for even published spikelet lengths of the two morphological extremes may overlap by as many as three millimeters (Gleason and Cronquist, 1963).

Rating S. validus and S. acuteus phenotypically (Klekowski and Beal, 1965) using ten morphological features revealed a definite skew of Kentucky specimens toward the S. validus phenotype (Fig. 8). Five specimens fell along the equational

Figure 7. Correlation of spikelet length and degree of inflorescence ray elongation within the Scirpus validus-acutus complex in Kentucky. Dots indicate the number of specimens falling at each level.

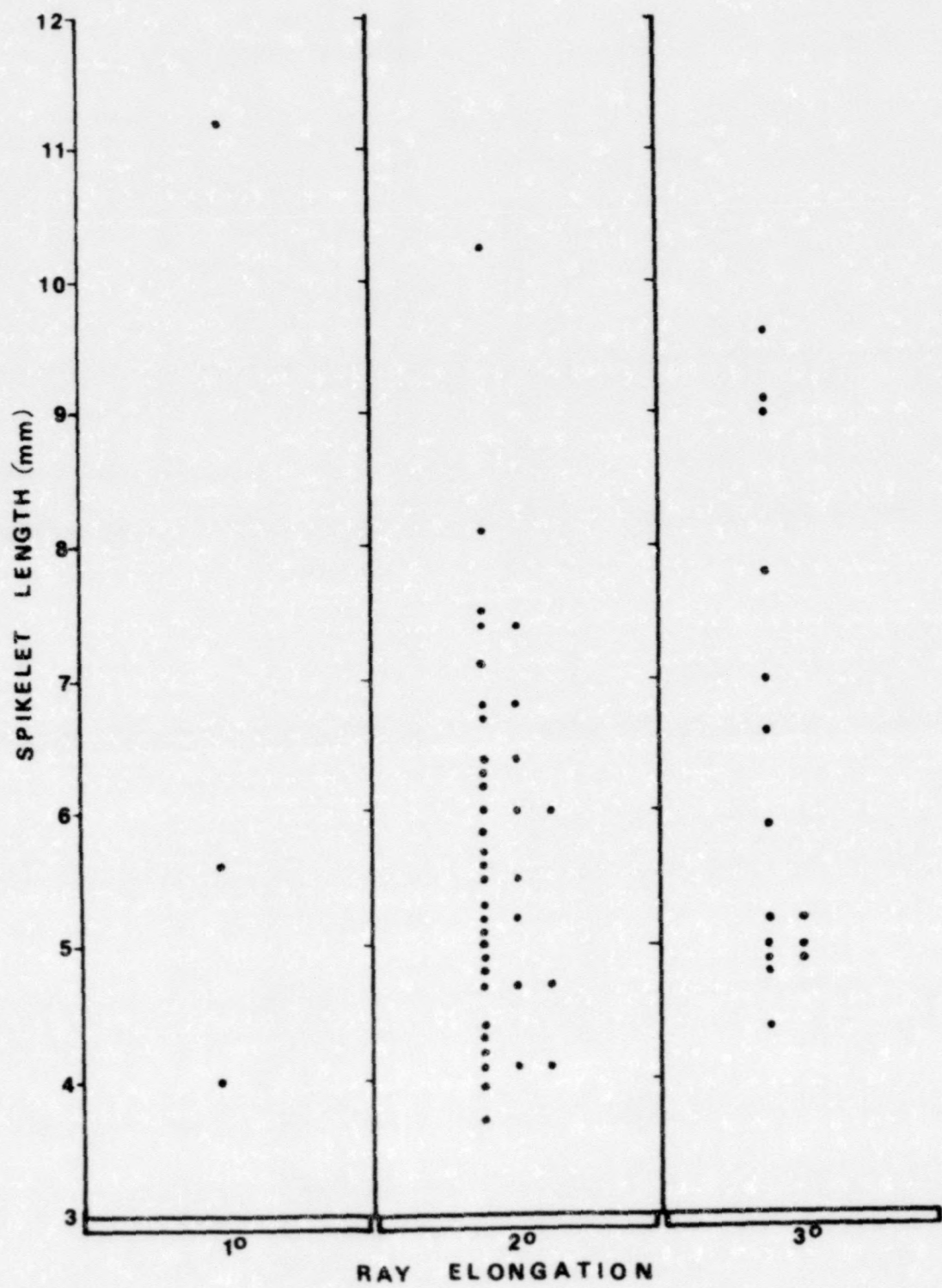


Figure 8. Comparative phenotypic ratings of specimens of the Scirpus validus-acutus complex from Kentucky. Numbers along the margins represent the number of morphological features of each phenotype possessed by a particular specimen. Numbers inside the boxes indicate the number of specimens scoring a particular rating. Based on the literature the following morphological features were observed:

Morphological Feature	Characteristic of:	
	<u>S. validus</u>	<u>S. acutus</u>
1. Achene length	1.8-2.3 mm	2.1-2.4 mm
2. Scale length	2 -4 mm	4 -5 mm
3. Spikelet length	5 -10 mm	6 -15 mm
4. Spikelet shape	short, ovoid	long, acutish
5. Spikelet color	reddish-brown	grey-grey brown
6. Scale midrib extension	awned	mucronate
7. Degree of scale pubescence	glabrous	pubescent
8. Appearance of in- florescence	spreading	close
9. Ray elongation	1 <sup>o</sup> , 2 <sup>o</sup> +/- or	3 <sup>o</sup> 1 <sup>o</sup> , some 2 <sup>o</sup>
10. Appearance of scale margins	ciliate	lacerate



line, indicating those in which S. validus and S. acutus scores are equal in magnitude. Of these five, two, at coordinates (6,6) and 5,5) exhibited primary ray elongation only. No specimen fell below the equational line into the S. acutus area, demonstrating that all specimens examined possessed a number of S. validus characters which in no instance was exceeded by the number of S. acutus characters. Thus one would expect none of the sixty-four specimens examined to key easily to S. acutus. Instead they exhibited a tendency toward the morphology of S. validus and intermediates. It is apparent that nearly all specimens examined are unquestionably the S. validus type, and the few intermediate specimens can easily be considered to be the same. Despite the apparent absence of "good" S. acutus in Kentucky, the continuity of intermediates within the complex implies that nearly any combination of characters from both extremes may be found.

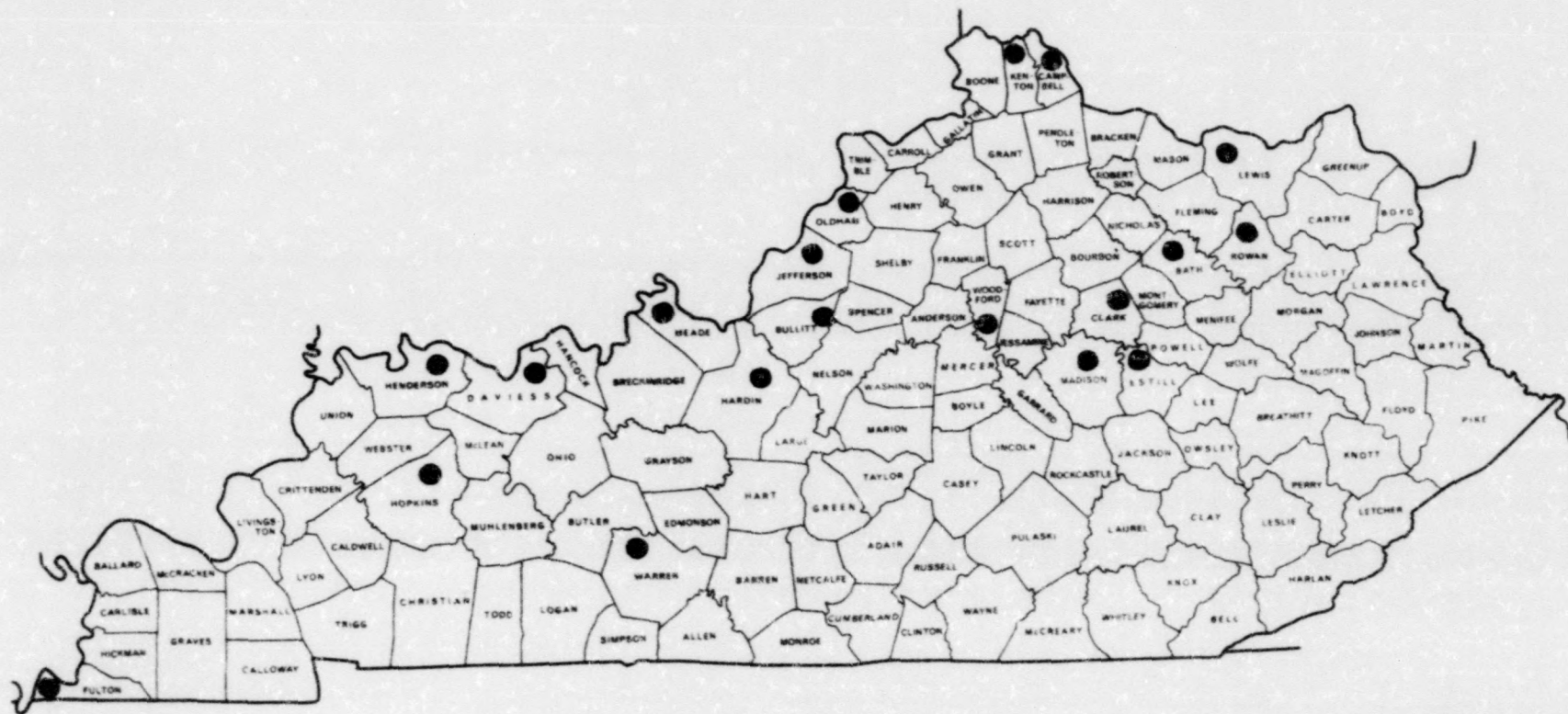
The data suggest S. acutus and S. validus in Kentucky are in fact one species, S. validus, S. validus being the older, legitimate name. Two morphological extremes, as well as a steady intergradation of intermediates possessing characteristics typical of both, are present in Kentucky. Although Correll and Correll (1972) maintain nomenclatural distinctness within this complex, it is evident their descriptions overlap. Furthermore, Correll and Correll note that intermediates occur between S. validus and S. acutus.

Comparison of these descriptions with Kentucky data revealed even further discrepancy in that features treated by Correll and Correll as diagnostic (for example, lacerate scale margins) are in fact doubtful and only confuse the issue. Beal and Monson (1954) concluded that S. acutus, S. validus, and their intermediates are morphological expressions of one species. Miller and Beal (1972) corroborated these findings. In a worldwide evaluation, Koyama (1962) considered S. acutus and S. validus to be synonymous with two varieties of the European S. lacustris.

Because all Kentucky specimens are the S. validus or intermediate types, distribution plots reveal little about physiographic separation of the two extremes. Scirpus validus occurs commonly in low areas along portions of the Ohio River and within the Blue Grass Region of the State (Fig. 9). There are also several representatives from the Western Coal Field including two from Henderson County (Kellerman, 8-20-57, DHL 5962; Kellerman, 8-20-57, DHL 1709) which fall along the equational line at coordinates (6,6) and (5,5) (Fig. 8). Two Fulton County specimens (Athey, 8-14-73, SIU 2480; Athey, 8-14-73, Memphis State University 6590), originally identified as S. acutus, are in fact more characteristic of the S. validus type on the basis of these ten morphological features and plot at coordinates (8,4) and (6,5), respectively. Given these instances, it does appear the specimens most closely resembling the S. acutus type are in this western area.

Figure 9. Distribution of Kentucky specimens of Scirpus  
validus.





C. Scirpus cyperinus-erriophorum-pelii-pedicellatus Complex

Four phenotypes are apparent in the Scirpus cyperinus-erriophorum-pelii-pedicellatus complex: S. cyperinus var. cyperinus, S. cyperinus var. erriophorum, S. cyperinus var. pelii, and S. pedicellatus. These seem to be separable only regarding degree of spikelet pedicellation. All four of these are sometimes referred to as varieties of S. cyperinus, although S. pedicellatus is more frequently considered a separate species altogether. The categories include spikelets mostly in glomerules (S. cyperinus var. cyperinus and S. cyperinus var. pelii), spikelets in glomerules or sessile with lateral spikelets pedicellate (S. cyperinus var. peditellatus).

Distinction on the basis of involucl color and color of the bases of involucral bracts separates only two specimens (Meade, 8-10-73, Morehead State University 0666; Gleason, 9-7-39, KY 3470) from the remaining forty-nine. These two (from Rowan and Montgomery Counties, both mountainous areas) exhibited blackish-brown color in accordance with descriptions of S. cyperinus var. pelii. All others exhibited a reddish brown color. Achene lengths of these two specimens ranged from 0.8-1.0 mm, scale lengths from 1.4-1.6 mm, and spikelet lengths averaged approximately 3.0 mm. Both specimens were mature upon collection.

Mean achene lengths of specimens grouped as S. cyperinus var. erriophorum, including some previously labelled S. pedicellatus, ranged from 0.6-1.0 mm. Reports of S. pedicellatus

(Meade, 7-16-73, EKU 06657; Meade, 8-7-74, Morehead State University 04508; Meade, 8-13-73, Morehead State University 06656; Davis, 10-14-51, DHL 7832) are apparently unfounded, for, no Kentucky specimen fitting published descriptions was examined. Additionally, Kentucky lies south of the published range of S. pedicellatus in North America (Schuyler, 1967). Mean scale lengths were 1.6-2.0 mm, and spikelet lengths fell within a range of 2.4-5.3 mm. All specimens grouped in this category exhibited a red-brown involucl color of varying light and dark shades. None approached the blackish brown hue of var. pelius. Of thirty-two specimens, ten were immature. Nine of these were collected during the last week of July and during the first two weeks of August. One was collected prior to this period on the eighteenth of July. This three-week period is evidently the maturation period for the entire S. cyperinus complex in Kentucky. No immature specimens were collected after the seventh of August. Seventeen mature specimens of S. cyperinus var. eriphorum were collected during this period, and no mature specimens were collected prior to this period. Physiographic distribution shows this group occurs in the far western portion of the State and across the State to the Blue Grass Region and Cumberland Plateau (Fig. 10).

Mean achene lengths of specimens grouped as S. cyperinus var. cyperinus were 0.6-0.9 mm, and scale lengths ranged from 1.6-2.0 mm, although one plant, (Meade, 8-13-73, Morehead State University 06655) had a mean scale length of 1.4 mm. Spikelet length ranged from 2.2-4.0 mm. All seventeen specimens exhibited reddish-brown coloring of the involucels and

Figure 10. Distribution of traditional varieties of Scirpus cyperinus in Kentucky. Open circles represent S. cyperinus var. eriophorum; filled circles represent S. cyperinus var. cyperinus; triangles represent S. cyperinus var. pelius. These varieties have not been accepted in the treatment of the species in Kentucky.



bases of involucre bracts. Most of the spikelets were in glomerules although some were solitary. Four specimens examined were immature and collection dates fell within the observed maturation period. Labels of all mature specimens showed collection dates during the maturation period or thereafter. None was collected before the twenty-fifth of July. Physiographic distribution (Fig. 10) is similar to that of the S. cyperinus var. eriophorum group. Only the "pelius" group does not extend beyond the mountain area.

In view of the degree of morphological similarity and overlap demonstrated by standard measurements and observed features, only pedicellation accounts for any morphological separation within the S. cyperinus-eriophorum-pelius-pedicellatus complex. Paired with other factors it may be valid; however, there seem to be no other apparent separating features. Physiographic distribution indicates no regional isolation of any of the phenotypes except perhaps the occurrence of "pelius" in the mountains. Other groups occur there also, which again shows an overlap in distribution. In fact, they grow sympatrically, mature concurrently, and appear to interbreed. As mentioned, comparison of degree of maturation and date of collection with phenotype implies definite overlap of maturation periods. It should be noted here that maturation dates on herbarium sheets do not necessarily coincide with those dates published by Schuyler (1967). Still, distribution and maturation data suggest segregation based on this information is inappropriate at the species level.

These data suggest it is best to consolidate all the components of the S. cyperinus-eriphorum-pelivus-pedicellatus complex into one taxon, S. cyperinus, which can exhibit all these morphological extremes and variations. In Kentucky, recognition of formal varieties within this taxon is inappropriate. Although Schuyler (1963) originally separated the taxa within this complex, he later (1967) combined them as synonymous with S. cyperinus and recognized no varieties. Data on Kentucky specimens studied support Schuyler's conclusion; the taxa within the S. cyperinus complex of Kentucky, except for S. pedicellatus, are combined in this study. Schuyler maintained S. pedicellatus as a separate species. As previously mentioned, no Kentucky specimens are definitively of the S. pedicellatus type as described by Schuyler, although some were so labelled originally. Thus it is impossible to compare Kentucky specimens of S. pedicellatus with S. cyperinus, since the former apparently does not occur in the State.

D. Scirpus lineatus and Scirpus pendulus

Taxonomic clarification by Schuyler (1966) has shown that the specific epithet, Scirpus lineatus, has been consistently misapplied by recent American authors to S. pendulus Muhl. and that the epithet, S. fontinalis Harp., has been misapplied to S. lineatus. All Kentucky specimens previously labelled S. lineatus or S. fontinalis are in fact S. pendulus. There is no specimen of true S. lineatus Michx. on record in Kentucky herbaria or in the herbaria of Southern Illinois University and Memphis State University. Previous references to S.

lineatus in Kentucky by Gunn (1953) and Braun (1943) were misapplications of the name.

Mean achene lengths in S. pendulus ranged from 1.0-1.4 mm. Lengths of spikelet scales varied from 1.6-2.3 mm and occasionally reached 2.4 mm. Spikelet lengths varied considerably from 4-9 mm. Of forty-three specimens, twenty-six exhibited one lateral inflorescence in addition to a terminal inflorescence. Two exhibited two lateral inflorescences, and the remaining fifteen possessed only a terminal inflorescence. None of the plants had axillary bulblets. According to distribution plots, S. pendulus occurs in various habitats and elevations across the State from along the Ohio River and within the Western Coal Field to the Blue Grass Region and Cumberland Plateau (Fig. 11).

#### E. Scirpus polyphyllus

Scirpus polyphyllus occurs in the mountain regions of Kentucky and is known from the western portions of the State and the periphery of the Blue Grass Region (Fig. 12). From known collections it is evident that S. polyphyllus occurs almost completely outside the Western Coal Field and the inner Blue Grass Region of the State. Standard measurements indicated a mean achene length of 1.0-1.3 mm. Achenes rarely were as long as 1.4 mm, and none were shorter than 1.0 mm. Scale length varied between 1.3 and 1.7 mm, and spikelet length, where measureable, varied from 2.5-3.4 mm. One specimen (Stamper, 7-28-78, ECU 04643) exhibited the only mean spikelet length at 4.4 mm, outside of this range.



Figure 11. Distribution of Scirpus pendulus in Kentucky.

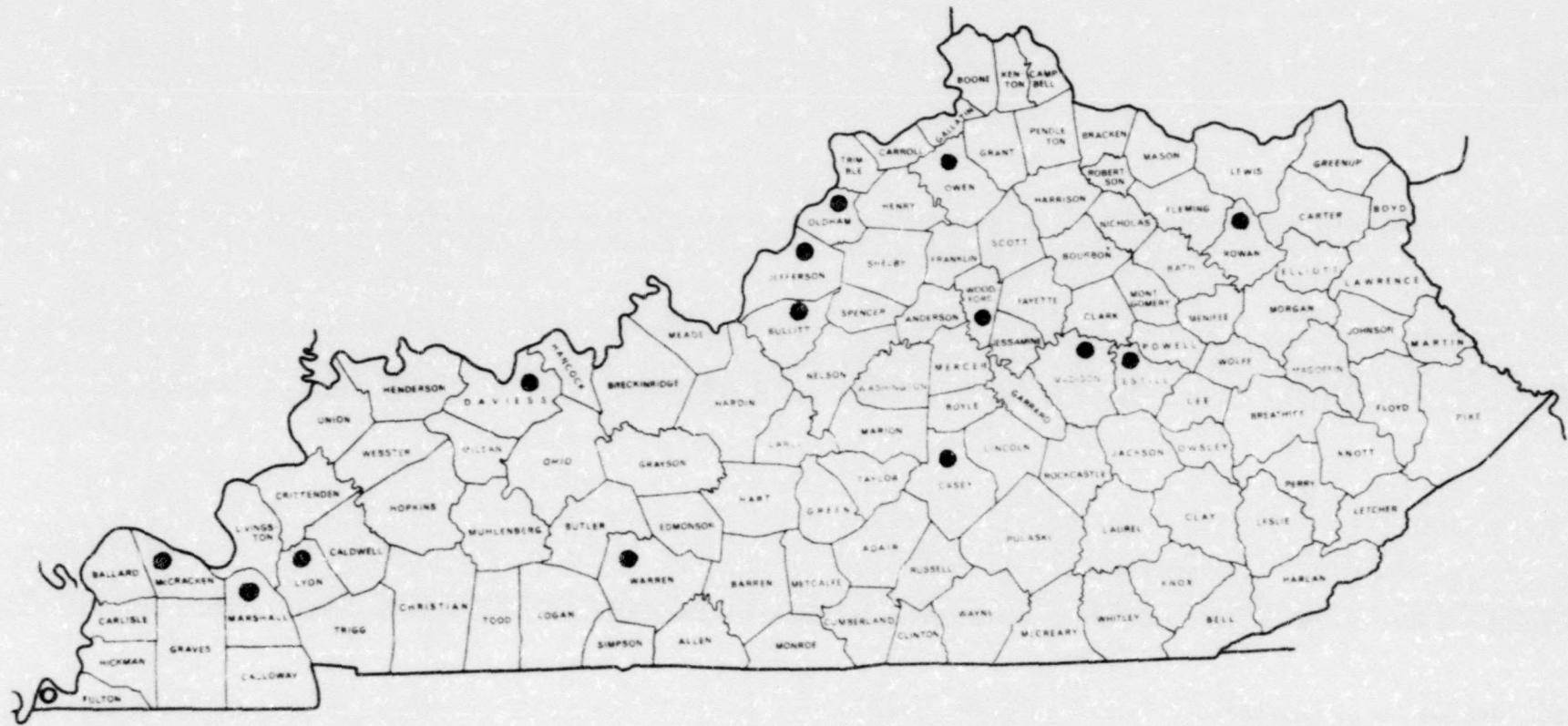
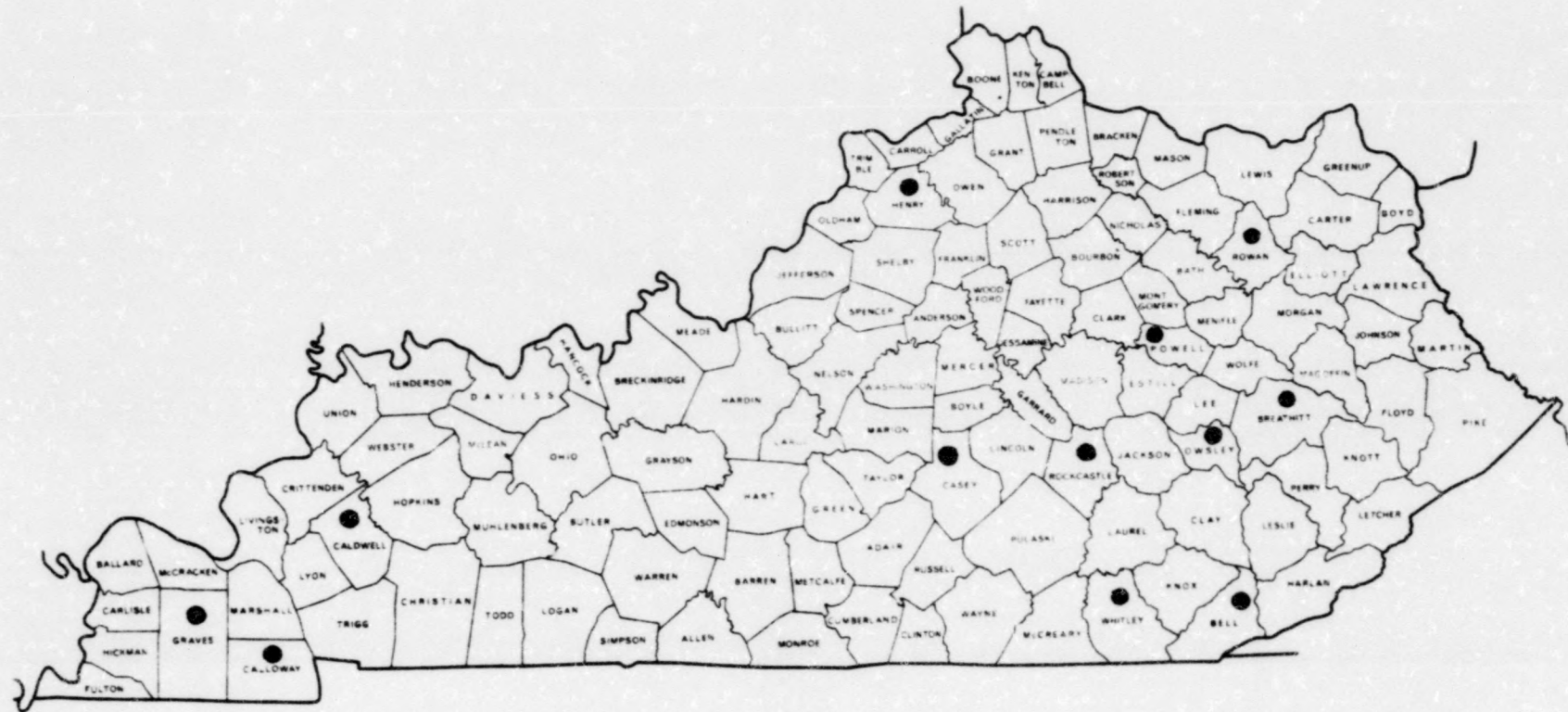


Figure 12. Distribution of Scirpus polyphyllus in Kentucky.



Achene and scale lengths of this individual fell well within the measured range mentioned above. Spikelet length-width ratios ranged between 1.2 and 2.4. Of twenty-six specimens examined, five, or nineteen percent, had fewer than ten leaves even though this taxon is characterized by Schuyler (1967) as having fewer than ten cauline leaves. Five specimens were immature. Four of these were collected in June and July, and the fifth was collected in late September. All five are from the mountainous regions of the State. Collection dates of the remaining mature specimens begin in June and continue through November. Distribution plots show S. polyphyllus in the extreme western portion of the State, especially around the Tennessee and Cumberland Rivers, and particularly at the higher elevations of the eastern regions (Fig. 12). North Carolina habitat data of Beal (1977) coincide with collection and distribution data provided by Kentucky specimens. This consistency, as well as that of quantitative measurements presented here with the literature, reinforce the delineation of S. polyphyllus as a species.

#### Remaining Taxa

All herbarium specimens examined of S. fluviatilis, S. koilolepsis, S. heterochaetus, S. holoschoenus, S. smithii, S. expansus, and S. americanus were correctly designated and showed particular characteristics recorded in the literature.

Because various morphological features unique to each taxon were observable, standard measurements to establish

identity were omitted. Scirpus koilolepsis has been collected only in the western portions of the State (Fig. 13). Scirpus heterochaetus and S. holoschoenus each represented by only one specimen, obviously are not widespread in Kentucky (Figures 14 and 15). These were collected in western Crittenden and Marshall Counties, respectively. Scirpus americanus is known from both the low western areas and the higher elevations around the Knobs and the Pottsville Escarpment. Scirpus smithii and S. expansus were also collected in the Knobs Region (Figures 14 and 15). Morphological features examined in these species compared favorably with the literature and no discrepancy regarding classification or description was encountered.

Figure 13. Distribution of Scirpus koilolepsis in Kentucky.





Figure 14. Distributions of Scirpus heterochaetus, S. fluviatilis, and S. expansus in Kentucky. Filled circle represents S. heterochaetus. Half filled circle represents S. fluviatilis. Open circle represents S. expansus.

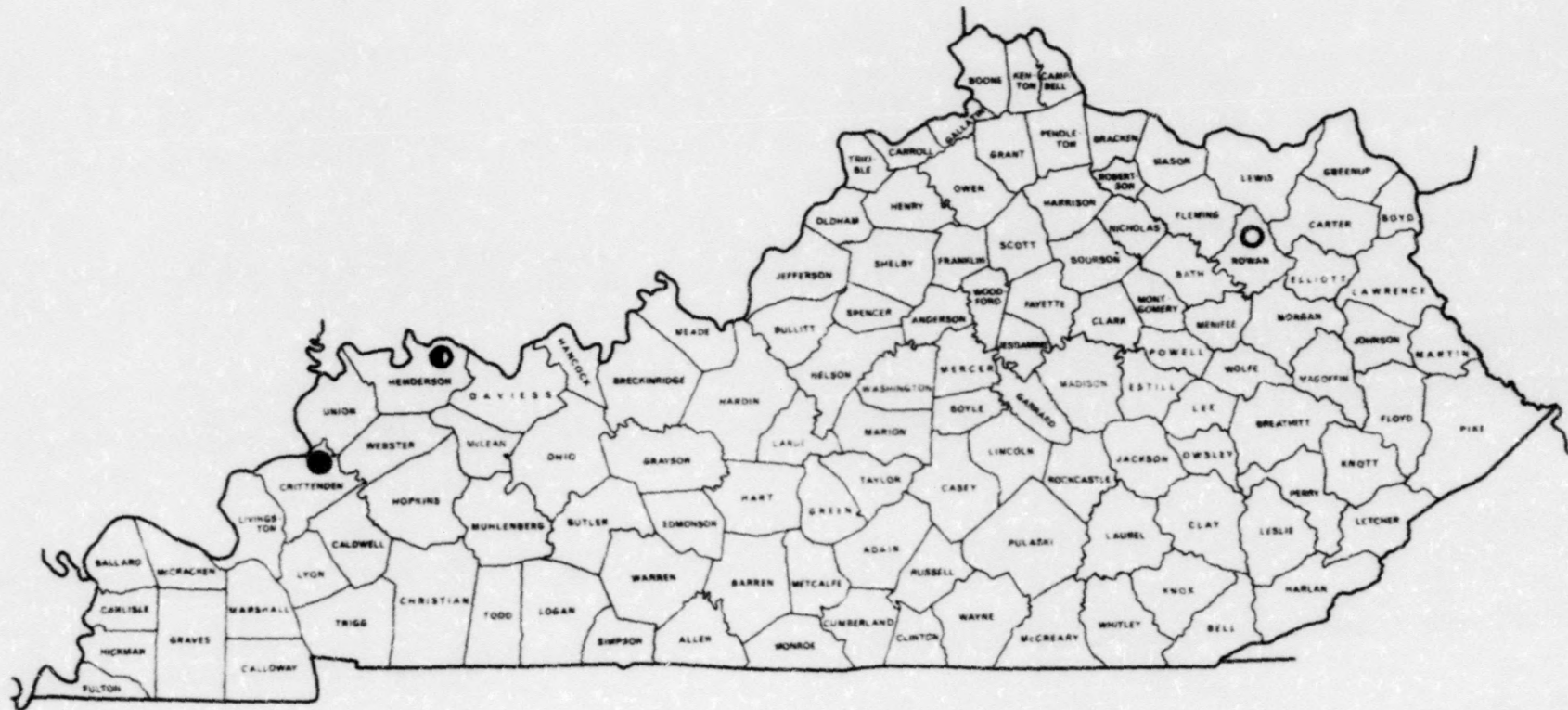


Figure 15. Distributions of Scirpus americanus, S. smithii, and S. holoschoenus in Kentucky. Filled circles represent S. americanus. Open circle represents S. smithii. Half filled circle represents S. holoschoenus.



TAXONOMIC TREATMENT

Key to Scirpus in Kentucky

- a. Inflorescence subtended by 1-2 bracts, one of which may appear as an extension of the culm; culm non-leafy.
- b. Inflorescence consisting of several tightly compacted glomerules, subtended by 2 bracts; spikelets 2-3 mm.  
..... 1. S. holoschoenus
- b. Inflorescence consisting of loose glomerules or solitary spikelets, subtended by one bract; spikelets longer than 3 mm.
- c. Spikelets in sessile clusters on culm or solitary on very short rays.
- d. Scales ovate, sharply keeled, boat shaped; spikelet usually solitary, occasionally 2 or 3 in a glomerule; style usually 3-cleft.  
..... 2. S. koilolepsis
- d. Scales oblong ovate, keel absent; spikelets usually 3 or more in a cluster; style usually 2-cleft.
- e. Achene plano-convex, cuneate-obovate, smooth, lustrous, black; culm 0.1-4 dm high ..... 3. S. smithii
- e. Achene plano-convex, obovoid, smooth, drab, olivaceous or brown; culm 0.3-15 dm high ..... 4. S. americanus

- c. Spikelets in branched clusters or branched and solitary.
- f. Inflorescence loose and spreading; spikelets mostly solitary at the tips of rays; style 3-cleft; bristles 2-4 (mostly), usually shorter than the achene; scales conspicuously exceeding the achene . . . 5. S. heterochaetus
- f. Inflorescence close or spreading; spikelets mostly in clusters at the tips of rays; style 2-cleft; scales scarcely exceeding the achene . . . . . 6. S. validus
- a. Inflorescence subtended by several foliaceous bracts; culm leafy.
- g. Culm sharply triangular; achene sharply trigonous, conspicuously beaked; bristles 6, stiff, robust, retrorsely barbed . . . . . 7. S. fluviatilis
- g. Culm terete to obtusely triangular; achene bluntly trigonous, or plane convex, may or may not be conspicuously beaked; bristles 0-6, delicate, smooth or retrorsely barbed.
- h. Bristles long and contorted, at least distally, conspicuously exceeding the achene.
- i. Bristles smooth, conspicuously exceeding achene at maturity, rendering a wooly appearance, white-light brown . . 8. S. cyperinus

- i. Bristles smooth or retrorsely barbed, exceeding achene at maturity, but remaining within spikelet scales, brown-red brown.
- j. Spikelets clustered in glomerules; bristles retrorsely barbed; terminal inflorescence only . . . . 9. S. polyphyllus
- j. Spikelets grouped at ends of rays, either sessile or peduncled; bristles smooth; inflorescence usually terminal, one, rarely two lateral inflorescences present 10. S. pendulus
- h. Bristles straight, shorter than to slightly exceeding the achene.
- k. Leaf sheaths red-tinged; bristles retrorsely barbed to base, exceeding achene; scales broadly oval, the midvein broad and green. . . . . 11. S. expansus
- k. Leaf sheaths green; bristles, if present, smooth or retrorsely barbed in distal portion of the bristle; scales broadly elliptic or obovate, slightly exceeding achene, the midvein slightly green only at immaturity.
- l. Bristles 4-6, slightly shorter to slightly longer than the achene; distal one-third to entire length retrorsely barbed, achene 1.0-1.3 mm. .12 a. S. atrovirens var. atrovirens

1. Bristles absent, vestigial or about one half as long as the achene, distal portion retrorsely barbed; achene 0.8-1.1 mm. . . 12b. S. atrovirens var. georgianus

1. Scirpus holoschoenus L.

Rare on ore piles of Marshall County, Kentucky. (Holoschoenus vulgaris Link).

2. Scirpus koilolepsis (Steud.) Gleason

Low areas, fields, limestone bluffs. Rare outside the Mississippi Embayment of the Gulf Coastal Plain in the western portion of Kentucky. [S. carinatus (Hook and Arn.) Gray]

3. Scirpus smithii Gray

Rare in wet areas of Rowan County, Kentucky.

4. Scirpus americanus Pers.

Infrequent along shorelines and in shallow water along the Pottsville Escarpment and the Tennessee and Cumberland Rivers.

5. Scirpus heterochaetus Chase

Rare along shorelines of Crittenden County, Kentucky.

6. Scirpus validus Vahl

Shorelines and very wet ground. Abundant along the Ohio River and its tributaries as well as the Pottsville Escarpment. Infrequent in the Blue Grass Region and Western Coal Field of Kentucky. [S. acutus Muhl., S. lacustris Linn. subsp. validus (Vahl) T. Koyama, S. validus Vahl var. creber Fern.]

7. Scirpus fluviatilis (Torr.) Gray

Swampy and wet areas of Henderson County in western Kentucky.



8. Scirpus cyperinus (L.) Kunth

Common in low ground, disturbed areas, ditches, and on stream banks. Especially frequent within the Mississippi Embayment of the Gulf Coastal Plain, the Western Coal Field, and the Cumberland Plateau of Kentucky. [Eriophorum cyperinus L., Scirpus eriophorum Michx., S. rubricosus Fern., S. cyperinus var. cyperinus, S. cyperinus var. rubricosus Fern., S. cyperinus var. eriophorum (Michx.) Kuntze, and S. cyperinus var. pelius Fern.]

9. Scirpus polyphyllus Vahl

Frequent in low moist areas or creek banks and shorelines. Occurs in the Mississippian Plateau and Cumberland Plateau of Kentucky, as well as within the Mississippi Embayment of the Gulf Coastal Plain. Infrequent in the Blue Grass Region of Kentucky. (Schoenus cymosus Willd., Scirpus brunneus Muhl.)

10. Scirpus pendulus Muhl.

Frequent along shorelines, in low areas and ditches. Common from the Cumberland Plateau and Blue Grass Region across the State to the Western Coal Field and Ohio River. (S. lineatus of most American authors, not Michx.)

11. Scirpus expansus Fern.

Rare in wet fields of Rowan County, Kentucky. (Scirpus sylvaticus L.)

12. Scirpus atrovirens Willd.

Frequent along shorelines, roadsides, and in low areas and marshes. Abundant throughout the State from the Pottsville Escarpment west to the Ohio River.

a. var. atrovirens

Chiefly within the Blue Grass Region and occasionally in western portions of the State. (Scirpus atrovirens Willd.)

b. var georgianus (Harp.) Fern.

Chiefly outside the Blue Grass Region and west to the Ohio River. (Scirpus georgianus Harp.)

## CONCLUSION

Three hundred eight specimens of Scirpus were examined and twelve species were found. Three taxonomic problem complexes were defined. On the basis of Kentucky data, S. atrovirens-georgianus is reduced to the varietal level as S. atrovirens var. atrovirens and S. atrovirens var. georgianus. Scirpus validus and S. acutus are consolidated into one taxon, S. validus, which Koyoma (1962) considers to be synonymous with a variety of S. lacustris. Characters used to separate S. cyperinus-eriphorum-pelivus-pedicellatus were found to be indistinct and continuous, so each taxon except S. pedicellatus is considered to be synonymous with S. cyperinus. Apparently, reports of S. pedicellatus in Kentucky are unfounded. Remaining taxa key easily and are morphologically distinct. Physiographic distributions show Scirpus occurs throughout the State. Physiographic distributions of the components of each of the three problem complexes shows overlap in occurrence of extremes and intermediates within each of the complexes.

Proper taxonomic application of the taxon S. pendulus to specimens formerly labelled S. lineatus Michx. has been observed according to clarification by Schuyler (1966).

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