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**A taxonomic study of variation in *Leptochloa fascicularis* in the central Great Plains.**

Todd A. Templeton

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A TAXONOMIC STUDY OF VARIATION  
IN LEPTOCHLOA FASCICULARIS  
IN THE CENTRAL GREAT PLAINS

A Thesis  
Presented to the  
Department of Biology  
and the  
Faculty of the Graduate College  
University of Nebraska

In Partial Fulfillment  
of the Requirements for the Degree  
Master of Arts  
University of Nebraska at Omaha

by  
Todd A. Templeton  
November 1985

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THESIS ACCEPTANCE

Accepted for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Master of Arts, University of Nebraska at Omaha.

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*Nov 28, 1985*  
Date

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## - ABSTRACT

Morphology of Leptochloa fascicularis (Lam.) Gray (Poaceae) was studied in 25 locations in eastern and central Nebraska to determine if this grass was separable into two distinct taxa as suggested in several recent sources. Field collections were supplemented with herbarium samples from the University of Kansas. Glume and lemma lengths, the characters used in published keys, provided no separations useful in dividing the material into two species or varieties. However, individual local populations exhibited significant differences from each other in these characters. Such local differences appear to be reasonable given the high degree of inbreeding that is to be expected with cleistogamous reproduction such as that predominating at most of the more xeric field locations. Chasmogamy was confined to moist habitats.

## INTRODUCTION

Leptochloa fascicularis (Lam.) Gray is an annual grass found in muddy or wet soils in marshes, along ditches and as a weed in gardens and parking lots. Gleason and Cronquist (1963) recognize this taxon as one species with three varieties, of which L. fascicularis var. fascicularis and L. fascicularis var. acuminata (Nash) Gleason are found in the Great Plains. Separation of varieties by Gleason and Cronquist is based on the length of the glumes and the lowest lemmas.

McNeill (1979) considered L. acuminata (Nash) Mohlenbrock (as Diplachne acuminata Nash) a distinct species from L. fascicularis (as D. fascicularis (Lam.) Beauv.) based on the length of the glumes and the lowest lemma, and on the scabrosity of the panicle and blade. In McNeill's treatment, L. fascicularis was reported to have a first glume length of 1.3 - 2.0 mm, second glume length of 2.2 - 3.5 mm, and lowest lemma length of 2.0 - 4.0 mm, and L. acuminata was said to have a first glume length of 2.0 - 4.0 mm, second glume length of 3.5 - 5.0 mm, and lowest lemma length of 4.0 - 5.0 (8) mm and a more scabrous panicle and blade than L. fascicularis. McNeill also stated that L. fascicularis was found in "natural habitats" in the southern and north central states and L. acuminata in roadside ditches and along railroads.

Fernald (1950) and Dore and McNeill (1980) also recognized both L. acuminata and L. fascicularis (as Diplachne) as did Mohlenbrock (1973) (as Leptochloa). All of these authors made separations similar to those used by McNeill, although Fernald suggested a gap in measurements between the two species. Dore and McNeill (1980) cited one collection from a railroad yard near Niagara Falls as evidence of a

separate species. Mohlenbrock (1973) recognized distinct species based on 12 collections of L. fascicularis and one collection of L. acuminata. The latter was reported to be adventive along a railroad.

The objective of this study was to determine if L. fascicularis forms two recognizable species in the central Great Plains.

#### MATERIALS AND METHODS

Collections of the Leptochloa fascicularis complex were made in 22 locations in eastern and central Nebraska between July and September in 1984 in a wide variety of habitats. I attempted to collect 10 plants at random from each location, but the number varied between two and 12, depending on availability. Habitats collected from included roadsides, wet ditches, and parking lots in sand, mud, gravel and crushed rock substrates. These collections were supplemented with 96 herbarium specimens borrowed from the University of Kansas (KANU). This material contained plants from from a wide variety of habitats in New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Wyoming and Illinois. In the text which follows, the term "Great Plains collections" includes both the 22 field collections and the 96 herbarium specimens. In addition to this general sample, large population samples, termed "individual population collections," were collected in three locations in eastern Nebraska during July and August of 1985 so that the extent of variability in single populations could be estimated. All specimens were preserved by pressing.

Morphology of the spikelet was observed and measurements were

recorded for length of the first and second glume, lowest lemma, lemma awn, pedicel, spikelet, and ligule. All data were obtained from spikelets on the middle of the panicle. The Duncan Multiple Range Test, the Student-Newman-Keuls Test and Scheffe's Test (Allen 1982) were used for the characters measured on the three individual population collections. A hybrid index (Bell 1967) was also applied to these populations so that several characteristics could more easily be visualized at the same time. The separations used in the construction of this index were mainly those of Fernald (1950), since he left room for intermediate conditions. However, the separation used for first glume length was that of McNeill (1979), since Fernald did not discuss that character. Blade width and scabrosity of the panicle and blade were also recorded on much of the material. All of these measurements were made with an ocular micrometer in a dissecting microscope. In addition, mean pollen diameter of 22 specimens was determined by measuring the diameter of 10 pollen grains from unopened anthers using an ocular micrometer in a compound microscope. The pollen grains were mounted in lactophenol cotton blue (0.02% cotton blue in 1:10 acetic acid:lactophenol) before measuring. In addition, 100 pollen grains from each of 22 specimens were observed for stainability as an indicator of viability. Field observations of the florets were made using a hand lens to determine if the anthers were exerted at the time of collection.

## RESULTS AND DISCUSSION

L. fascicularis was found to be abundant in eastern Nebraska. It was easily found in areas of disturbance, especially along roadsides and in wet ditches, and was also common in wet sandy areas such as river banks. The species seemed to be isolated from most other plants in the same habitat, perhaps because it did not compete well. For example, in roadside habitats it was always found close to the pavement, but decreased in occurrence away from the road as other plants became dominant.

Collections made in early July showed that Leptochloa fascicularis commonly flowered within the sheath. Upon dissection of the individual florets, anthers were found to be tangled in the stigmas. Later in the flowering period the panicles were commonly exerted from the sheath, but the frequency of the anthers being exerted from the florets depended on the habitat. Plants collected in wet habitats commonly had some, but not all, anthers exerted on individual spikelets. Plants collected in dry habitats did not have any anthers exerted.

GREAT PLAINS COLLECTIONS

The characters analyzed, the lengths of the two glumes and the lemma, those used by previous workers. Other characters measured either 1) showed very similar patterns of variation (e.g. pedicel length), 2) varied erratically over a wide range (e.g. ligule length), or 3) varied over such a narrow range that it was impossible to measure them precisely using the available equipment (e.g. anther length). All

authors mentioned scabrosity as a useful separating character, but that feature varied erratically and proved impossible to quantify.

In Great Plains material, first glume length ranged from 1.0 - 4.0 mm, second glume from 1.7 - 6.2 mm, and lowest lemma from 2.1 - 6.8 mm. Histograms of these three characters show no obvious separation into two populations (Fig. 1). Scatter diagrams for the same set of data also show no separation between taxa (Fig. 2). Using McNeill's or Fernald's separations, a number of individual plants would have been identified as one species using first glume length and another species using second glume length with similar consequences when comparing second glume length and lemma length. Using Fernald's separations, a high percentage of the plants of this study were intermediate between the taxa.

Pollen diameter measurements for each of the 22 populations sampled were very consistent, averaging 25  $\mu$ . Stainability of pollen ranged from 15% - 98%. No relationship was apparent between stainability of pollen and morphology of the spikelet.

#### INDIVIDUAL POPULATION COLLECTIONS

A total of 157 plants were collected from three locations in eastern Nebraska. Seventy-five plants were collected along the Platte River at Two Rivers State Recreation Area, Douglas Co., NE, on August 12, 1985. All plants were collected in wet, sandy soil along the river bank. Cleistogamy was observed in the majority of the plants, but some were observed to have some anthers exerted on the florets, indicating some chasmogamous reproduction. Thirty-two plants were collected in a salt marsh on 27th Street in Lincoln, Lancaster Co., NE. on August 31,

Figure 1. Histograms of A) first glume length, B) second glume length, and C) lowest lemma length for Great Plains collections. The lines labelled a represent McNeill's (1979) separation between L. fascicularis and L. acuminata. The spaces between lines a and b represent the separation Fernald (1950) creates between his two species.

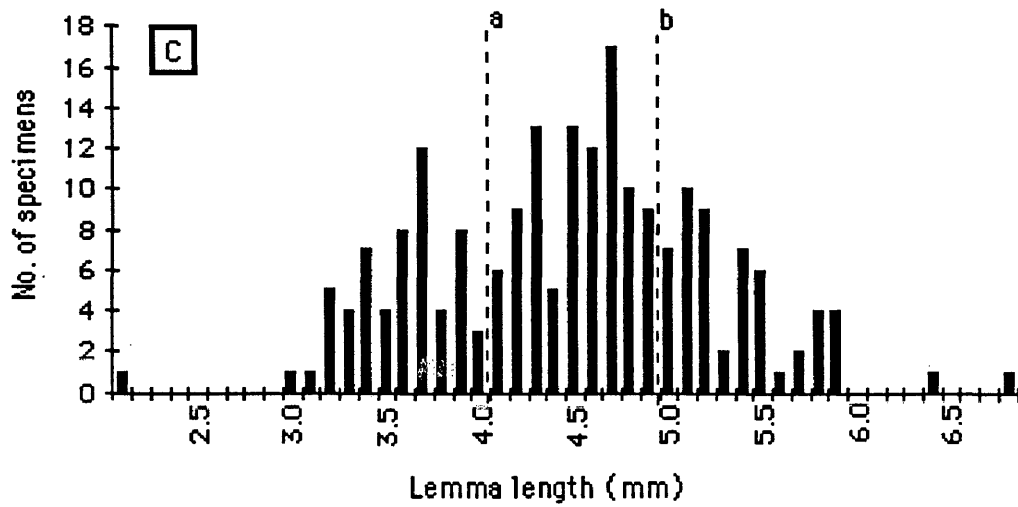
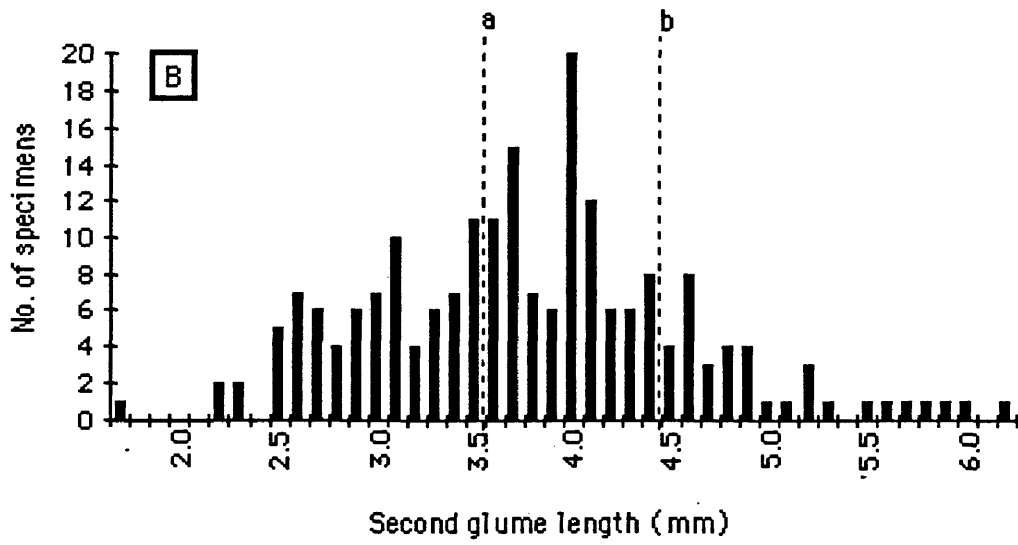
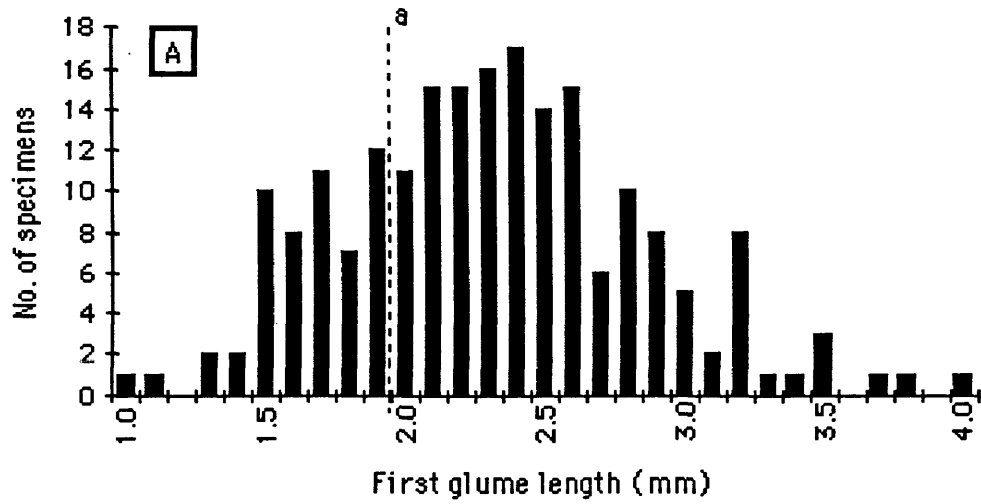
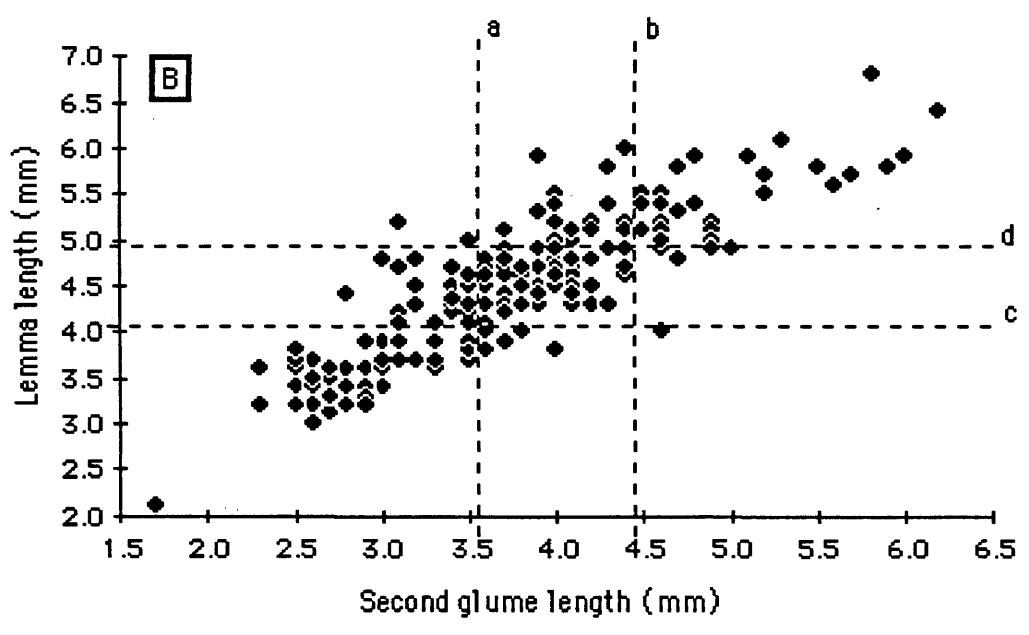
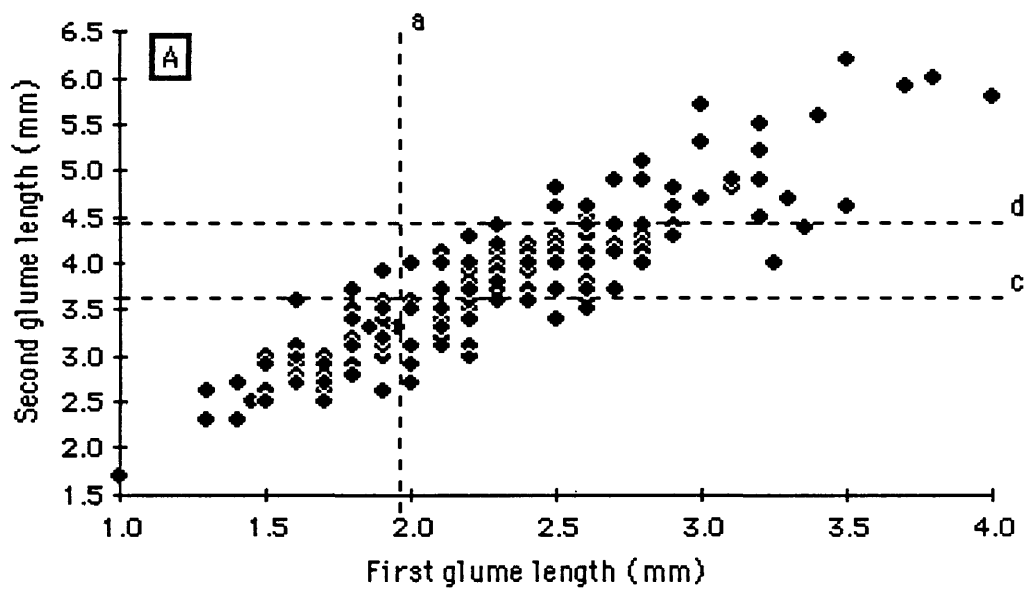




Figure 2. Scatter diagrams of A) first glume length vs. second glume length and B) second glume length vs. lemma length for Great Plains collections. Lines a and b represent the points of separation between McNeill's (1979) two species. The gap between lines a and b and between b and c represent the separation Fernald (1950) creates between his two species. (Fernald does not utilize first glume length).



1985. Fifty plants were collected in a disturbed habitat in the parking lot of the University of Nebraska at Omaha (U.N.O.), Douglas Co., NE, in an area in which the soil appeared to be very dry. Twenty-four of the 50 U.N.O. plants had panicles exerted from the sheaths on June 27, 1985, and were collected at that time. The remaining 26 plants represented in the U.N.O. data were collected on July 7, 1985. After the June 27 collection, however, very little rain fell and the remaining plants were exposed to temperatures ranging from 90 to 100 degrees F almost every day. Many plants were found with panicles exerted from the sheaths, but all plants were very small and dry. No plants were observed to have anthers exerted from the florets, possibly indicating that this population was entirely cleistogamous.

The ranges and means for lengths of first glumes, second glumes, and lemmas for these three populations are given in Table I. The three statistical tests applied showed that all three characteristics were significantly different for all three populations.

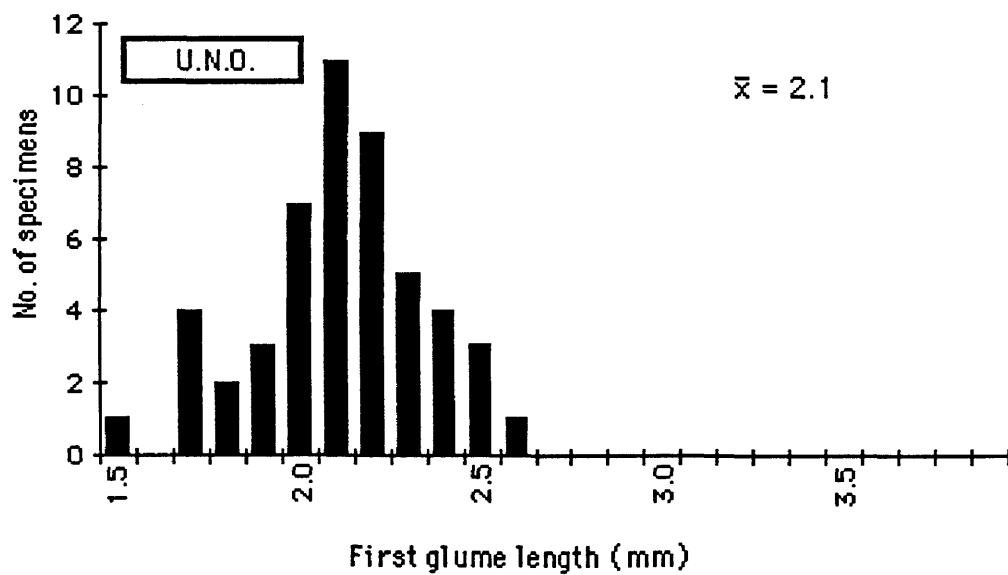
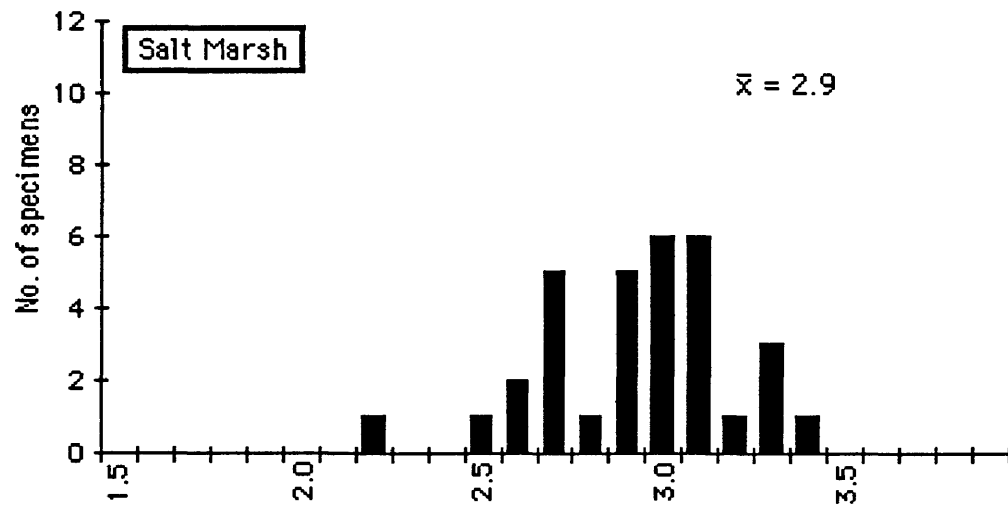
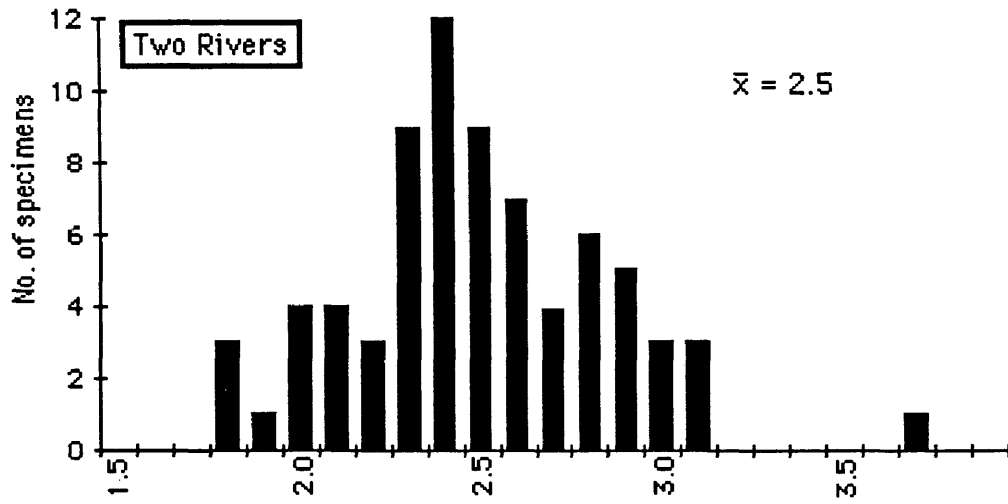
All plants collected from the Salt Marsh had a first glume length greater than 2.1 mm. Those authors recognizing two separate species would place all of this collection into L. acuminata based on this character. The Two Rivers and U.N.O. populations contained plants that fell on either side of 2.0 mm; however, neither histogram showed separate peaks indicating more than one taxon (Fig. 3).

For second glume length, following McNeill's separation, all of the plants collected in the Salt Marsh would fall into L. acuminata.

TABLE I. Ranges and means for lengths of first glumes, second glumes, and lemmas for the Two Rivers, Salt Marsh, and U.N.O. populations. All values for parameters between populations differ significantly ( $P = 0.05$ ) using the Duncan Multiple Range Test, Student-Newman-Keuls Test, and Scheffe's Test (Allen 1982).

Populations	First glume (mm)	Second glume (mm)	Lemma (mm)
Two Rivers	1.8 - 3.7 x = 2.5	3.1 - 4.9 x = 4.0	3.6 - 4.9 x = 4.8
Salt Marsh	2.2 - 3.4 x = 2.9	3.7 - 5.5 x = 4.7	5.0 - 6.3 x = 5.5
U.N.O.	1.5 - 2.6 x = 2.1	2.9 - 4.3 x = 3.6	3.8 - 4.8 x = 4.3

Figure 3. Histograms showing variation in the first glume length from the Two Rivers, Salt Marsh, and U.N.O. populations.



Fernald's separation, on the other hand, would place 11 of these plants as intermediates between his two taxa with the remaining 21 plants being categorized as L. acuminata. The Two Rivers population contained individuals that fell into one or the other of the two species using either McNeill's or Fernald's separations; as with first glume length, however, the data do not separate into distinct peaks. The U.N.O. population would fall into both species using McNeill's separation, with about half the plants in each. Using Fernald's separation, however, the U.N.O. population contained about half L. fascicularis and half intermediate specimens with none being characterized as L. acuminata (Fig. 4).

Both McNeill's and Fernald's classifications would place all specimens from the Salt Marsh into L. acuminata using lemma measurements. The other two populations contained material from both species according to McNeill's criteria, but, again, no separation is obvious on the histograms. Following Fernald, the Two Rivers population contained two specimens that would fall into L. fascicularis, with the remaining specimens intermediate or falling into L. acuminata; the U.N.O. population did not contain any specimens assignable to L. acuminata, the majority being intermediate (Fig. 5).

When the three characteristics were considered together in scatter diagrams, each population formed its own distinct cluster, but none of the three populations showed any internal separations (Fig. 6). In the Two Rivers and U.N.O. populations, a number of individuals which were intermediate with respect to lemma length could be seen to be

Figure 4. Histograms showing variation in the second glume length from the Two Rivers, Salt Marsh, and U.N.O. populations.



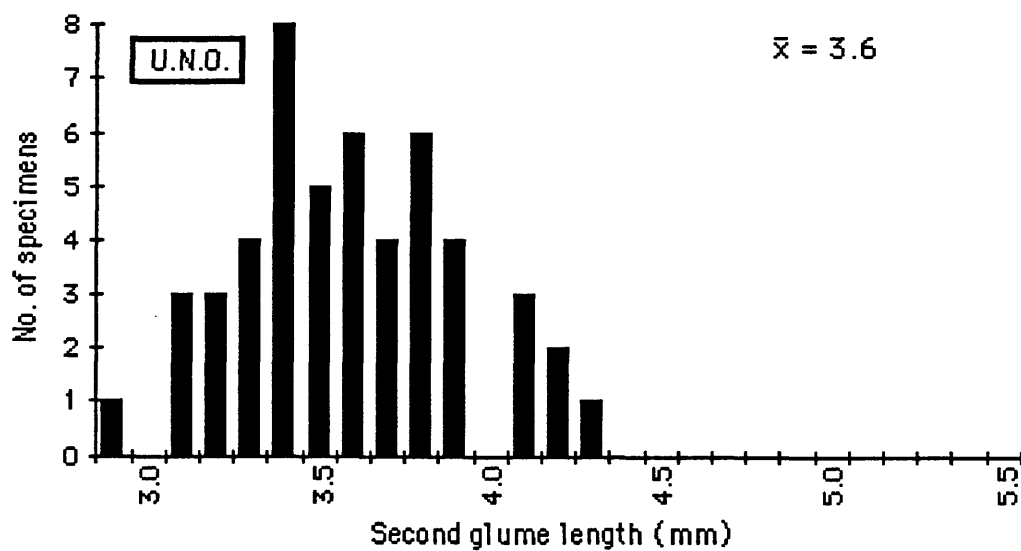
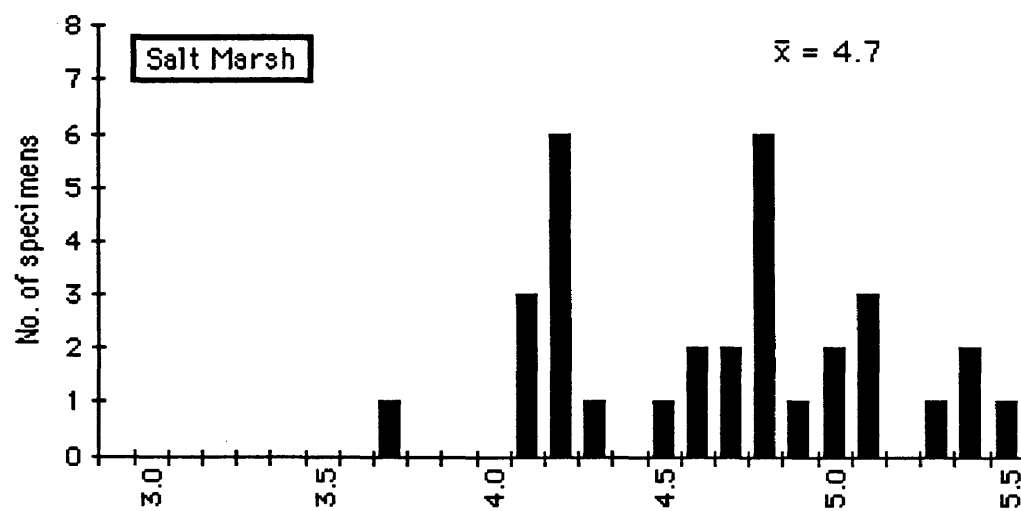
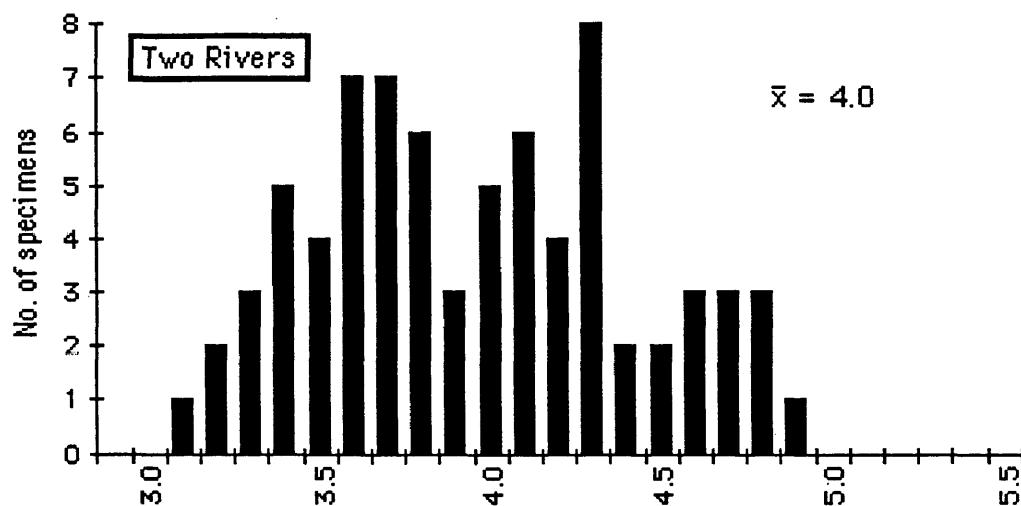


Figure 5. Histograms showing variation in the lowest lemma length from the Two Rivers, Salt Marsh, and U.N.O. populations.

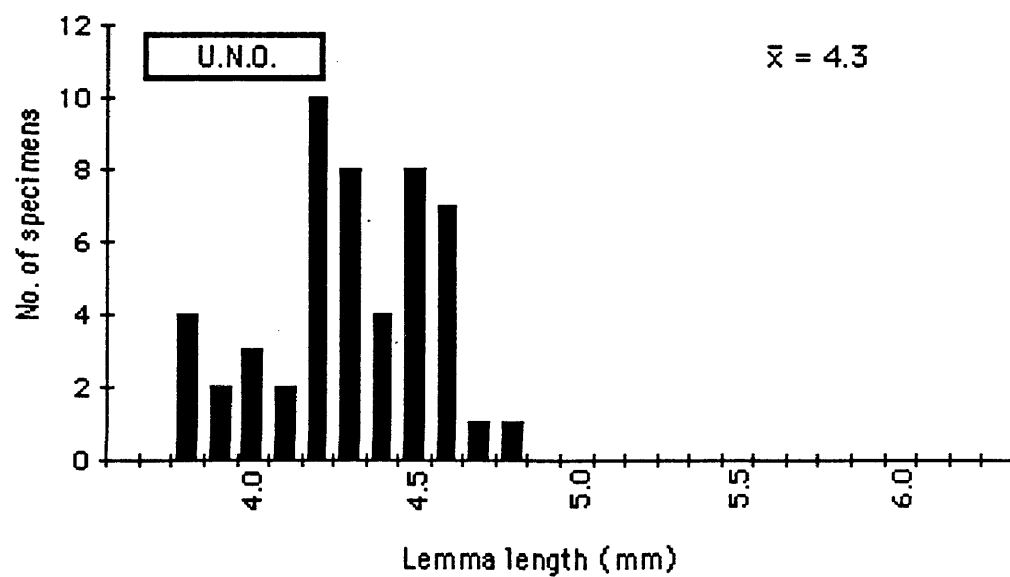
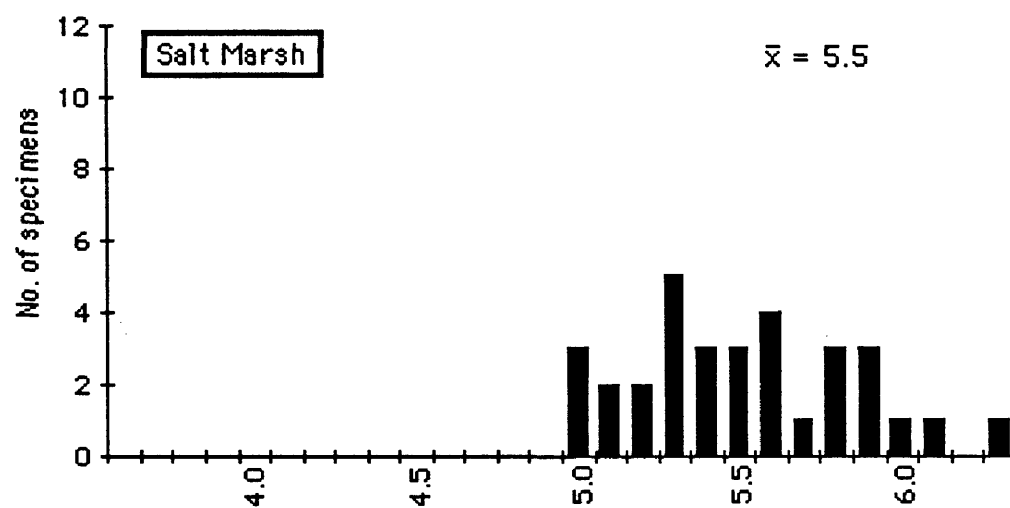
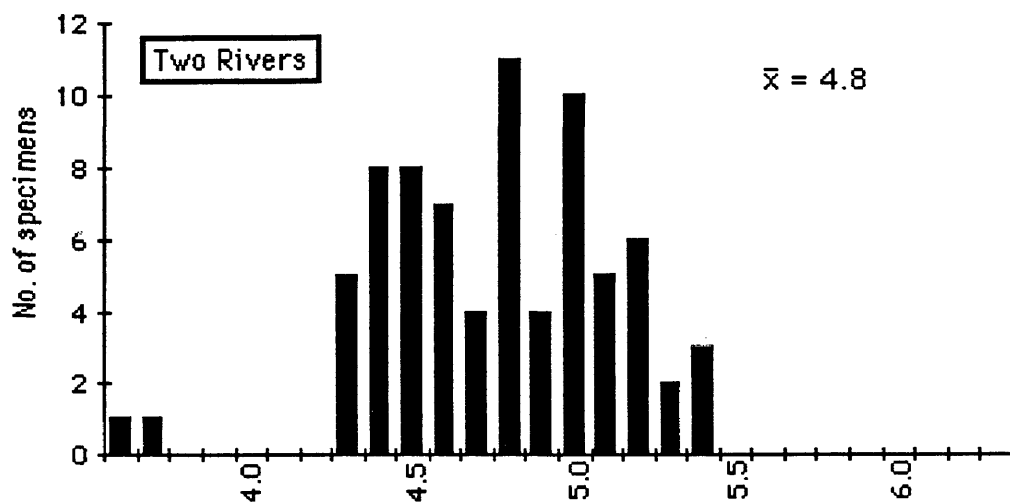
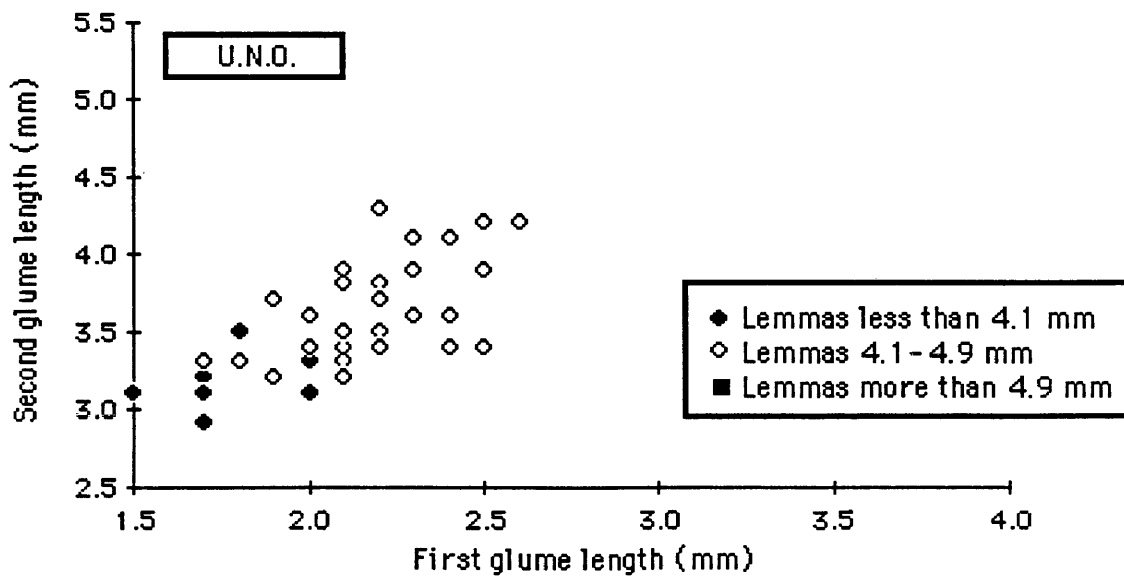
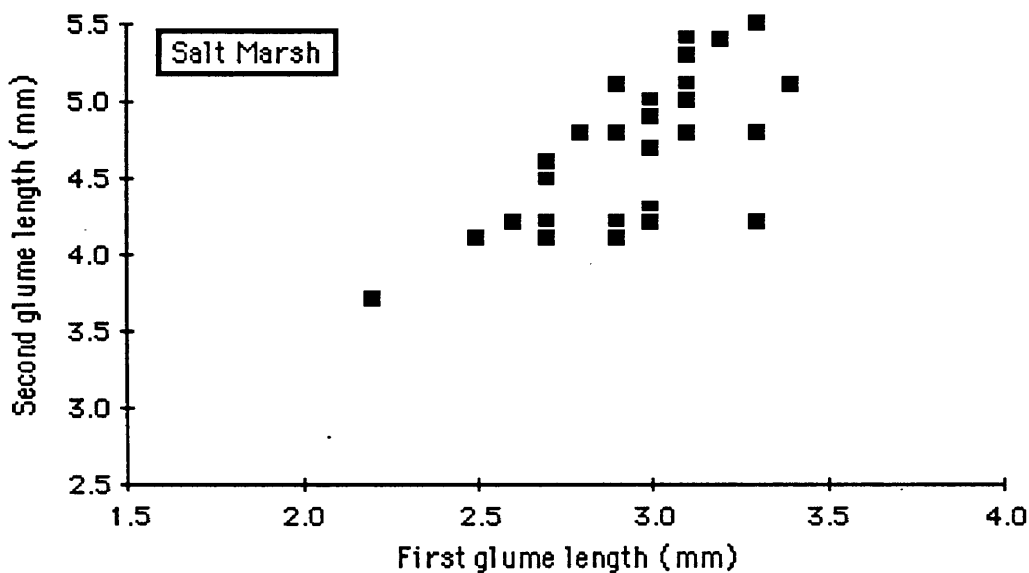
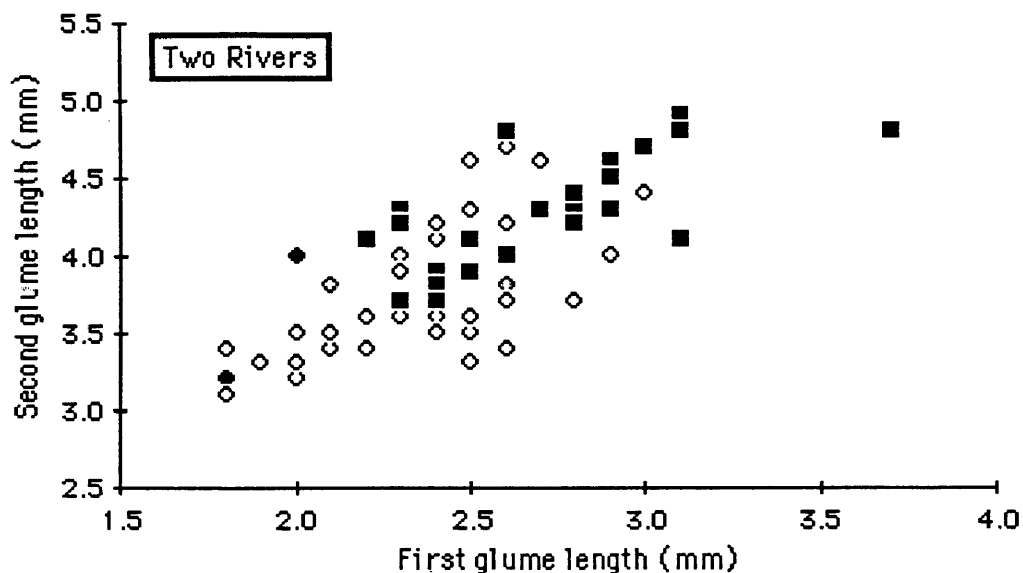


Figure 6. Scatter diagrams plotting first glume length vs. second glume length for the Two Rivers, Salt Marsh, and U.N.O. populations, with lemma length categories indicated by symbols.



assignable to one species or the other based on glume length.

When the characteristics were combined in a hybrid index, each population was again shown to be distinctively different (Table II, Fig. 7). The hybrid index for the Two Rivers population assigned only one specimen to L. fascicularis and nine specimens to L. acuminata, the remaining 65 plants being intermediates. The Salt Marsh population had 21 plants assignable to L. acuminata, none to L. fascicularis, and the remaining 11 as intermediates. Four plants from the U.N.O. population were assigned to L. fascicularis, none to L. acuminata and the remaining 46 as intermediates.

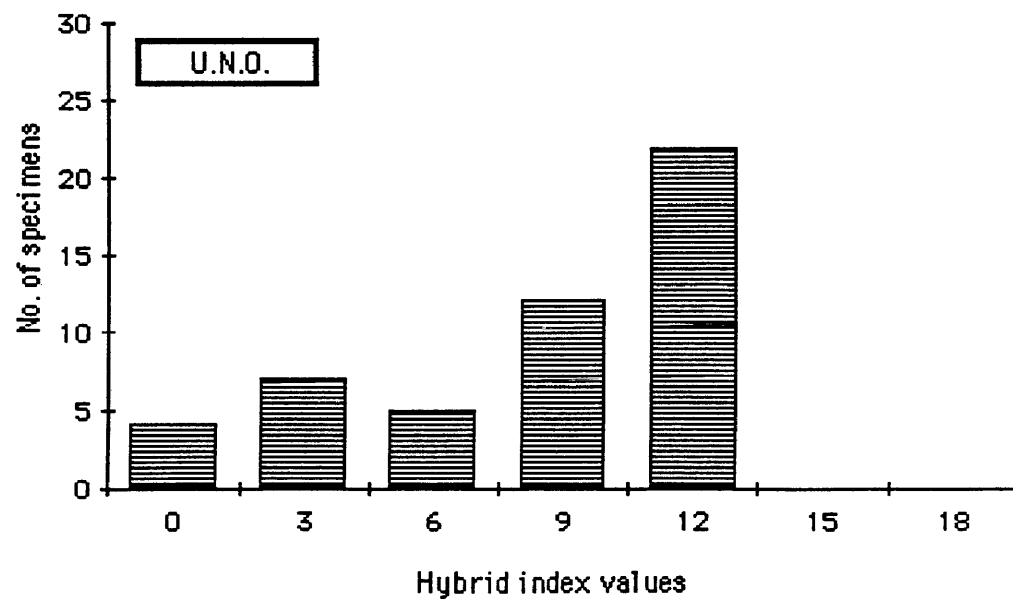
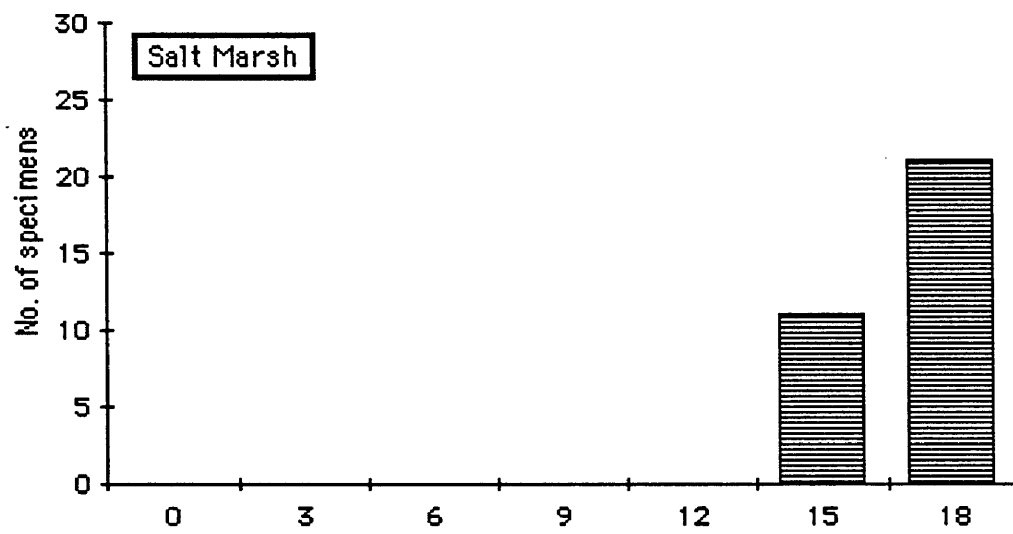
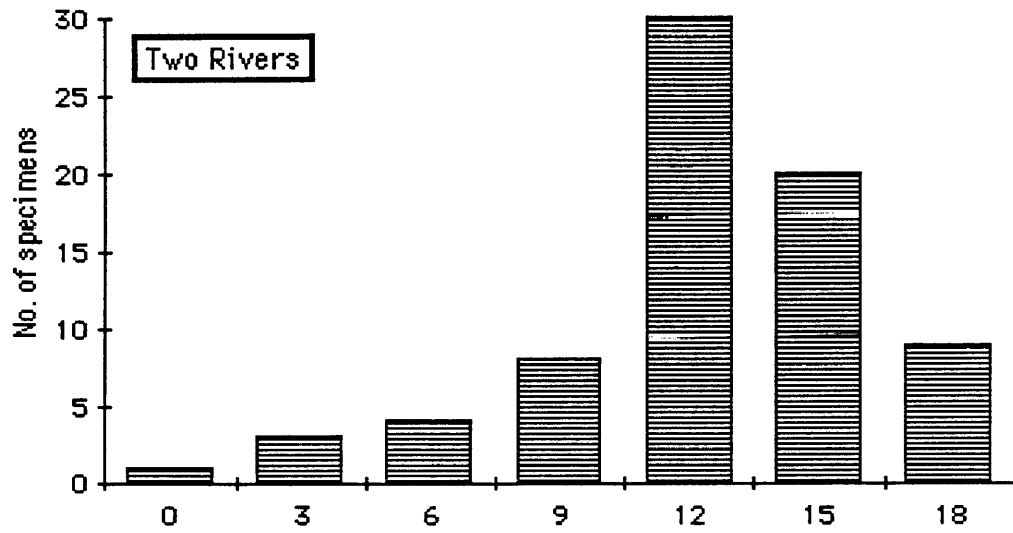
Using glume and lemma lengths, the Leptochloa complex in the Great Plains appears to represent a single taxon, but with individual populations significantly different from other such populations. Authors basing the separation of species on data obtained from a small number of small collections (Dore and McNeill 1980, McNeill 1979, Mohlenbrock 1973) may not observe the continuous range of variation that occurs in reality. Though the number of populations sampled is not reported by Fernald in his separation of the taxa, it would appear that he may have based his separations on a few populations as evidenced by the large number of intermediate individuals collected for this study. This study indicates that local populations may differ markedly from each other, even when the geographical distance between them is not great and particularly when populations exhibit a high frequency of cleistogamy. Adequate sampling of a sufficiently large number of populations is needed to separate plants accurately into different taxa.

Table II. Measurements used and index values assigned in the construction of the hybrid indices in Figure 7.

HYBRID INDEX VALUES			
CHARACTER	INDEX VALUE 0	INDEX VALUE 3	INDEX VALUE 6
First Glume Length (mm)	< 2.0	2.0	> 2.0
Second Glume Length (mm)	< 3.5	3.5-4.5	> 4.5
Lowest Lemma Length (mm)	< 4.0	4.0-5.0	> 5.0
Total Index Value	0	3 - 15	18
Species Designation	<u>L. fascicularis</u>	intermediate	<u>L. acuminata</u>

Figure 7. Hybrid index plots for the Two Rivers, Salt Marsh, and U.N.O. populations combining first glume length, second glume length, and lemma length. See Table II.





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