

XYRIS (XYRIDACEAE) OF THE CONTINENTAL UNITED STATES AND CANADA

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The family Xyridaceae comprises two genera of rushlike perennial or annual herbs, primarily aquatic or of high hydroperiod soils. One genus (*Abolboda*, 10 supp.) is tropical American. The other genus, called *Xyris*, has approximately 190 species of which a majority is pantropical. Little economic importance attaches to the family; a few are used as aquarium subjects (Lawrence, 1951) and the seed of a few are used by game birds such as turkey.

This treatment is of 22 entities, all occurring naturally within the area comprising the United States and Canada, all within the section *Xyris* (*Euxyris*, Endl.) which is distinguished primarily on the basis of a one-celled, 3-parietal ovulary. Some argument (unpublished) presently exists as to whether *X. elliotii* rightfully belongs within this section in that it has been observed to have free-central placentation. However, my own observations of this species have been that the placentae are attached to the ovary wall at the base of the ovulary, departing from it above the midpoint to intrude into the cell. It is also true that the placentae of other *Xyris* will on drying, separate from the upper wall of a ripe capsule; therefore this treatment is of only the one section.

Several studies of North American *Xyris* have been made, the most comprehensive being done by Malme (1913 et al.), with several helpful, though more local, ones being done by Elliott (1824), Chapman (1860 et al.), Ries (1892), Harper (1903 et al.), Small (1903 et al.), Fernald (1950), Gleason (1952), Blomquist (1955) and others. To a reader who has had considerable field experience with species of *Xyris* it quickly becomes apparent that the writings of A. W. Chapman on the subject are best, in that they are based upon the most first hand observation. In fact it becomes evident that field observations of North American Xyrids are more the exception than the rule in published treatments, including those of Malme.

The present work began with a treatment of the Florida *Xyris* (1960), which was to serve as a partial base for this somewhat more comprehensive approach. Since then, many hundreds more specimens have been collected by the writer within an area extending from New Jersey south to the tip of Florida and west in the Coastal Plain into Texas; many more, including type specimens and photographs of types, were obligingly made available by the curatorial staffs of the following institutions (whose symbols are those suggested by Lanjouw and Stafleu, 1964): BM, British Museum of Natural History, London; CHARL, the Charles-

ton Museum, Charleston, S.C.; FLAS, the Herbarium, Agricultural Experiment Station, Gainesville, Florida; FSU, the Herbarium, Florida State University, Tallahassee, Florida; GH, Gray Herbarium of Harvard University, Cambridge, Mass.; K, the Herbarium, Royal Botanic Gardens, Kew, Great Britain; NY, the New York Botanical Garden, New York, N.Y.; P, Museum National d'Histoire Naturelle, Laboratoire de Phanerogamie, Paris, France; PH, Academy of Natural Sciences, Philadelphia, Pa.; SMU, Herbarium of Southern Methodist University, Dallas, Texas; US, the U.S. National Museum, Smithsonian Institution, Washington, D.C.; VDB, Vanderbilt University, Nashville, Tenn.; WIS, Herbarium of the University of Wisconsin, Madison, Wisc. The fine private collections of Mr. F. H. Sargent and of Mr. S. McDaniel were also examined.

It is a pleasure to acknowledge the assistance of the following people: Dr. L. H. Shoiners, Southern Methodist University, who has made available to me not only working space and herbarium facilities but a wealth of competent criticisms and suggestions; Professor Joseph Ewan of Tulane University and Professor Samuel W. Geiser of Southern Methodist University, for their kindnesses in suggesting the whereabouts of type specimens and the possible itineraries of some of this country's nineteenth century naturalists; Dr. Alicia Lourteig, Museum National d'Histoire Naturelle, Laboratoire de Phanerogamie, for her kindness in making comparisons of recently collected specimens of *Xyris* with type specimens. Latin diagnoses of new taxa have been provided by Dr. Shoiners.

Thanks are extended also to the directors and curators of the institutions mentioned above for their cooperation in lending specimens or providing photographs of type specimens.

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HISTORICAL ACCOUNT

The genus *Xyris* was proposed by Linnaeus (Sp. Pl. I: 42. 1753), and is based upon the name *X. indica*. Unfortunately the specific epithet is based upon discordant elements, one North American and represented by a species collected by Clayton (at BM) and by Kalm (at LINN), the other East Indian (Fl. Zeyl. 35). The first person clearly to state the problem was Sir J. E. Smith (in Rees' Cycl. 39, 1818) who designated the East Indian entity as the Linnaean type while assigning the name *X. torta* to the material collected by Clayton and Kalm. Argument as to the validity of this solution exists today (Keepers' correspondence of 7 May, 1963, from Mr. John Lewis, British Museum, in regard to specimen *Clayton 219*) and therefore a more detailed explanation will follow the treatment of *X. torta* in this work.

The first post-Linnaean addition to nomenclature of North American *Xyris* was that of Walter (1788:69) and the only species described in "Flora Caroliniana" is *X. caroliniana*:

caroliniana 1. Fol. gladiatis, scapo longo, floribus
luteis, filamentis latis barbatis, Stylo
trifido patulo, longitudine stamin-
um. Stigmatibus capitatis.

According to Rendle (1899), the specimen upon which the above description was based is not among the Walter specimens at BM. Rendle strongly implies that such a specimen is no longer extant. It is certainly true that the brief description written by Walter could well be applied to very many species within the range of this treatment. However, there is deposited in the Lamarck Herbarium at P a specimen sent by Fraser to Lamark, presumably the very same plant examined by Walter. According to Dr. Lourteig, this specimen matches perfectly with a specimen of *X. flexuosa* (Demaree 32511) sent to her for comparison. Therefore, however brief and inconclusive the description of Walter, the name *Xyris caroliniana* appears to be adequately typified in the form of a specimen of what most North American authors currently call *X. flexuosa*.

The next pertinent work was that of L. C. Richard (Act. Soc. Hist. Nat. Paris I: 106. 1792), which contains a description of *X. jupicai*. While the type is from South America (Cayenne), the species is well represented in the southern United States as a weed of wetlands.

In 1803, two species of *Xyris* were treated by Michaux in his "Flora." The first was *X. brevifolia* Michx., a photograph of the type of which is before me; the second was *X. jupicae*, which appears from the description to be the same as *X. jupicai* Richard, the type for which is at the Paris Museum.

Two species, *X. brevifolia* Michx., *X. anceps* Pers., are cited and one, *X. flexuosa* proposed in Muehlenberg's "Catalogus Plantarum" (1813). *X. anceps* is here considered in the synonymy of *X. jupicai*, *X. flexuosa*, it develops, is a superfluous name for the Walterian *X. caroliniana*.

The work of Elliott (1816) is significant in that it contains descriptions of two new species, *X. fimbriata* Ell. and *X. juncea* Baldw. Original material of both still exists in the Elliott Herbarium at Charleston. However the latter name was found by Schultes (1822) to be a later homonym, thus the species is presently known as *X. baldwiniana* Schultes.

When Smith (l.c.) described one of the discordant Linnaean elements of *X. indica* as *X. torta*, he designated two specimens as examples, both of which are of the same species which rarely ranges into the southeastern Coastal Plain east of the Mississippi River. Subsequent authors were to confuse it with an exclusively Coastal Plain species, here treated as *X. caroliniana*.

The study of *Xyris* by Kunth (1843) includes several detailed descriptions of North American Xyrids together with a detailed diagnosis of a new species, *X. ambigua*, written by its discoverer, Beyrich.

1860 marks the date of publication of the first edition of Dr. Chapman's "Flora of the Southern United States," by far the greatest contribution

to our existing knowledge of North American *Xyris*. Chapman, residing at Apalachicola, Florida, which is in one of the finest regions of the U.S.A. for the genus, submitted descriptions of nine new species. Prior to this time no workers had had quite the wealth of field experience with *Xyris* in the United States; thus it is unfortunate that some of Chapman's acute comments, particularly in regard to habitat and flowering, were ignored later by less experienced workers. It is also unfortunate that some of Chapman's concepts were expressed only as label names in that these, inadmissible under the Code, add somewhat to the task of designating types.

A diminutive, coldwater bog species of the northern United States and southern Canada (*X. montana*) was described by H. Ries in 1892. Shortly thereafter (1895) G. V. Nash described the southern *X. smalliana* and R. Harper (1903) discovered the endemic *X. scabrifolia*. The most current comprehensive treatments were those of Malme (l.c.) who described an additional species, *X. drummondii*, together with some varieties of previously recognized species. Malme's final revision of North American *Xyris* (North American Flora 19: 1937) was based strictly on herbarium specimens; the difficulty of applying it to living specimens or to the now much vaster reservoir of collections of *Xyris* is actually the provocation leading to this paper.

MORPHOLOGY

All remarks on the morphology of *Xyris* are based solely on a study of living material of the species treated below, and thus are not intended to be general.

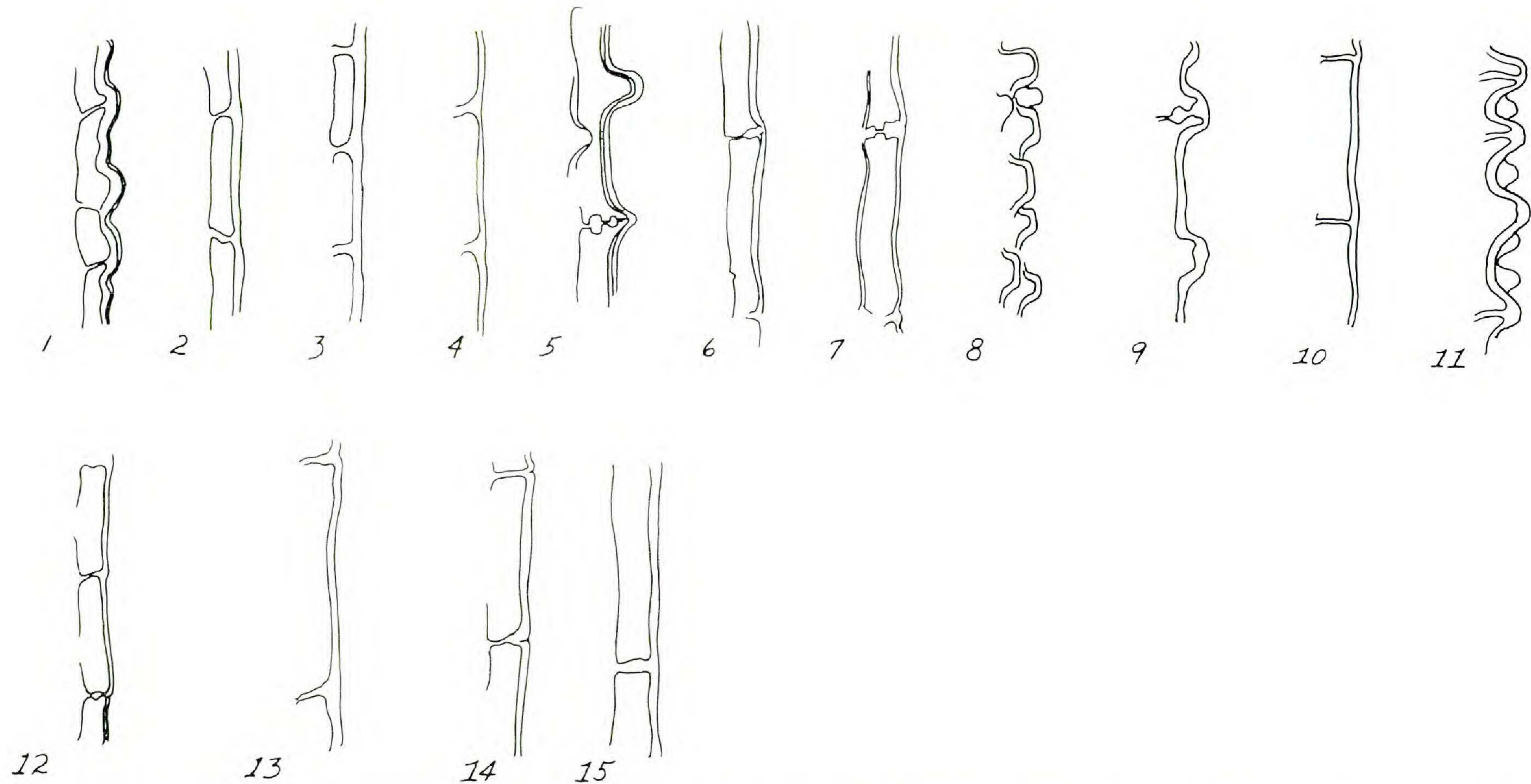
Habit. Barring drought or drainage of the wetlands which *Xyris* frequents, all of the entities treated below are at least short-lived perennials. However a considerable number of species increase prodigiously on disturbed habitats which are, of course, the most likely to drastic fluctuations in soil water. Drying out of the habitat, unless severe and long lasting, usually does not keep a current crop of *Xyris* from setting seed, but the otherwise perennial plants will die in that no overwintering buds are produced; hence the reason for assignment of an annual habit to some soft-based species by some authors. Species such as *X. jupicai*, whose latitudinal range in the United States is from Florida to at least New Jersey may be annual to the north, perennial in the south (Blomquist 1955). Perennation is by means of lateral, overwintering buds. These are most often produced in pairs, one axillary bud, from each of two approximate nodes, and are generally concealed by the dead and living leaf bases of the parent plant; often they are large enough to be called "bulbs." A rhizomatous habit has been attributed to at least one entity, *X. montana* Ries. However, I have observed specimens of *X. baldwiniana*, *X. drummondii*, and *X. elliottii* whose caespitose bases, having been buried in wash or peat, have responded by an elongation of internodes to produce ascending, rhizome-like structures. It would

therefore appear that anything like a rhizome in this complex is actually a habitat reaction!

Roots. The root system of *Xyris* is not extensive, being shallow and unbranched. An individual root is somewhat similar to that of some orchids, being fleshy. When the plant bases are buried, some species will respond by developing roots on the buried nodes.

Leaves. The leaves of *Xyris* are equitant, distichous, even on the seedlings. The two margins of the equitant portion are usually very thin, or hyaline; these converge to form one margin of the linear blade, the midrib forming the other margin. Such is not uncommon in the monocots (i.e. many Iridaceae, such as *Iris*, *Gladiolus*). Inasmuch as the blade margins themselves may be thin, or thickened-cartilaginous, smooth, papillose, or scabrid, this portion of the leaf provides a taxonomic character of use (see Fig. 1). Surfaces of the leaves vary from smooth to papillose or scabrid. In some of the species (e.g. *X. platylepis*) the stomata are raised, and the oblong guard and subsidiary cells therefore could be confused with papillae. However, genuine cellular protuberances do exist, usually appearing in short, transverse or diagonal lines (see Fig. 2), which appears to be most concentrated along the end-walls and cell-corners. Such deposits take the form of tubercles, or domes; they are clear and quite hard, and account for the roughened or "glazed" appearance of foliage of such species as *X. scabrifolia*, *X. difformis* (vars.), *X. serotina*. The bulk of the epidermis of the *Xyris* leaf is made up of chains of cells whose long axis parallels the leaf blade, interspersed with shorter guard and subsidiary cell-pairs. My own, still limited, studies of epidermal peels of *Xyris* may be an indication that further work with epidermal peel characters of the species might be of taxonomic value in that size of cells, thickness of cell walls, and shape and frequency of guard and subsidiary cells do differ between complexes of species. Detailed internal analyses of *Xyris* leaves have been done by Malme (1913), Carlquist (1960), Smith and Downs (1960) and have thus become much a part of the taxonomy of South American Xyrids.

Bases of leaves of *Xyris* are often specifically different. In one group containing such species as *X. flabelliformis*, *X. jupicai*, *X. smalliana*, *X. fimbriata*, *X. difformis*, and *X. longisepala*, the leaf bases are dilated, but are thin and soft, also definitely keeled; the scale-like overwintering bud leaves are elongate. In another group containing such species as *X. ambigua*, *X. stricta*, *X. scabrifolia*, *X. platylepis*, *X. caroliniana* and *X. torta*, the leaf bases are not only dilated but considerably thickened, in the aggregate, the overwintering bud leaves are shorter, fleshier. Still another group of species including *X. baldwiniana*, *X. elliotii*, *X. drummondii*, *X. brevifolia* and *X. isoetifolia*, have hard, somewhat thickened or leathery, but definitely not bulblike aggregations of leaf bases; the overwintering bud leaves are elongate. The backs of the leaf-bases of both these latter categories are rounded. Especially longlived species



LEAF MARGINS OF XYRIS, AT MID-LEAF. From fresh material. 1. *X. stricta*. 2. *X. caroliniana*. 3. *X. smalliana*. 4. *X. platylepis*. 5. *X. difformis* var. *curtissii*. 6. *X. difformis* var. *difformis*. 7. *X. jupicai*. 8. *X. ambigua*. 9. *X. fimbriata*. 10. *X. elliottii*. 11. *X. serotina*. 12. *X. baldwiniana*. 13. *X. iridifolia*. 14. *X. scabrifolia*. 15. *X. torta*.

such as *X. elliottii*, *X. baldwiniana*, *X. isoetifolia*, may produce enormous clumps of plants whose flowering scapes may total in the hundreds.

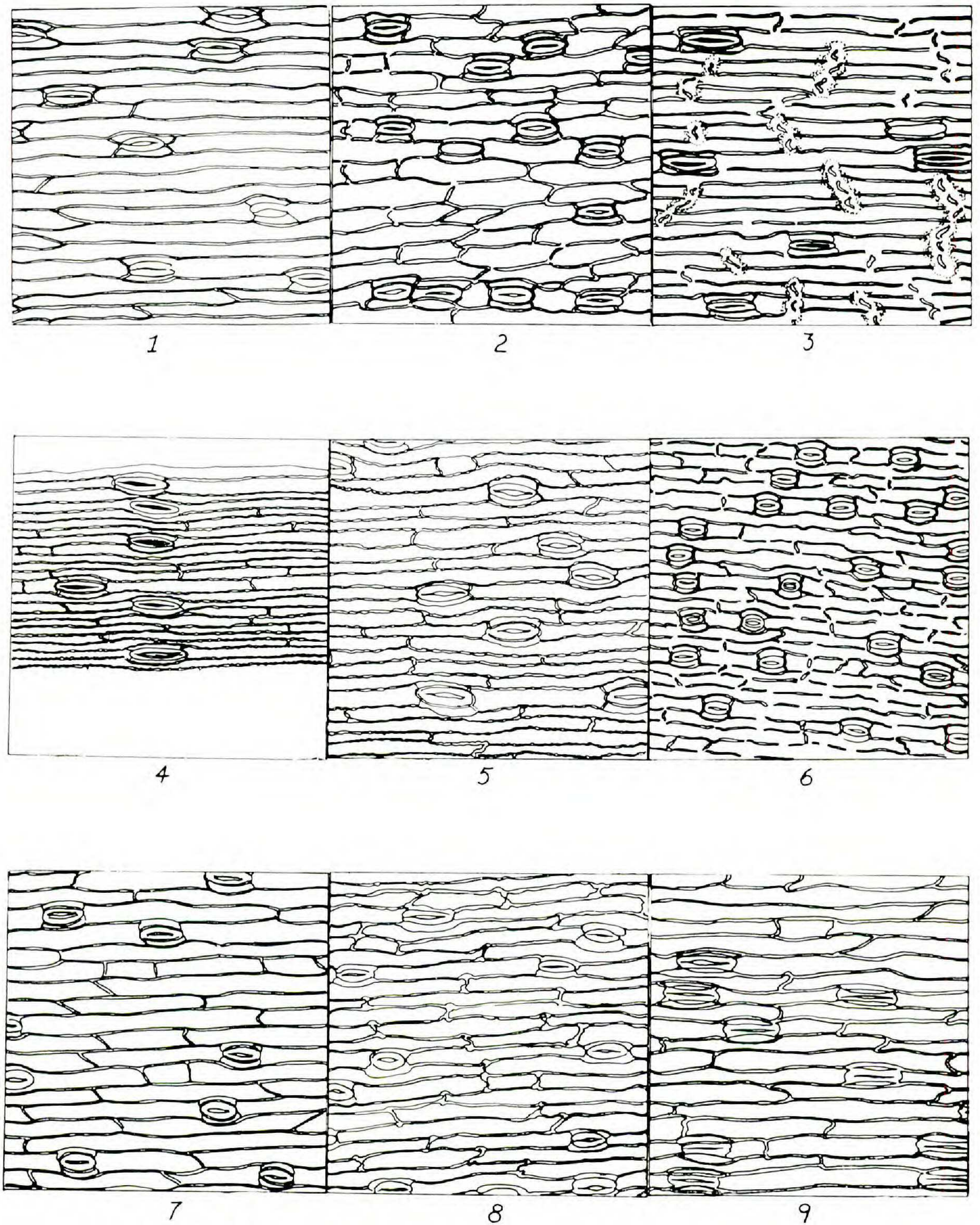
The seedling leaves of all *Xyris* could be useful in distinguishing between species complexes, sometimes even species (see p. 198). The leaves are, in most, flabellately arranged, but there are surprising differences in shapes, length, and pigmentation.

Pigmentation of leaves may be of inestimable taxonomic value in *Xyris*. This character may differ between otherwise very similar species and it fortunately does persist for a fairly long time on herbarium specimens. The most conspicuous pigment is in the red range and when present appears to be concentrated in short chains of elongate cells which are liberally deposited longitudinally throughout the leaves. Such pigments are also present in the scapes. Where present in association with chlorophyllous tissue they tend to darken the green of the foliage; however, they are most noticeable in the lower parts of leaves where the masking chlorophyll is less (i.e. *X. difformis* & vars., *X. platylepis*, *X. smalliana*, *X. flabelliformis*, *X. iridifolia*).

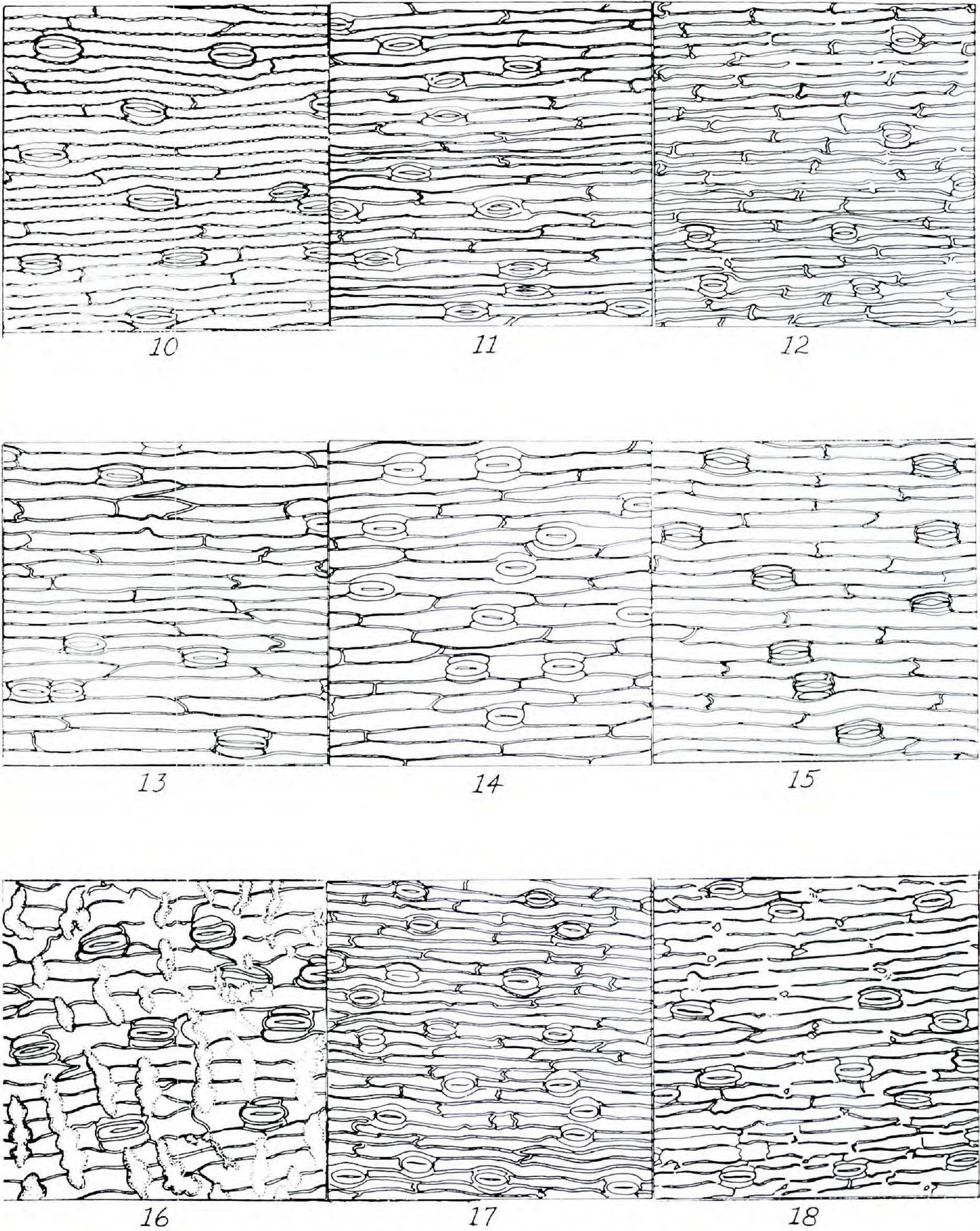
Scape. The scape of *Xyris* is characteristically longer than the leaves, its lower portion sleeved by an inner leaf. The lower portion of a scape is twisted, usually subterete, with many low, longitudinal, (siliceous?) clear, hard ridges but the upper part in most species (save *X. baldwiniana*, *X. flabelliformis*, *X. brevifolia*, *X. torta*, some *X. difformis*) tends to flatten and have less, but more conspicuous, ridges. The epidermis and pigmentation of the scape will be similar to that of the foliage leaves, except that the lines of cells comprising the scape-ridges will generally have thicker end-walls, often produced outward into tubercles or papillae. In some species (e.g. *X. fimbriata*) these projections are large enough to make the scape edges harsh to the touch.

Inflorescence. The inflorescence of *Xyris* is a cone-like spike comprised of spirally arranged, imbricate, tough, bracts, all but the lowermost subtending a flower. I have found that shape of spike is a fine field characteristic but that it must be used with care in herbarium studies. Drying and pressing tend to distort spike shapes and to change the colour of the bracts.

Bracts. Bracts of *Xyris* are characteristically broad, thickest toward the midrib, thinnest at the margin. Bract apices may be entire or lacerate. The concave inner surface is usually brown and very lustrous; the outer surface shows two zones consisting of a subapical, elliptic, rectangular, ovate or triangular "dorsal area" which is green at flowering time in contrast to the rest of the surface of the bract which ranges in colour from tan to dull-brown or reddish-brown. However, any comment on colour character of outer surfaces of bracts ought to be accompanied by a statement about age of the bract. It is of interest that the dorsal area is most prominent on the lowermost, barren bracts. Here it may protrude (*X. drummondii*) from the bract apex as a cusp or mucro,



EPIDERMAL PATTERNS OF XYRIS, AT MID-LEAF. From fresh material. 1. *X. torta*. 2. *X. difformis* var. *curtissii*. 3. *X. serotina*. 4. *X. elliottii*. 5. *X. caroliniana*. 6. *X. brevifolia*. 7. *X. iridifolia*. 8. *X. smalliana*. 9. *X. baldwiniana*.



EPIDERMAL PATTERNS OF XYRIS, AT MID-LEAF. From fresh material. 10. *X. equisetifolia*. 11. *X. jupicai*. 12. *X. stricta*. 13. *X. difformis* var. *diformis*. 14. *X. platylepis*. 15. *X. fimbriata*. 16. *X. scabri-folia*. 17. *X. ambigua*. 18. *X. flabelliformis*.

or it may even assume a somewhat foliar character.

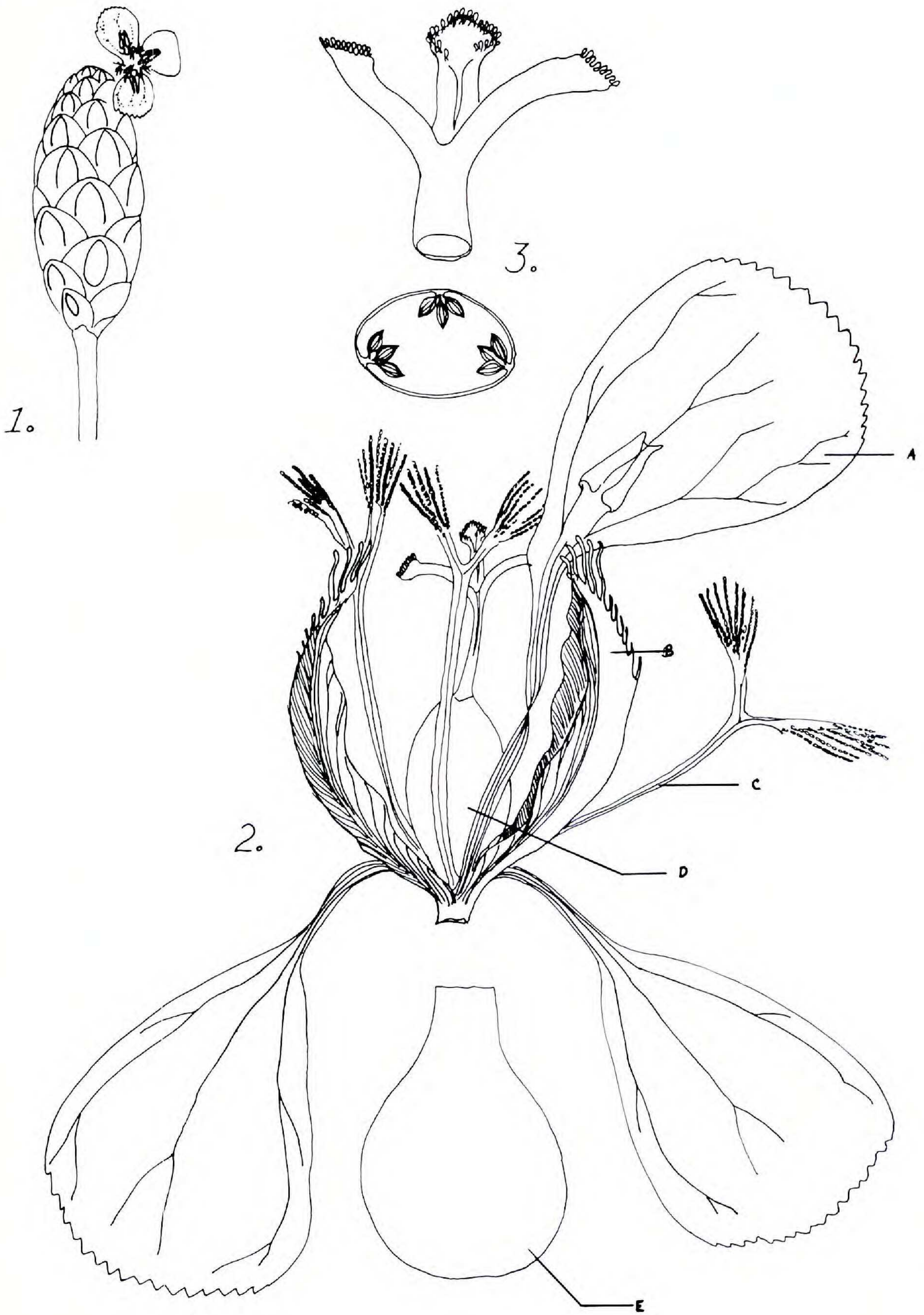
Flower. The flower of *Xyris* is zygomorphic, perfect, trimerous (see p. 187). The corolla itself is actinomorphic, ephemeral in that it lasts but for a part of a day. The commonest flower colour is yellow, but there are white-flowered forms of *X. caroliniana*, *X. platylepis*.

Sepals. *Xyris* flowers have 3 sepals, of which the outer is almost membranaceous, forming a translucent covering for the rest of the flower in the bud, disarticulating at anthesis. The inner two, called "lateral sepals" oppose each other, finally clasping the ripened capsule. The character of the lateral sepals has long been considered of paramount taxonomic importance. Each sepal is boat-like (see pp. 189-193), with thin or membranaceous sides and a thicker, narrow or relatively broad, keel. However in some species (*X. difformis*, *X. jupicai*, *X. smalliana*, etc.) the margin of this keel is thin and the cells tend to fray irregularly. In others, more than one layer of cells is involved in the keel margin, from which individual cells or chains of cells may protrude or have narrow tuberculate or papillate protrusions (*X. torta*, *X. ambigua*, *X. flabelliformis*, *X. brevifolia*) which appear in 1, 2 or 3 rows along the keel margin. In other species relatively long chains of elongated cells may part from other cells of the keel, particularly toward its apex, to give it a fimbriate appearance (*X. caroliniana*, *X. fimbriata*).

Petals. The petals of *Xyris* are 3, plane, subequal, and separate to the very base. At anthesis each petal consists of a clawed base (see p. 187) which is concealed by the subtending bract and a broad, yellow or white, usually jagged-margined, limb which is exposed. An individual corolla is expanded for but part of a day, as already mentioned, but the *time* of day during which it is full varies from species complex to species complex. The petals are supplied by 3 traces which are simple to their point of juncture with the departure of the stamens, anastomosing beyond this point.

Stamens. Each flat petal claw shows 3 prominent traces which lead to the base of a functional stamen which is attached and whose filament departs from the base of the petal blade. The central trace supplies the short filament. Each anther is comprised of two thin-walled thecae which are slightly convergent apically. Occasionally, at the point on the petal where the lateral traces join the margins of the filament base, there may be short, flat protuberances of cells or small tufts of moniliform trichomes similar to those found on staminodia.

(*Opposite*) XYRIS CAROLINIANA. 1. Spike with single flower at anthesis. 2. Flower: (A) petal, (B) lateral sepal, (C) staminodium, (D) gynoecium, (E) outer sepal. 3. (above) Upper portion of style showing three branches, stigmatic areas. (below) Cross section through ovul-ary.



Staminodia. Alternating with the petals and just inside them on the receptacle is a cycle of 3 staminodia, the filaments of which are flattened and bear a single trace. At about the level of the anthers each staminodial filament branches into 2 blades, the trace likewise forking at this junction. Each blade is slightly folded and keeled, the concave side pointed outward; strands of cells comprising the blade separate from it along its edges to form long, usually moniliform, trichomes which are remarkably similar in character from species to species. The only exception to the above-described staminodia lies in *X. baldwiniana*, whose staminodia are reduced and beardless.

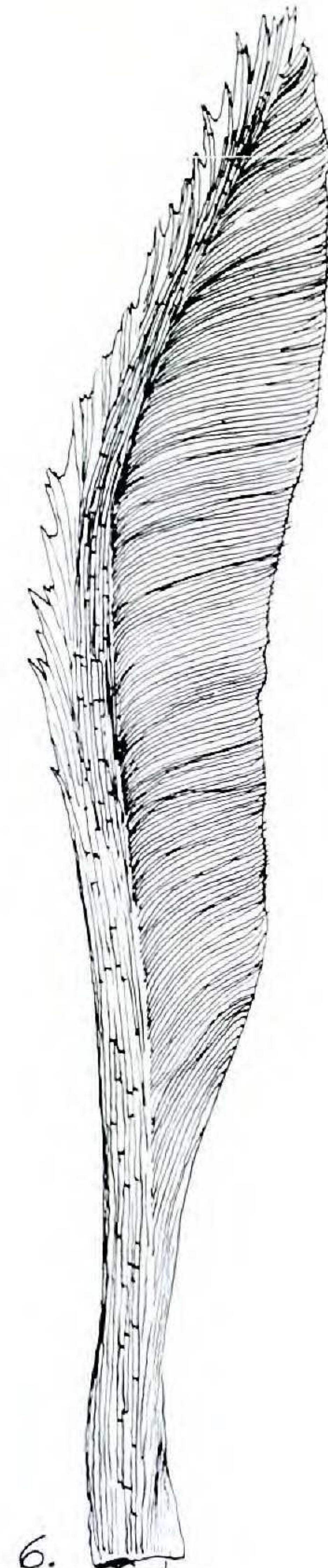
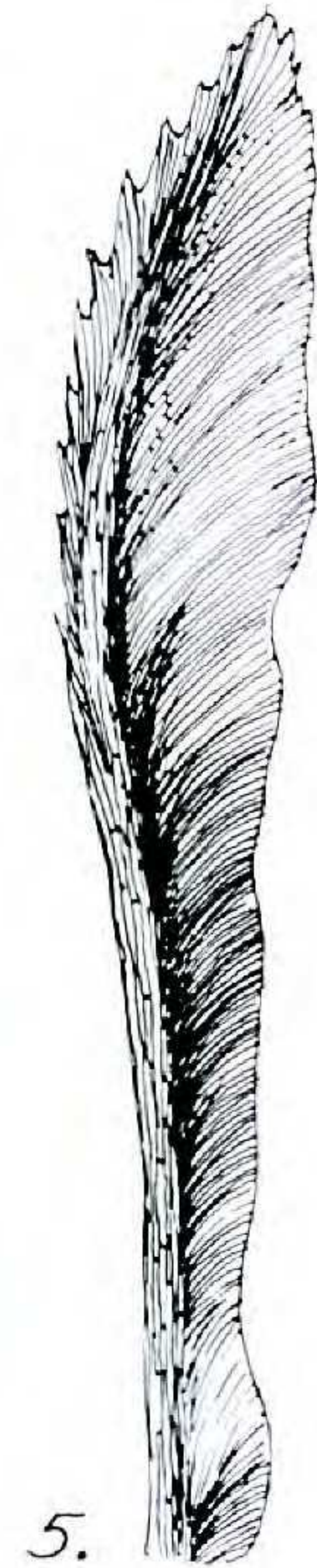
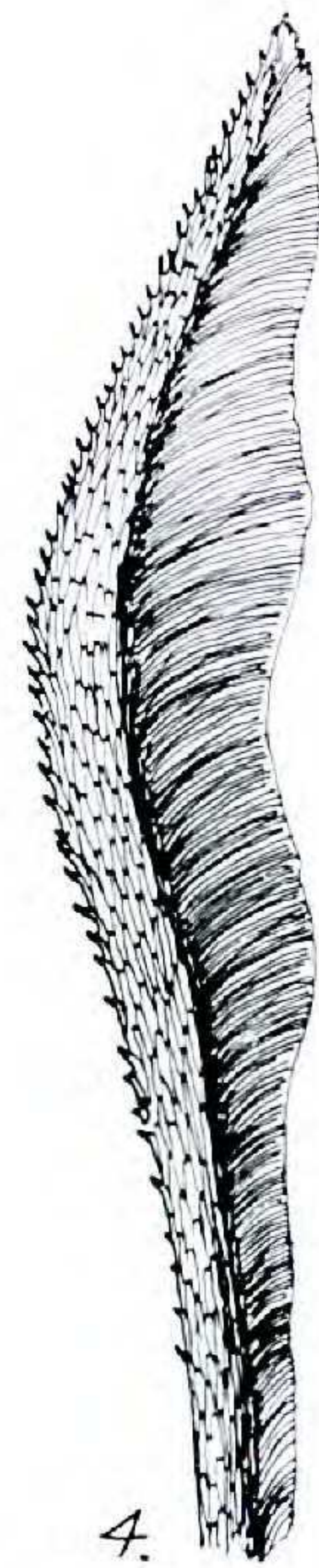
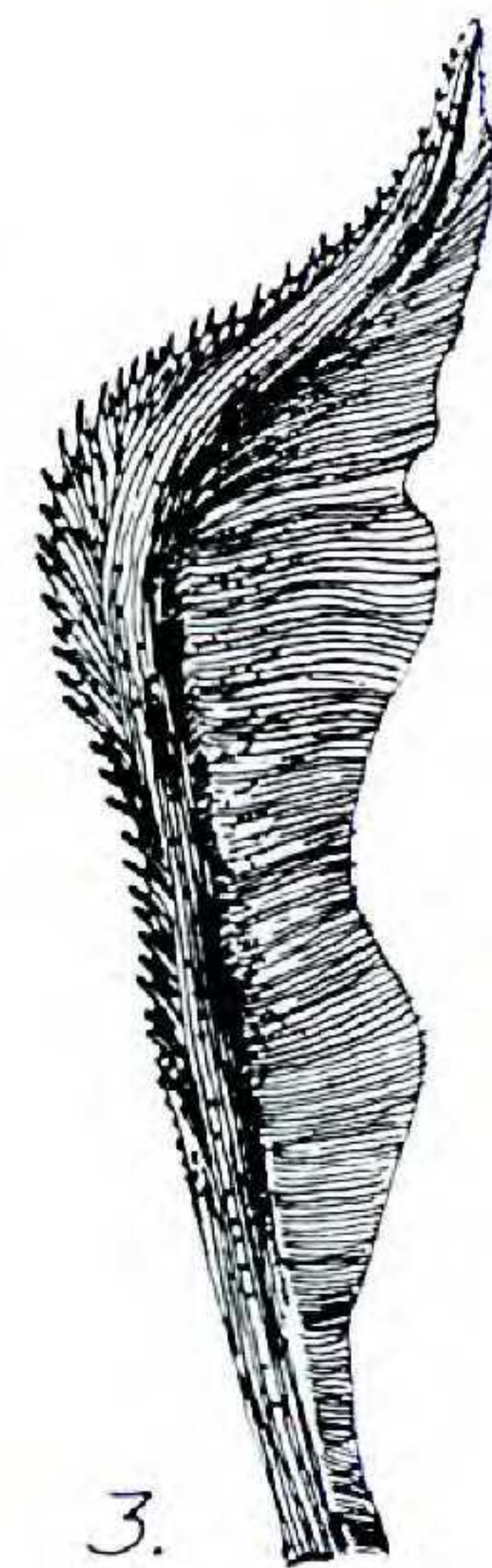
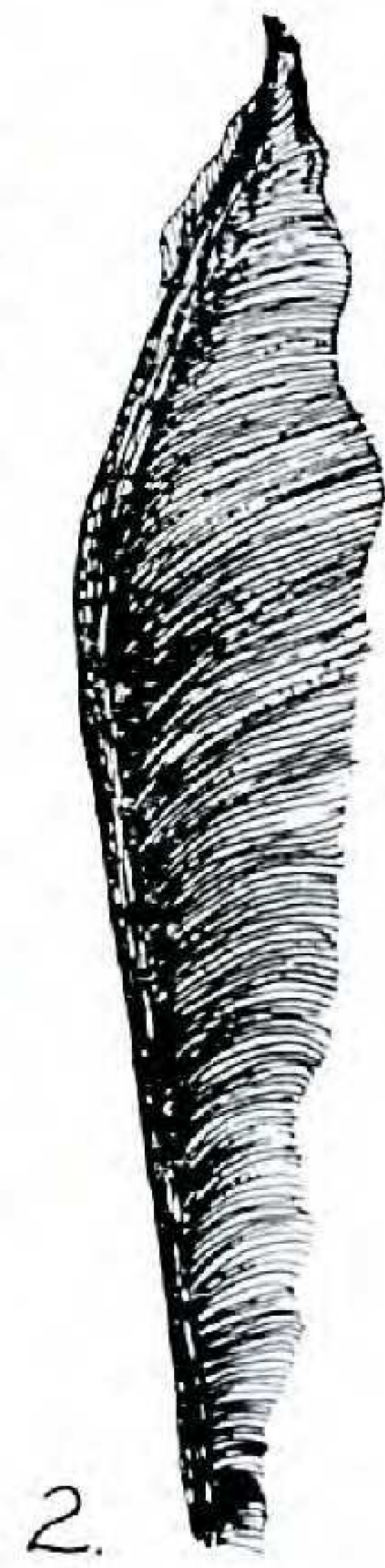
Carpels. Our *Xyris* have 3 carpels which comprise a single, unilocular ovary and a hollow style which branches above into 3 parts, each style-branch being conduplicately folded and cylindrical. Toward the very apex, the folded margins of a style branch are truncated to form a "U," the rim of which is lined with short, stigmatic, hairs. These are at approximately the same level in the flower at anthesis as are the anthers and the staminodial hairs. Placentation is 3-parietal, the placentae intruding and the funiculi of the abundant ovules variously elongate. Some question exists as to the mode of placentation in that placentae may intrude toward the summit of an ovulary (i.e. *X. elliotii*, *X. baldwiniana*, *X. difformis* var. *curtissii*) and in that the placentae themselves may separate from the ovary wall of the fruit.

Fruit. Fruit of *Xyris* is a thin walled capsule which may rupture irregularly or along placental lines. It is generally dorsiventrally compressed.

Seeds. The seeds of *Xyris* are minute, 1 mm. long or less, tending to be ovoid or narrower in outline. However, shape of seed is often dependent to a degree on crowding of seed within a capsule while length, relative width, and sculpturing of seed coat are independent of crowding. All *Xyris* seed have longitudinal lines whose character is diagnostic (see pp. 194-197). In some species the lines appear broad and flattened, under high magnification reminiscent of thick strips of tape (*X. caroliniana*, *X. fimbriata*); in others the lines are comprised of contiguous series of darker coloured, rod-shaped papillae or domelike processes of the testum (*X. ambigua*, *X. difformis*, etc.). Transverse lines, usually fainter than the longitudinal, are also evident in most species. Most *Xyris* seeds have translucent, yellowish or amber contents save for an opaque region near the embryo. However a few (*X. serotina*, *X. difformis* var. *floridana*, *X. iridifolia*, *X. stricta*) are darker, opaque throughout, and have varying quantities of a powdery or mealy (farinose) substance on their coats.

(Opposite) LATERAL SEPALS OF XYRIS. 1. *X. flabelliformis*. 2. *X. brevifolia*. 3. *X. drummondii*. 4. *X. isoetifolia*. 5. *X. baldwiniana*. 6. *X. elliotii*. 7. *X. torta*.

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Life History. Germination of seed seems to be independent of season, appearing to be triggered more by moist conditions, warm weather, and sunlight. I have gotten good germination of *Xyris* in February, April, June, as well as in the autumn months. In nature, seedlings in all stages of development may be found on a single locality, often forming a turf. The cotyledon is linear or strap-shaped, epigeal, green, erect or flattened against the substratum. The husk of the seed usually remains on the tip of the seed-leaf for many weeks after germination (see p. 198). In about a month's time small rosettes, usually fan-shaped, of five or more leaves are visible. Most of the species will flower within a year of seed sowing, so that a fall planted crop will usually be in bloom by the following summer; a few (i.e. *X. brevifolia*, *X. flabelliformis*, *X. jupicai*) may go from seed to flower in four months. Stock of *X. brevifolia* and *X. flabelliformis* was moved to the greenhouse in January 1963. By March of the same year it was in bloom and a crop of seed was removed the following month which itself was developed into seed-producing plants by August 1963.

Xyris may overwinter in the seedling stage or perennate by means of pairs of lateral buds which develop in the upper axils of the contracted stem. In several species (*X. torta*, *X. platylepis*, *X. scabrifolia*, *X. caroliniana*) these buds are bulb-like and the outermost scales never become photosynthetic. The inner scales, which are also fleshy, produce cusp-like prolongations which are highly meristematic and which finally elongate, become green, and plane out to become leaf blades. The central or parent plant dies as the lateral buds gain size and strength, often being brown long before killing frosts arrive. In all cases the pattern of growth appears to be forking, usually two daughter plants arising from the parent stem.

FLOWERING TIMES, POLLINATING AGENTS, CHROMOSOMES

Flowering Times. A majority of species of *Xyris* flower in the morning. *X. ambigua*, *X. elliottii*, *X. jupicai*, *X. difformis* and varieties, *X. baldwiniana*, *X. brevifolia*, *X. flabelliformis*, *X. drummondii*, *X. isoetifolia*, *X. iridifolia* and *X. torta* open their delicate flowers early in the morning and are usually closed toward midday. A few such as *X. fimbriata*, *X. stricta* and *X. serotina* open their flowers later in the morning and are usually closed toward early afternoon. However such species as *X. scabrifolia*, *X. caroliniana*, *X. smalliana*, *X. longisepala*, and *X. platylepis*, usually flower in the afternoon, with the exception of some forms of *X. caroliniana*.

(Opposite) LATERAL SEPALS OF XYRIS. 1. *X. caroliniana*. 2. *X. ambigua*. 3. *X. stricta*. 4. *iridifolia*. 5. *X. fimbriata*.



Season of Flowering. Short lived, weedy species such as *X. brevifolia*, *X. flabelliformis*, *X. jupicai* and *X. smalliana* may flower at any time of year if given adequate warmth and moisture. In fact, one species or another of *Xyris* is often in bloom throughout the year in southern peninsular Florida. However, there are definite *peaks* in quantity of blooms produced by a given species, and definite *sequences* of species coming into bloom on a given area. First to commence heavy flowering are *X. brevifolia*, *X. flabelliformis*, *X. baldwiniana*, *X. elliotii*, *X. torta*; this is usually in the spring, continuing to early summer. By early summer *X. caroliniana*, *X. isoetifolia*, *X. longisepala*, *X. smalliana*, *X. stricta*, *X. ambigua*, and *X. jupicai* are blooming and continue to bloom and set seed throughout the rest of the season. From mid summer until fall *X. drummondii*, *X. fimbriata*, *X. scabrifolia*, *X. difformis* (and *varieties*), *X. serotina*, *X. platylepis*, and *X. iridifolia* are in bloom.

Pollinating Agents. The only insects which I have observed visiting the flowers of *Xyris* are bees of the families Andrenidae, Bombidae. Their leisurely behavior (the smaller ones rolling around like little hogs in a wallow) would be an indication that the stops are for pollen. No nectaries are evident in the odourless flowers.

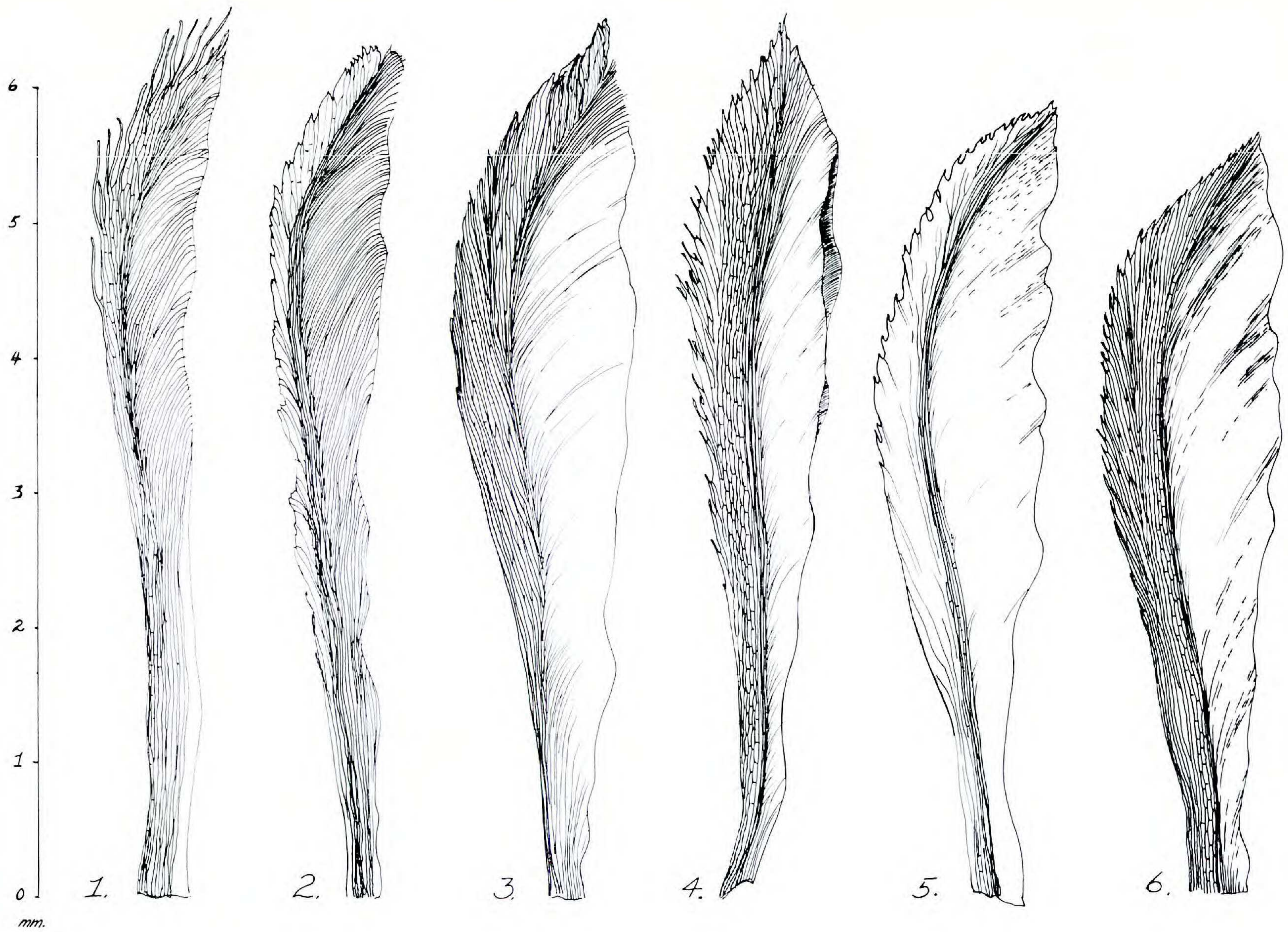
Chromosomes. Chromosome counts of all *Xyris* (save *X. longisepala*, *X. montana*) native to the United States have been done either by Lewis (1961) or myself. All of the samples thus far have shown a haploid count of 9, a diploid complement of 18, with no evidence of somatic doubling. My technique for making aceto-carminic smears permanent was that of Beeks (1955), which involves Hoyer's Solution. The handling of root tips was based on the double-staining technique first described by Snow (1963). Behavior of chromosomes in meiosis appears very similar from species to species, but there are differences in size of chromosomes, the smallest being found in short-lived, soft-based, species such as *X. brevifolia*, *X. flabelliformis*, *X. jupicai* (see pp. 199-203).

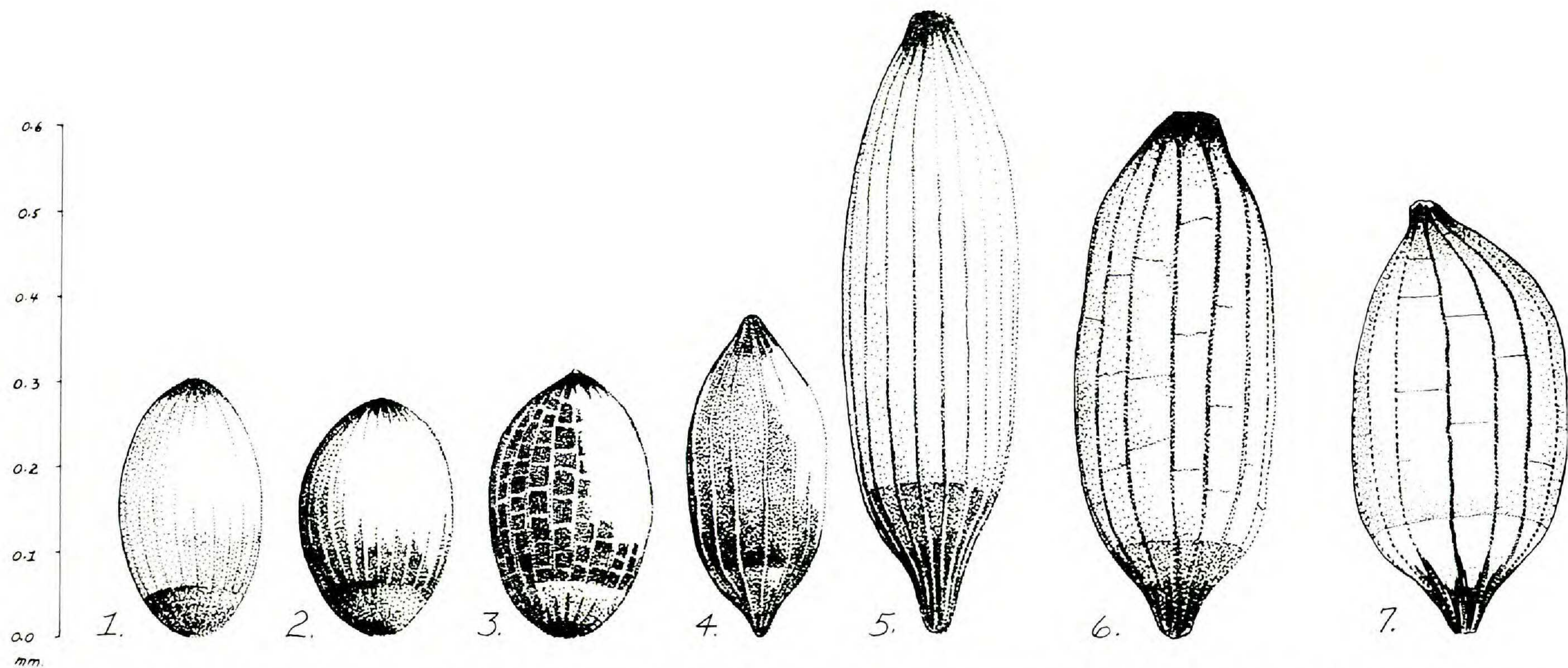
A list of specimens which serve as vouchers for my work is below:

Anther Smears: N equals 9

1. *Xyris ambigua* Beyr. FLORIDA. ESCAMBIA CO.: Kral 17728; WALTON CO.: Kral 19376. GEORGIA. MCINTOSH CO.: Kral 18750. LOUISIANA. OUACHITA PAR.: Kral 8060. NORTH CAROLINA. COLUMBUS CO.: Kral 19050.
2. *Xyris baldwiniana* Schultes. FLORIDA. ESCAMBIA CO.: Kral 17731; LIBERTY CO.: Kral 19316B. LOUISIANA. BEAUREGARD PAR.: Kral 20206B; VERNON PAR.: Kral 20080. GEORGIA. GRADY CO.: (from greenhouse stock of Kral 15507).

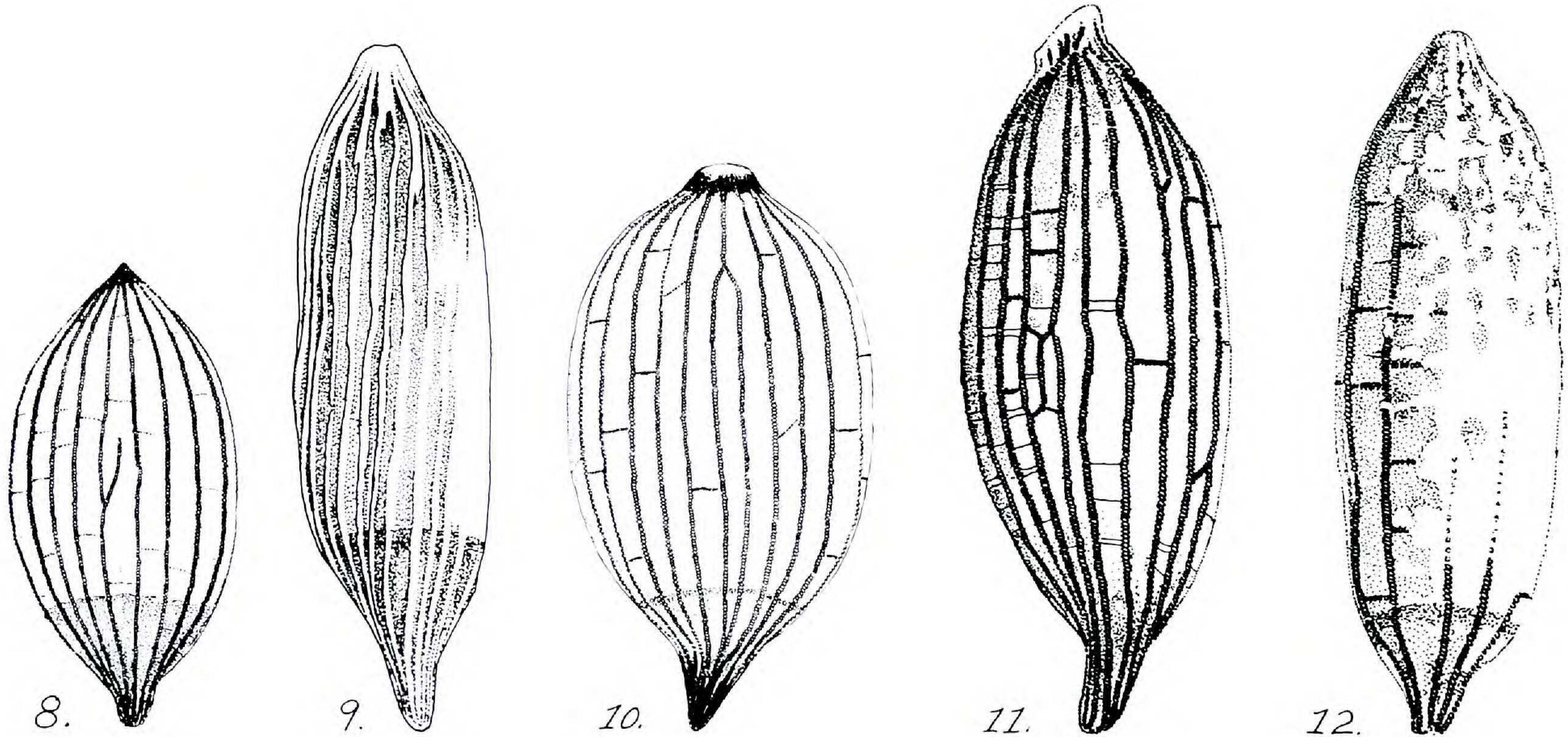
(Opposite) LATERAL SEPALS OF XYRIS. 1. *X. scabrifolia*. 2. *X. platylepis*. 3. *X. smalliana*. 4. *X. longifolia*. 5. *X. jupicai*. 6. *X. serotina*.



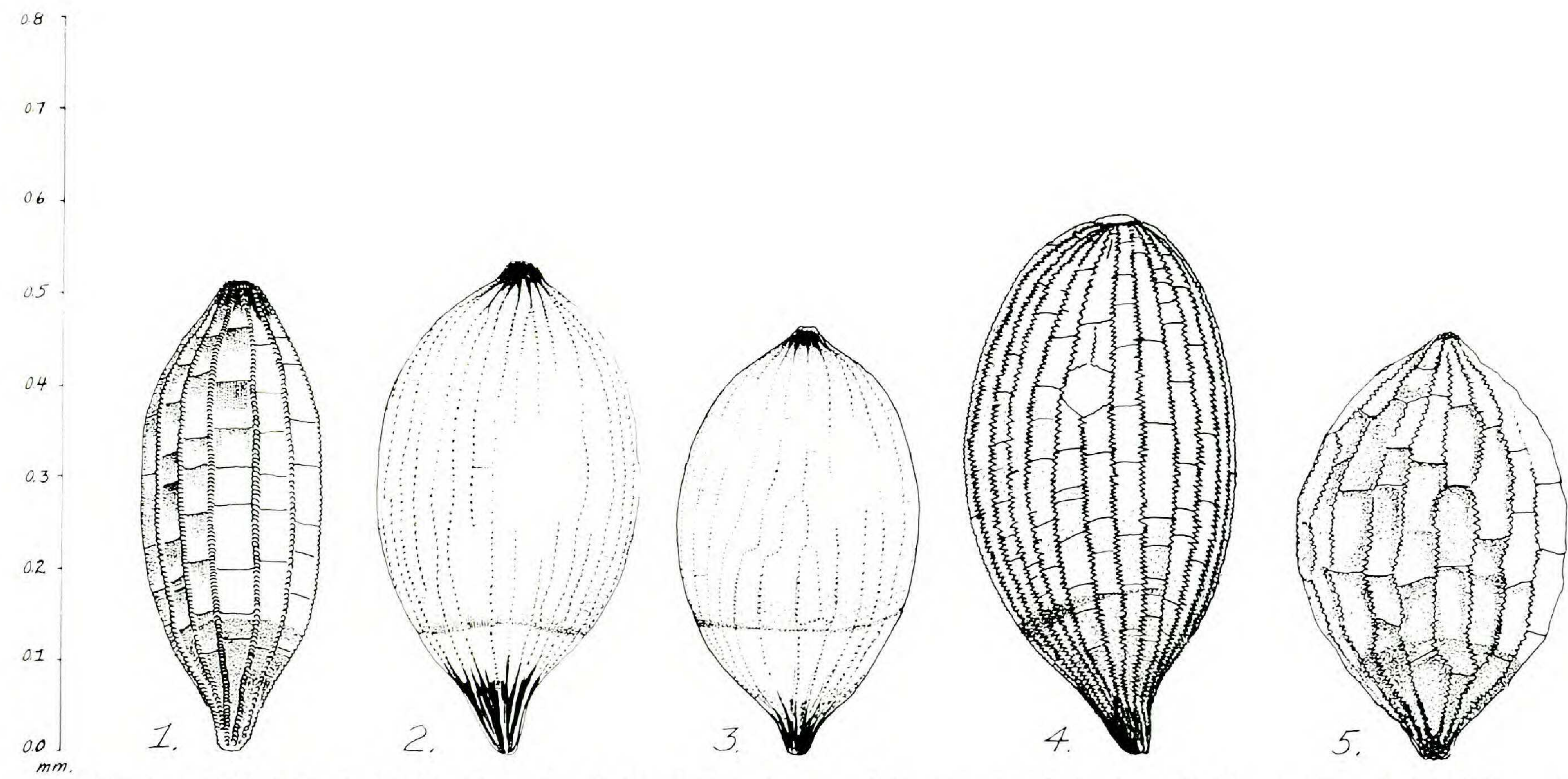


SEEDS OF XYRIS. 1. *X. flabelliformis*. 2. *X. brevifolia*. 3. *X. drummondii*. 4. *X. isoetifolia*. 5. *X. baldwiniana*. 6. *X. elliotii*. 7. *X. difformis* var. *curtissii*.

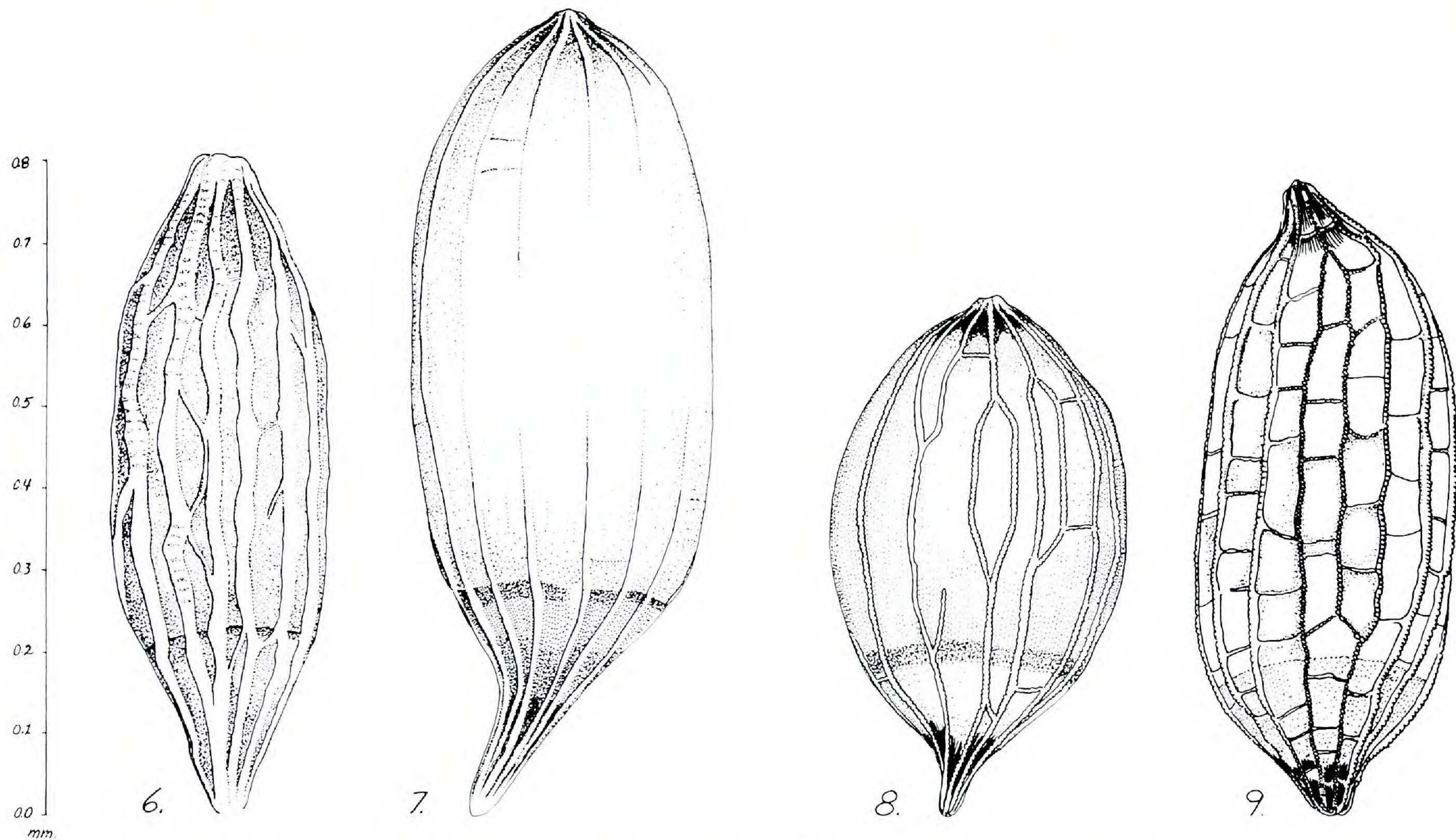
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
mm.



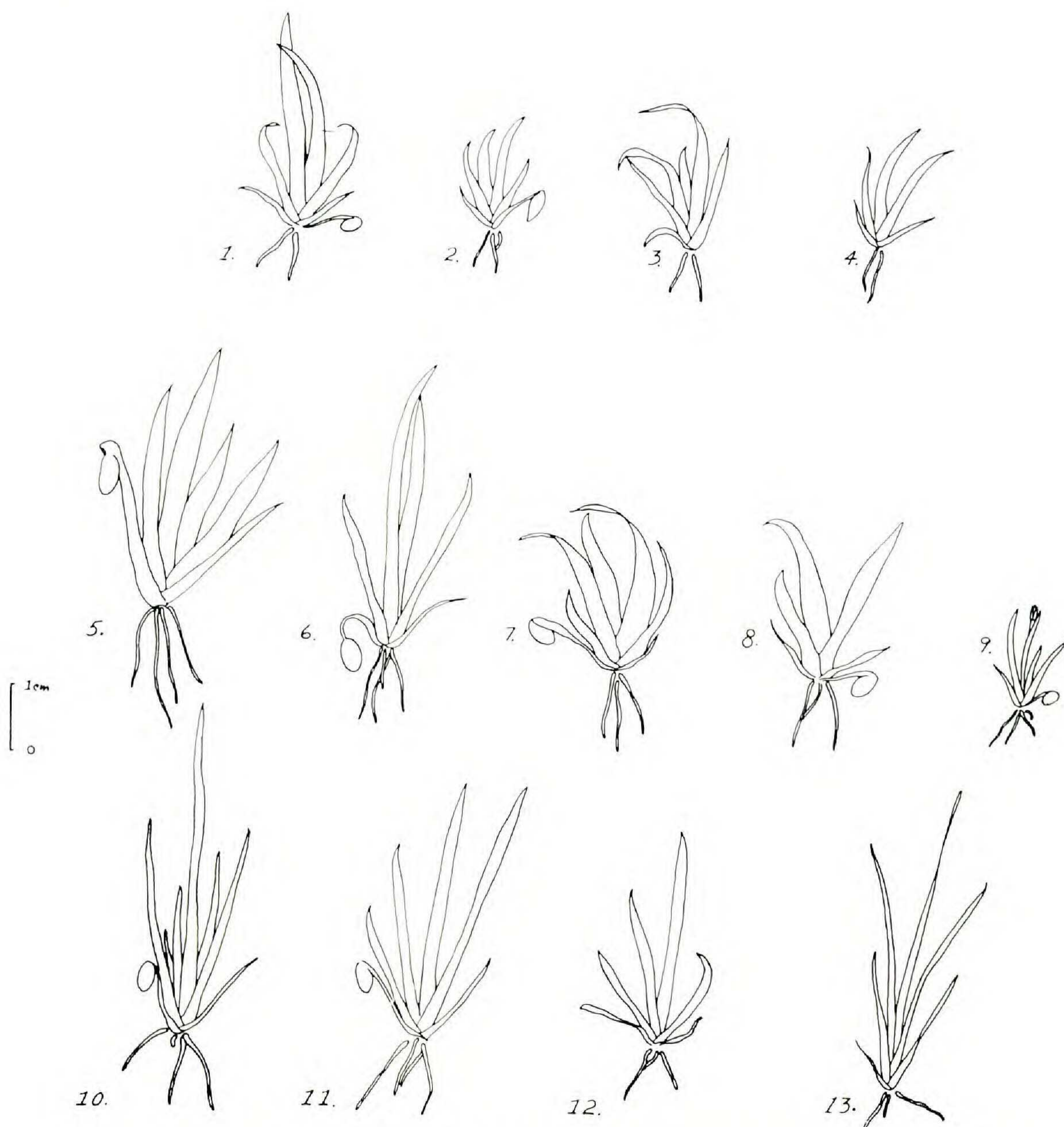
SEEDS OF XYRIS. 8. *X. torta*. 9. *X. caroliniana*. 10. *X. ambigua*. 11. *X. stricta*. 12. *X. iridifolia*.



SEEDS OF XYRIS. 1. *X. longisepala*. 2. *X. difformis* var. *difformis*. 3. *X. jupicai*. 4. *X. serotina*. 5. *X. difformis* var. *floridana*.

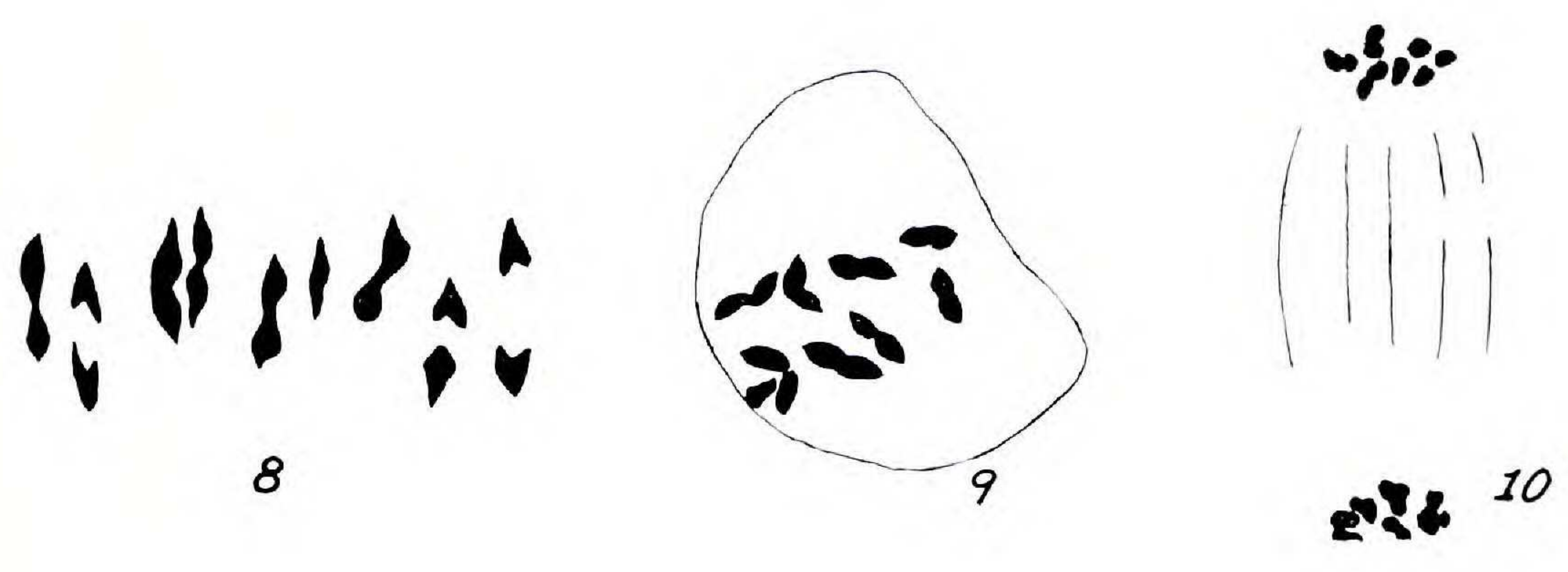
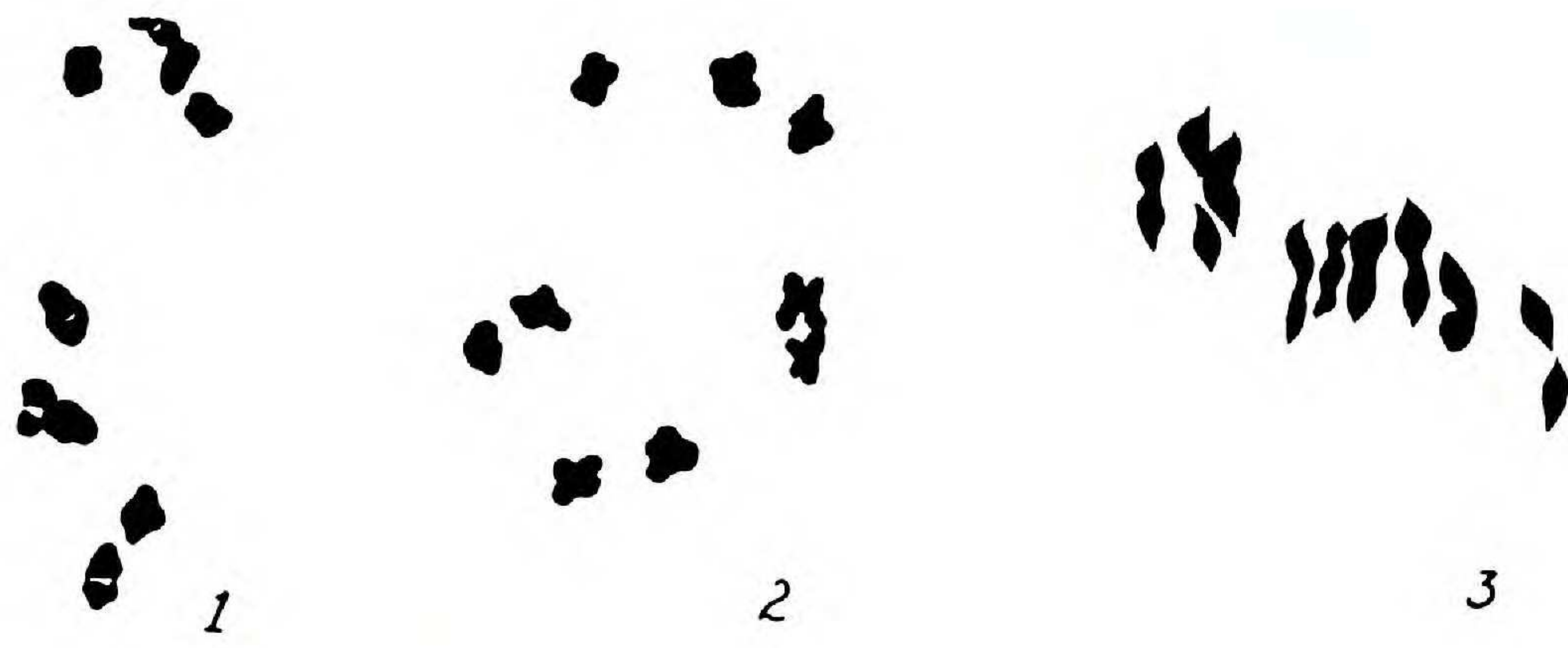


SEEDS OF XYRIS. 6. *X. fimbriata*. 7. *X. scabrifolia*. 8. *X. platylepis*. 9. *X. smalliana*.



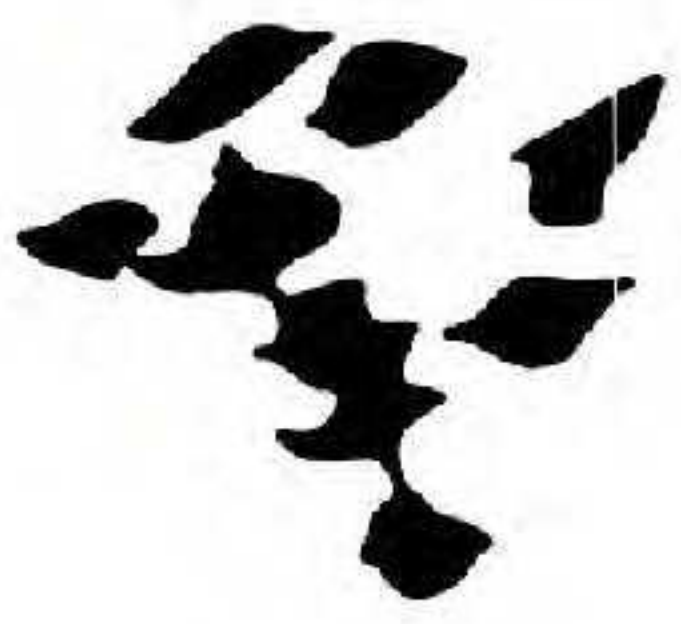
(Above) SEEDLINGS OF XYRIS. Age 3 months, from fresh material. 1. *X. difformis* var. *difformis*. 2. *X. iridifolia*. 3. *X. fimbriata*. 4. *X. smalliana*. 5. *X. serotina*. 6. *X. stricta*. 7. *X. ambigua*. 8. *X. platylepis*. 9. *X. brevifolia*. 10. *X. isoetifolia*. 11. *X. longisepala*. 12. *X. jupicai*. 13. *X. baldwiniana*.

(Opposite) MEIOTIC CHROMOSOMES OF XYRIS. 1. *X. ambigua* (prophase I). 2. *X. ambigua* (prophase I). 3. *X. platylepis* (metaphase I). 4. *X. caroliniana* (prophase I). 5. *X. 5A, 5B, X. caroliniana* (metaphase I). 6. *X. baldwiniana* (metaphase I). 7. *X. baldwiniana* (prophase II). 8. *X. serotina* (metaphase I). 9. *X. fimbriata* (metaphase I). 10. *X. brevifolia* (metaphase II).

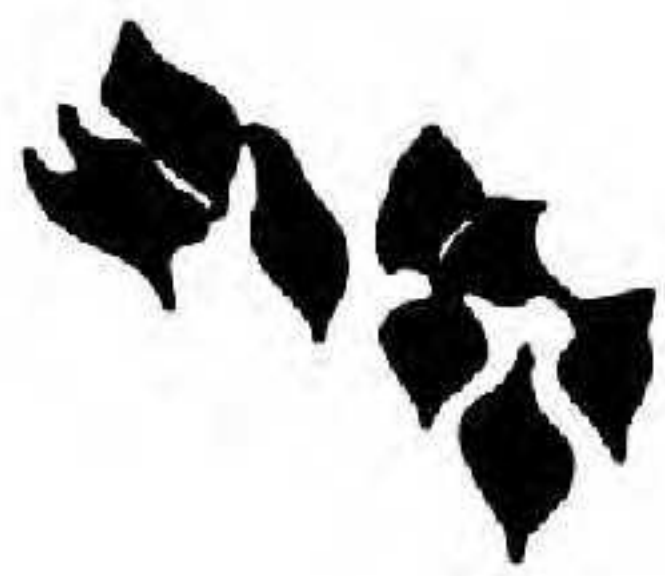


3. *Xyris brevifolia* Michx. FLORIDA LEON CO.: greenhouse stock from 8 mi. w. Tallahassee, grown from seed collected in December 1962; VOLUSIA CO.: Kral 18442; WAKULLA CO.: greenhouse stock collected by Kral & Godfrey in December 1963 from Newport, the same locality as Kral 6442.
4. *Xyris difformis* Chapm. var. *curtissii* (Malme). FLORIDA. ESCAMBIA CO.: Kral 17589; LIBERTY CO.: Kral 19316. NORTH CAROLINA. COLUMBUS CO.: Kral 19037.
5. *Xyris difformis* Chapm. var. *difformis*. GEORGIA. WARE CO.: Kral 19239; MCINTOSH CO.: Kral 18765. NORTH CAROLINA. ROBESON CO.: Kral 19144. SOUTH CAROLINA. COLLETON CO.: Kral 18980; BERKELEY CO.: Kral 19213. LOUISIANA. VERNON PAR.: Kral 20662; WASHINGTON PAR.: Kral 19783.
6. *Xyris difformis* Chapm. var. *floridana*. FLORIDA. FLAGLER CO.: Kral 18554; NASSAU CO.: Kral 18617A; VOLUSIA CO.: Kral 18461. GEORGIA. CHATHAM CO.: Kral 18941; MCINTOSH CO.: Kral 18748. LOUISIANA. WASHINGTON PAR.: Kral 19385.
7. *Xyris drummondii* Malme. FLORIDA. ESCAMBIA CO.: Kral 17635; LIBERTY CO.: Kral 19316.
8. *Xyris elliottii* Chapm. FLORIDA. NASSAU CO.: Kral 18629A; ESCAMBIA CO.: Kral 17729; GULF CO.: Kral 17795.
9. *Xyris fimbriata* Ell. FLORIDA. ESCAMBIA CO.: Kral 17732; LIBERTY CO.: Kral 15689; VOLUSIA CO.: Kral 18440. GEORGIA. CAMDEN CO.: Kral 18618B; LIBERTY CO.: Kral 18851; MCINTOSH CO.: Kral 18890.
10. *Xyris flabelliformis* Chapm. FLORIDA. JEFFERSON CO.: Kral 6434; WAKULLA CO.: (Both the preceding collected by Kral & Godfrey from the numbered localities and transplanted to greenhouse in January 1964.) WALTON CO.: Kral 19840.
11. *Xyris caroliniana* Walt. FLORIDA. VOLUSIA CO.: Kral 18464; WALTON CO.: Kral 19377. NORTH CAROLINA. COLUMBUS CO.: Kral 19051; ROBESON CO.: Kral 19116. LOUISIANA. VERNON PAR.: Kral 20650. SOUTH CAROLINA. COLLETON CO.: Kral 18981.
12. *Xyris iridifolia* Chapm. FLORIDA. LIBERTY CO.: Kral 15687 (cytological material gathered one year later, in 1963). GEORGIA. CAMDEN CO.: Kral 18617B; MCINTOSH CO.: Kral 18766. LOUISIANA. VERNON PAR.: Kral 20658; WASHINGTON PARISH: Kral 19384.

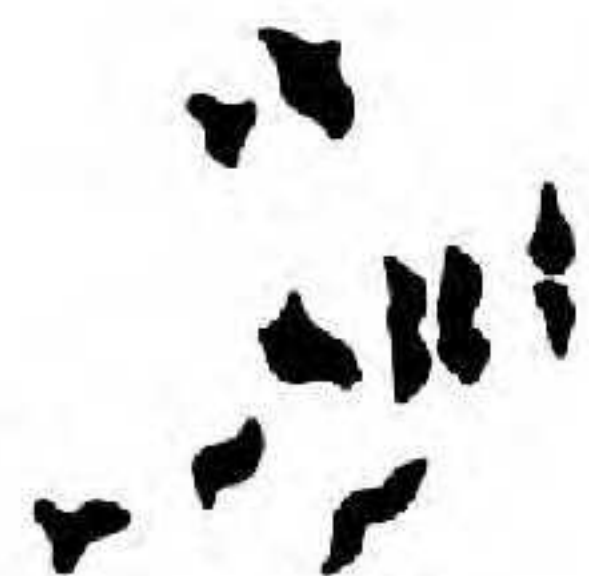
(Opposite) MEIOTIC CHROMOSOMES OF XYRIS. 11. *X. drummondii* (A, B metaphase I, C metaphase II). 12. *X. flabelliformis* (metaphase II). 13. *X. torta* (prophase I). 14. *X. elliottii* (prophase I). 15. *X. elliottii* (prophase I). 16. *X. torta* (prophase I). 17. *X. scabrifolia* (metaphase I). 18. *X. caroliniana* (prophase I). 19. *X. difformis* var. *difformis* (metaphase I). 20. *X. difformis* var. *difformis* (prophase I). 21. *X. jupicai* (prophase I). 22. *X. jupicai* (prophase I).



11a



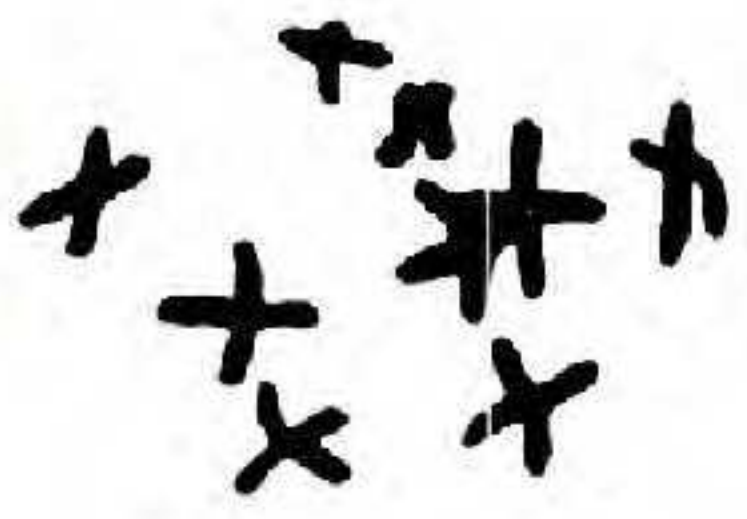
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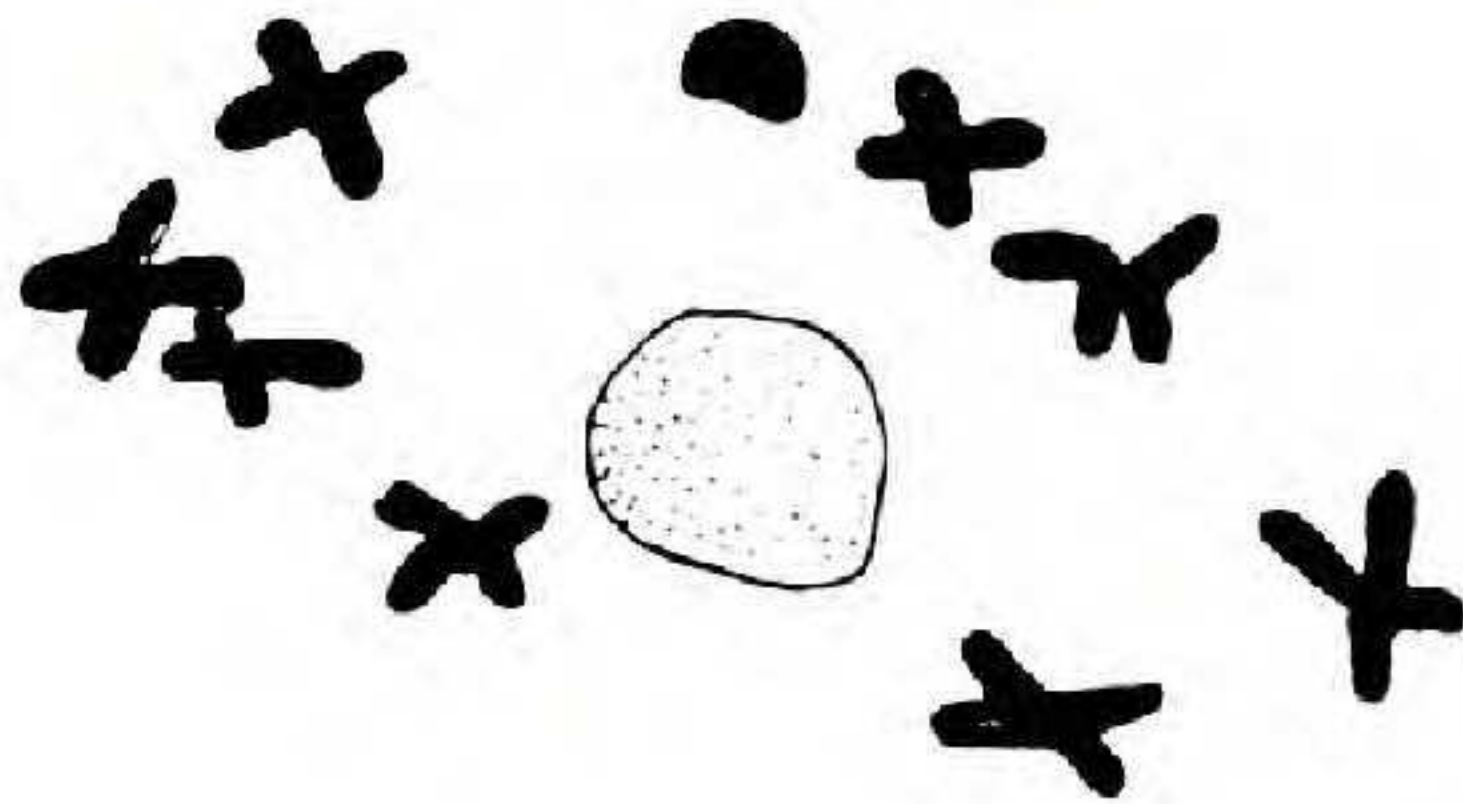
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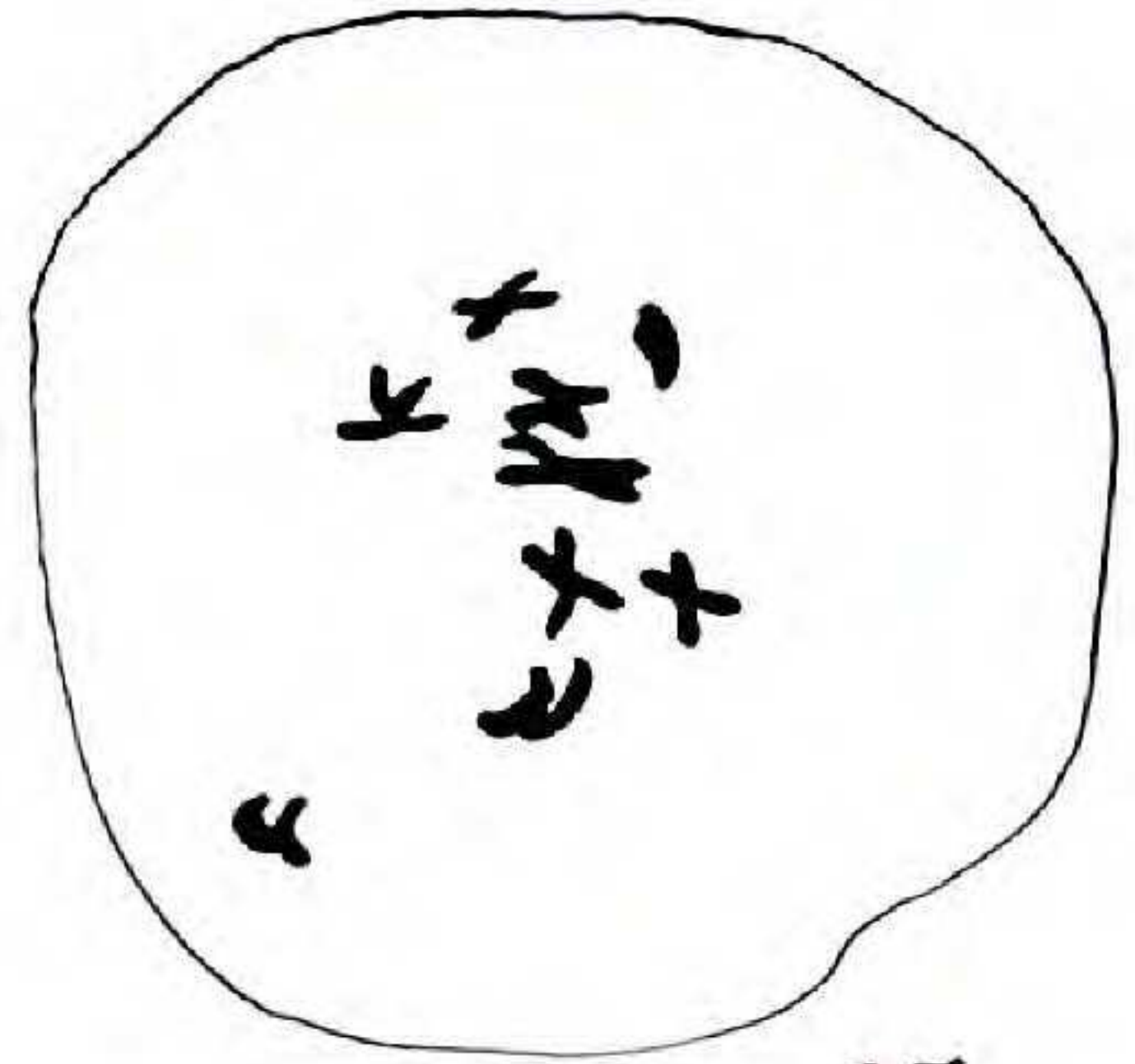
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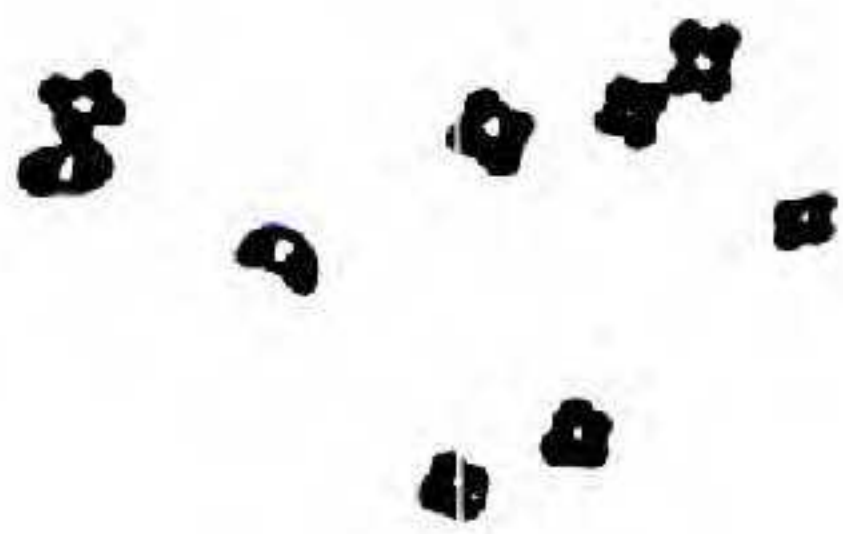
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14



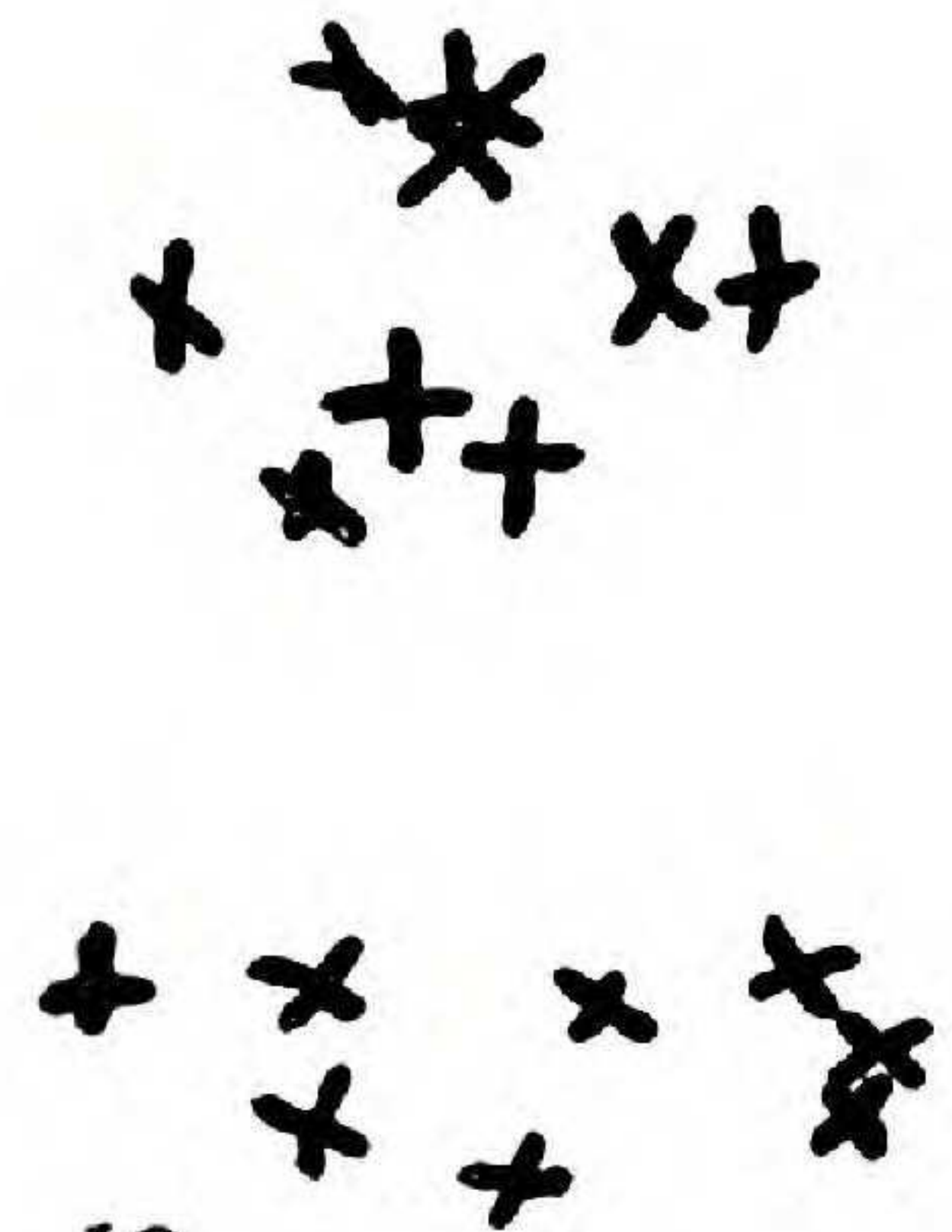
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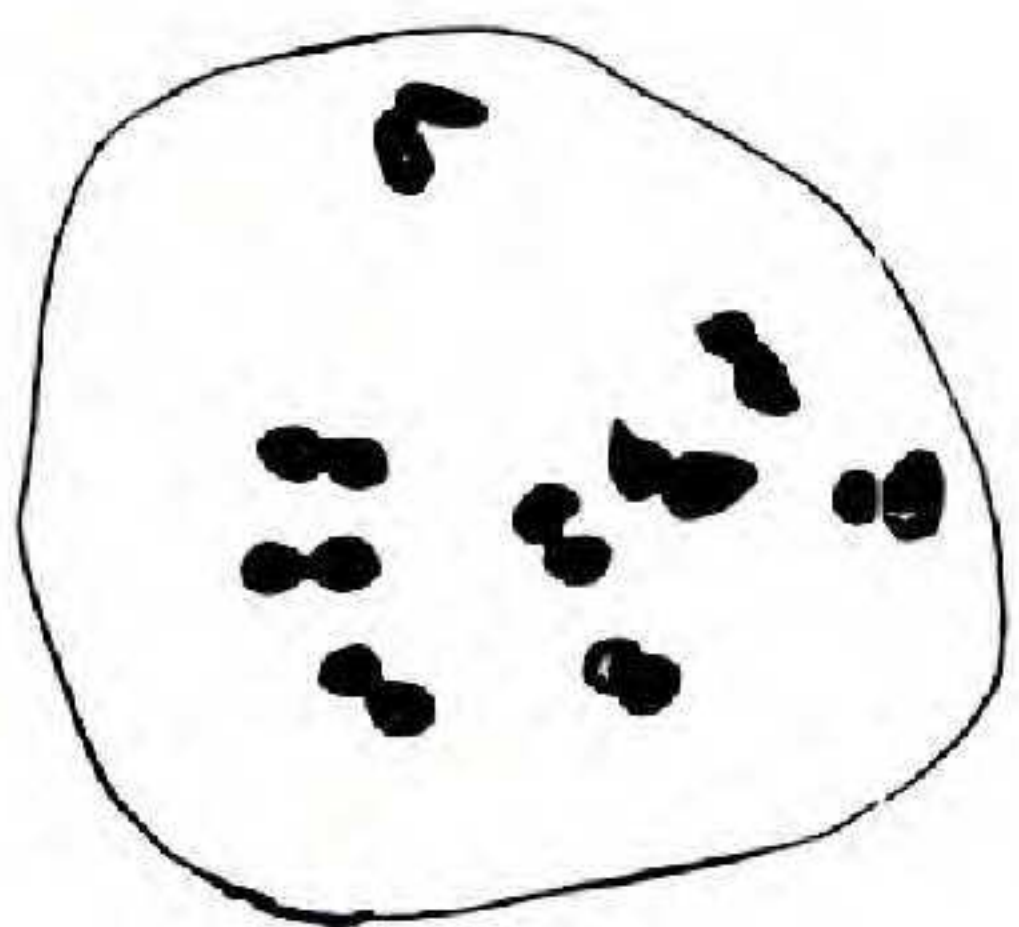
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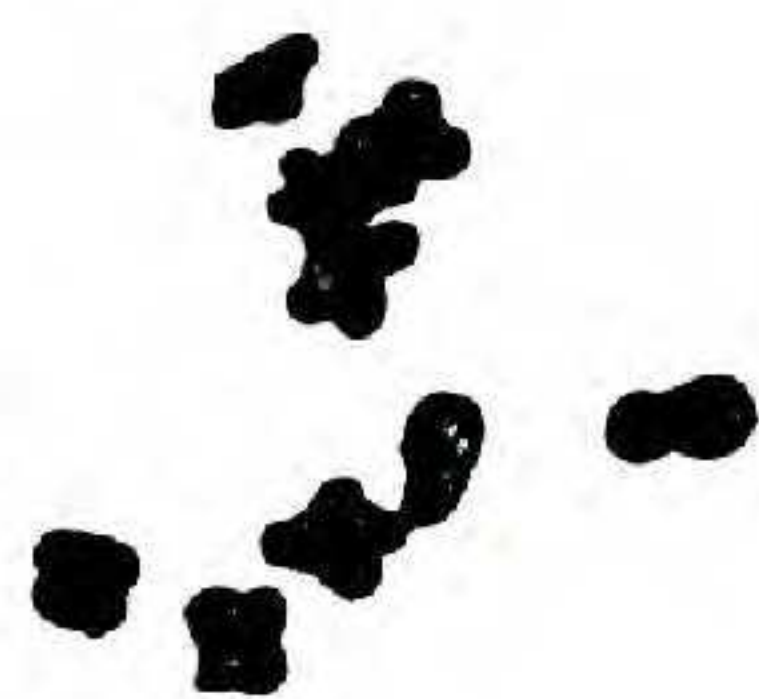
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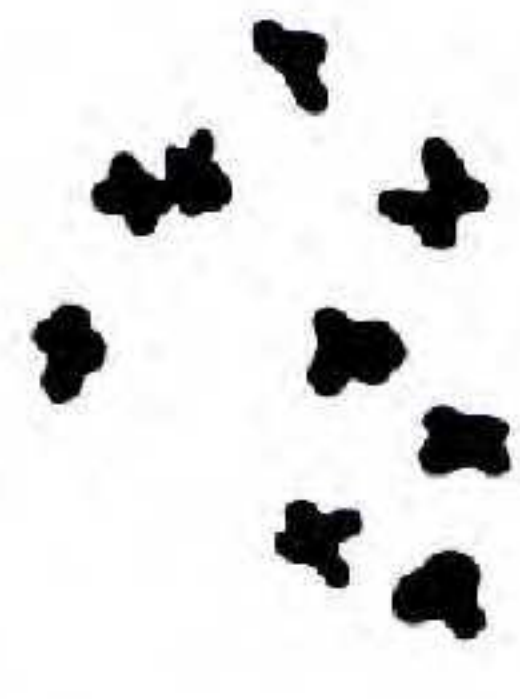
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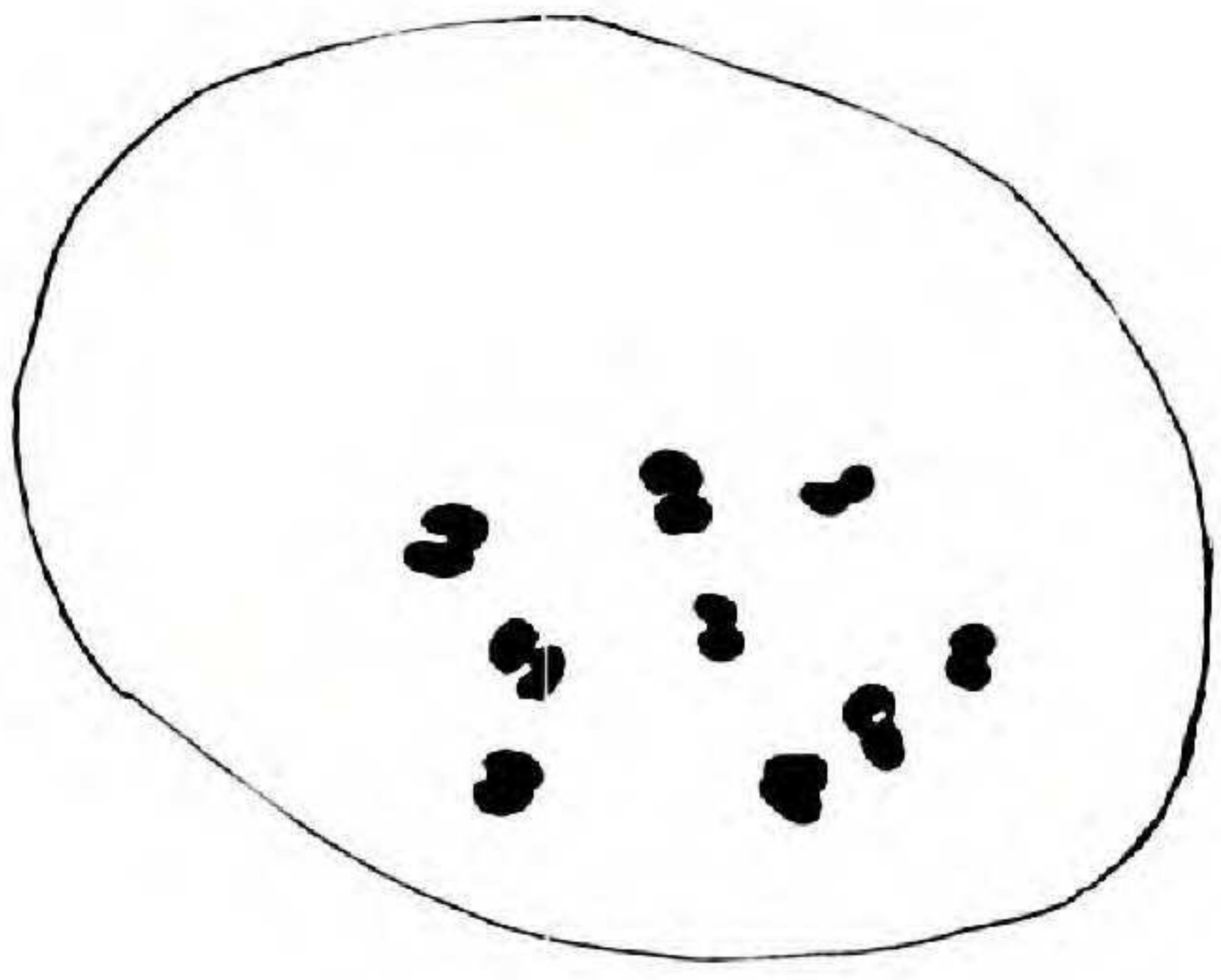


22

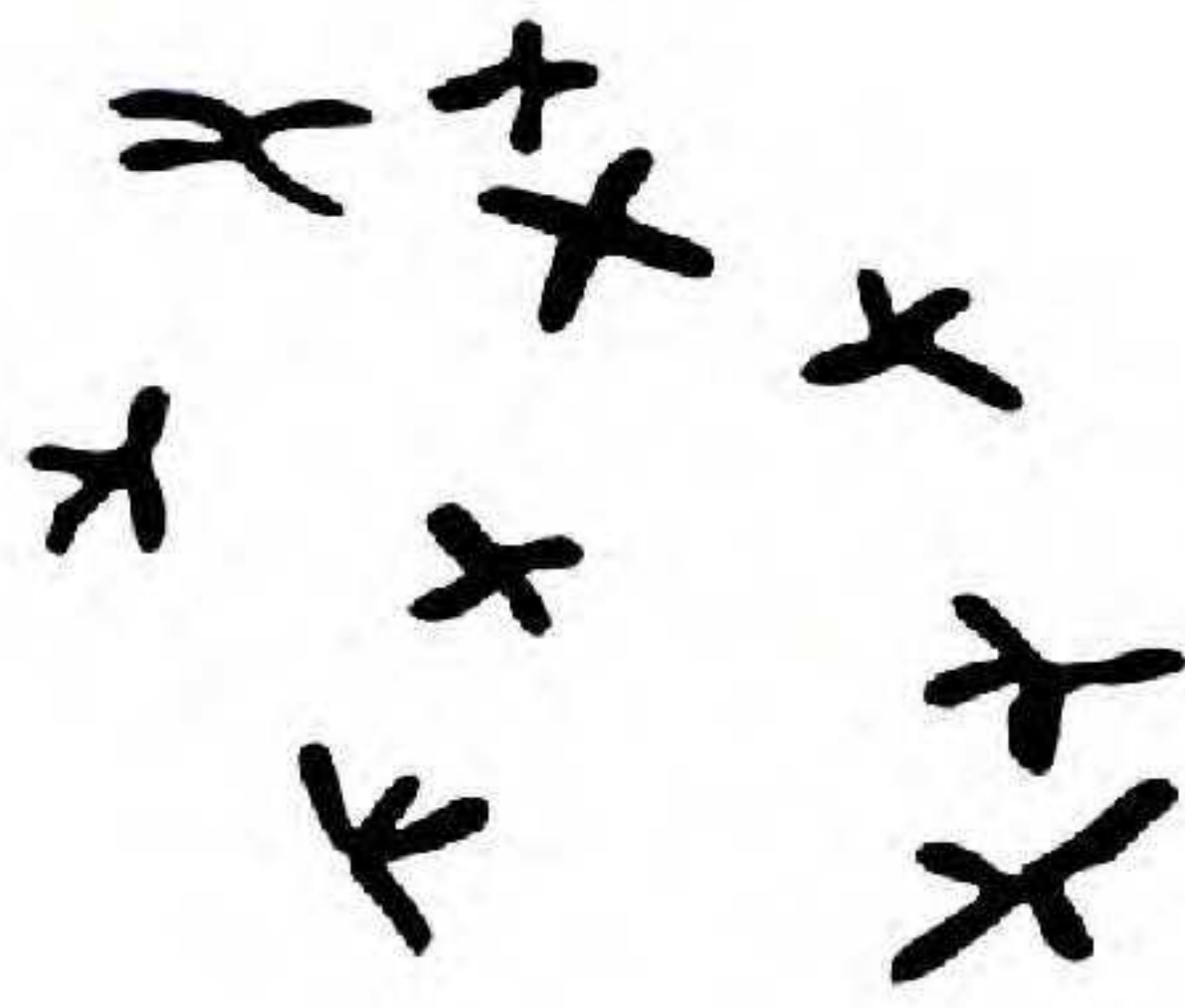
13. *Xyris jupicai* Rich. FLORIDA. LIBERTY CO.: Kral 19322; NASSAU CO.: Kral 18624A; VOLUSIA CO.: Kral 18466; WALTON CO.: Kral 18368. GEORGIA. MCINTOSH CO.: Kral 18751. LOUISIANA. LINCOLN PARISH: Kral 19401.
14. *Xyris paltylepis* Chapm. FLORIDA. NASSAU CO.: Kral 18618A; VOLUSIA CO.: Kral 18447; WALTON CO.: Kral 19367. GEORGIA. WARE CO.: Kral 19237.
15. *Xyris scabrifolia* Harper. FLORIDA. BAY CO.: Kral 15631.
16. *Xyris serotina* Chapm. FLORIDA. ESCAMBIA CO.: Kral 17725; LIBERTY CO.: Kral 15688. GEORGIA. MCINTOSH CO.: Kral 18746A. NORTH CAROLINA. COLUMBUS CO.: Kral 19035.
17. *Xyris smalliana* Nash. FLORIDA. ESCAMBIA CO.: Kral 17723; LIBERTY CO.: Kral 15687; MARTIN CO.: Kral 18232. GEORGIA. CLINCH CO.: Kral 19224.
18. *Xyris stricta* Chapm. FLORIDA. ESCAMBIA CO.: Kral 17733; LIBERTY CO.: Kral 15713. GEORGIA. MCINTOSH CO.: Kral 18747.
19. *Xyris torta* J. E. Smith. LOUISIANA. LINCOLN PARISH: Kral 17298. OUACHITA PARISH: Kral 17309. VERNON PARISH: Kral 20669.

Root Tips: 2N equals 18

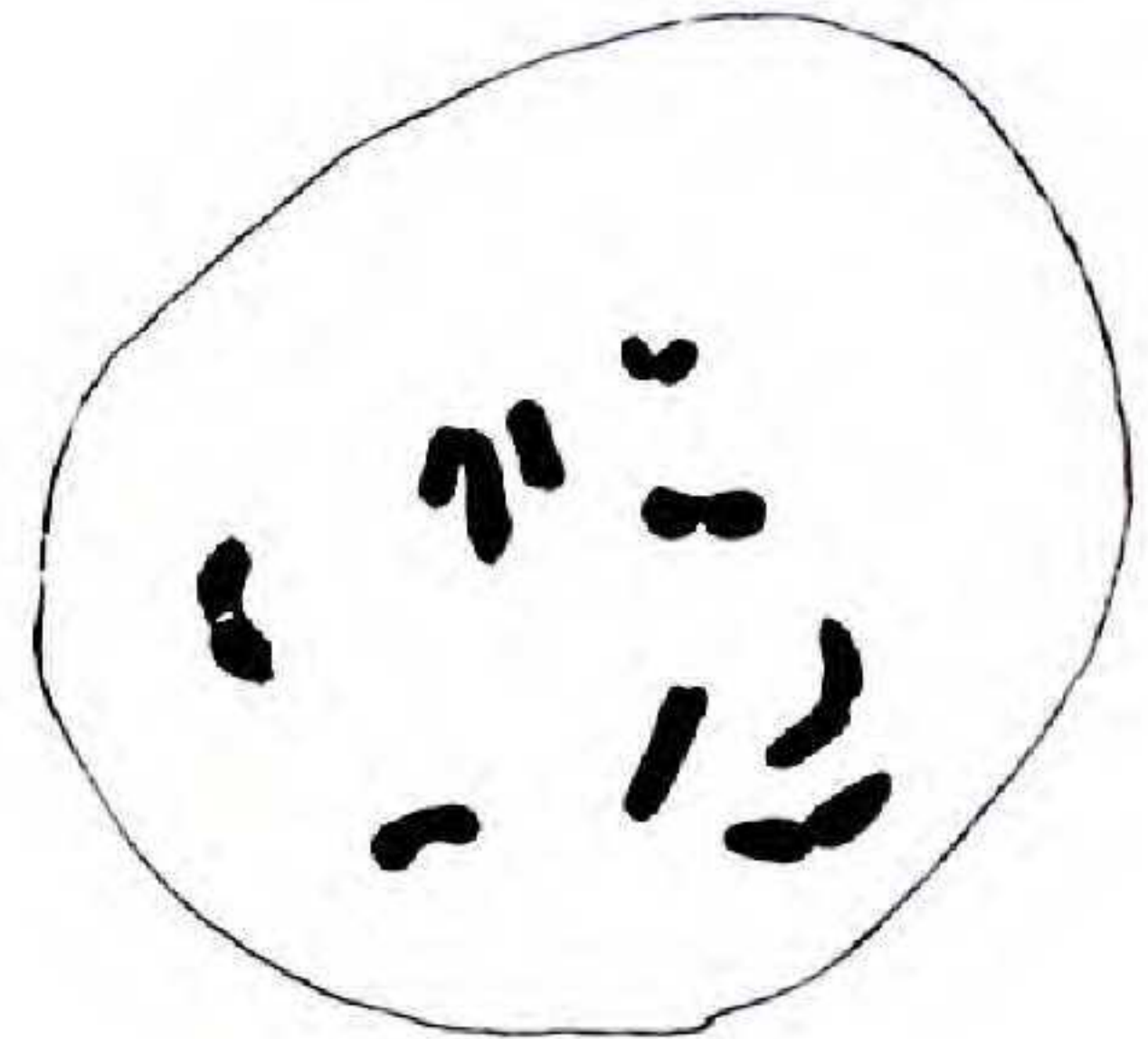
1. *Xyris ambigua* Beyr. FLORIDA. SCAMBIA CO.: Kral 17228; SANTA ROSA CO.: Kral 17683; MARTIN CO.: Kral 18213. MISSISSIPPI. PEARL RIVER CO.: Kral 17401.
2. *Xyris baldwiniana* Schultes. FLORIDA. ESCAMBIA CO.: Kral 17731; LIBERTY CO.: roots were gotten from a specimen for which I have lost the population sample, but the location is 5 miles s. of Telogia. MISSISSIPPI. PEARL RIVER CO.: Kral 17362.
3. *Xyris difformis* Chapm. var. *curtissii*. FLORIDA. ESCAMBIA CO.: Kral 17589; SANTA ROSA CO.: Kral 17686.
4. *Xyris difformis* Chapm. var. *difformis*. FLORIDA. LEON CO.: Kral 15564. MISSISSIPPI. STONE CO.: Kral 17405.
5. *Xyris drummondii* Malme. FLORIDA. ESCAMBIA CO.: Kral 17635; SANTA ROSA CO.: Kral 17687.
6. *Xyris elliottii* Chapm. FLORIDA. ESCAMBIA CO.: Kral 17729; MARTIN CO.: Kral 18234.
7. *Xyris fimbriata* Ell. FLORIDA. LEON CO.: Kral 15552.
8. *Xyris iridifolia* Chapm. FLORIDA. LIBERTY CO.: Kral 15687; ESCAMBIA CO.: Kral 17724.
9. *Xyris isoetifolia* Kral. FLORIDA. BAY CO.: Kral 15651 (type locality).
10. *Xyris jupicai* Rich. FLORIDA. ESCAMBIA CO.: Kral 17727; LIBERTY CO.: Kral 19322; MARTIN CO.: Kral 18233.
11. *Xyris platylepis* Chapm. FLORIDA. LEON CO.: Kral 15554B; MARTIN CO.: collected Dec. 1962 from 5 mi. n. Stuart, and grown in greenhouse at Louisiana Tech.



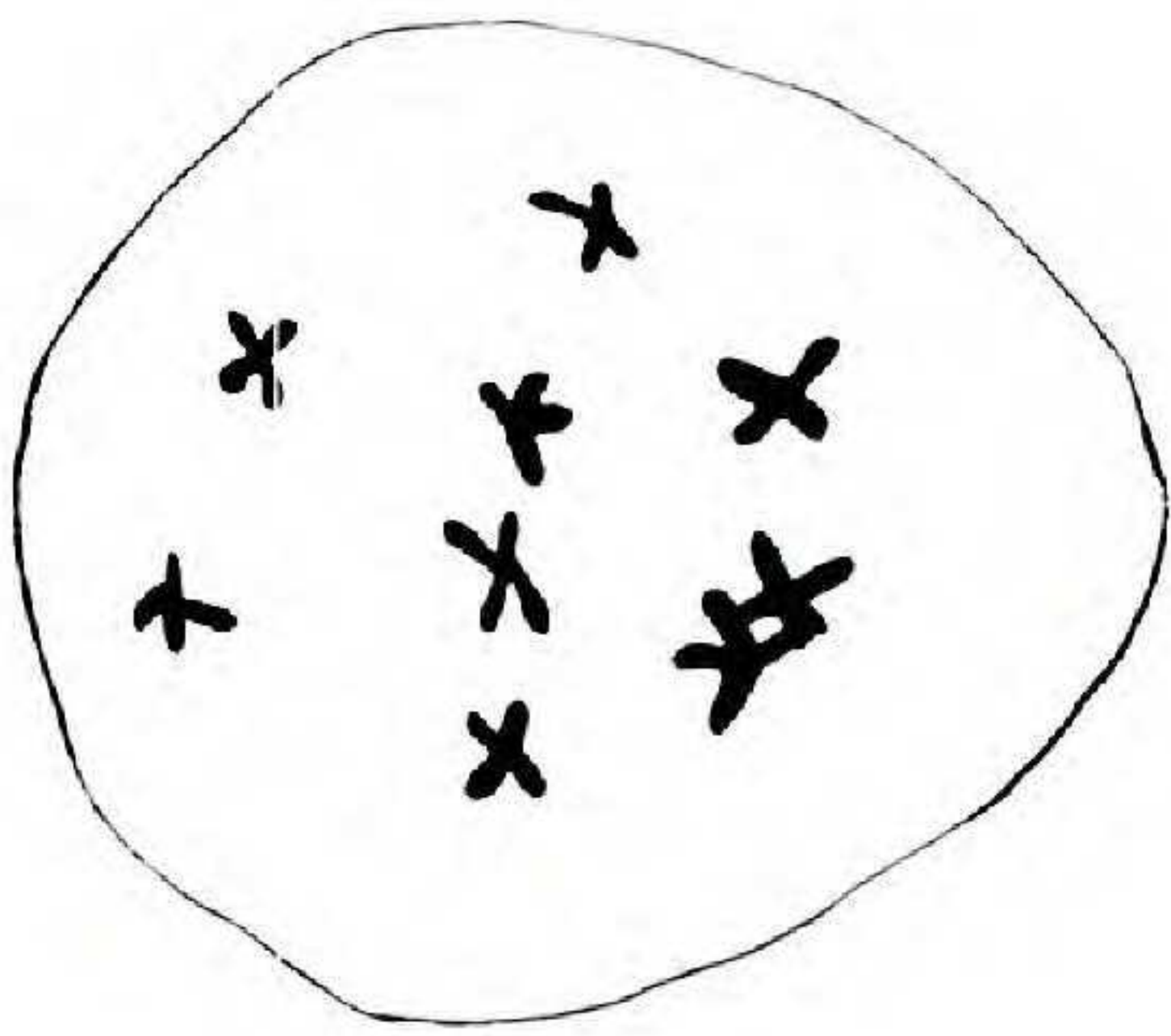
23



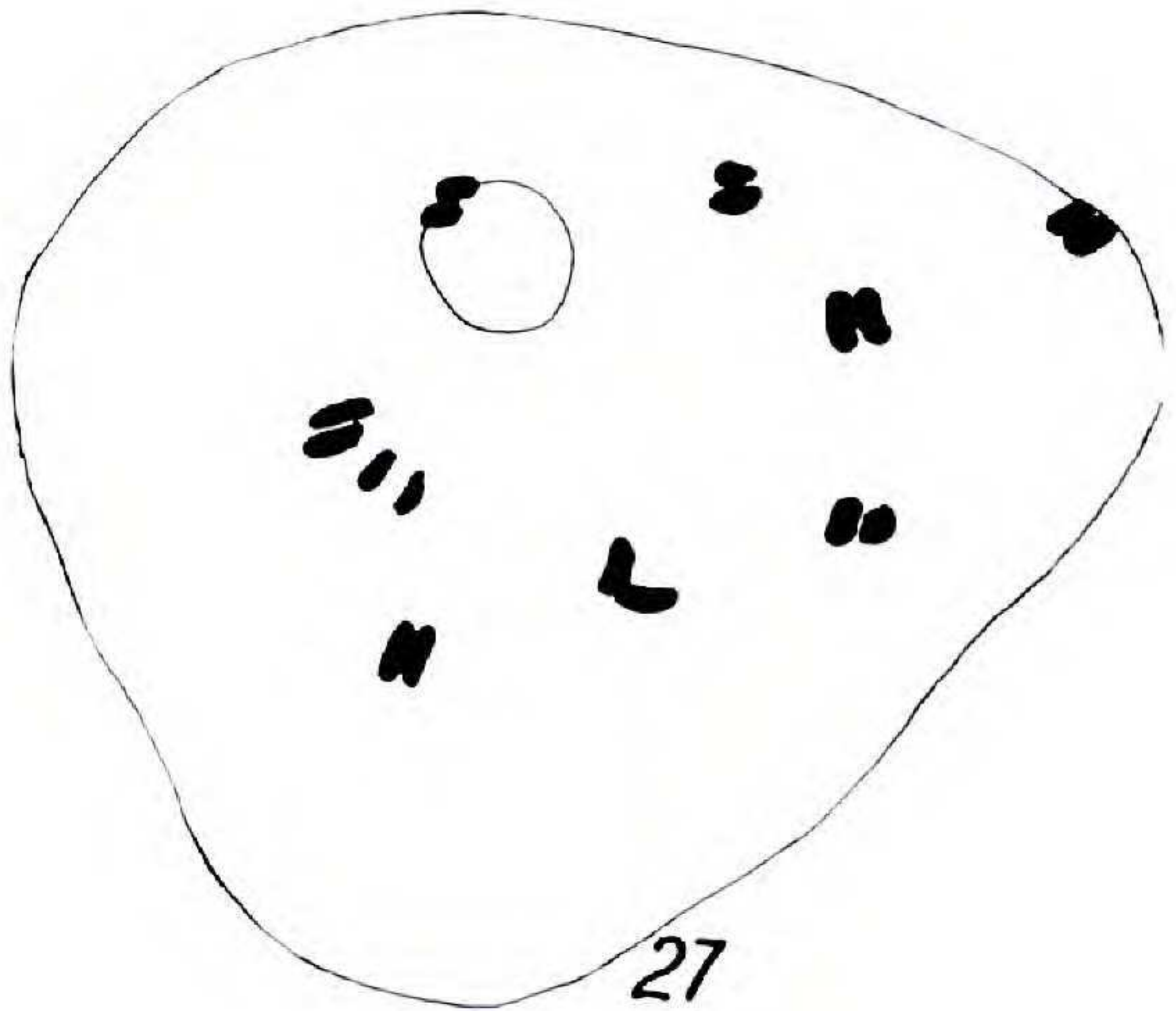
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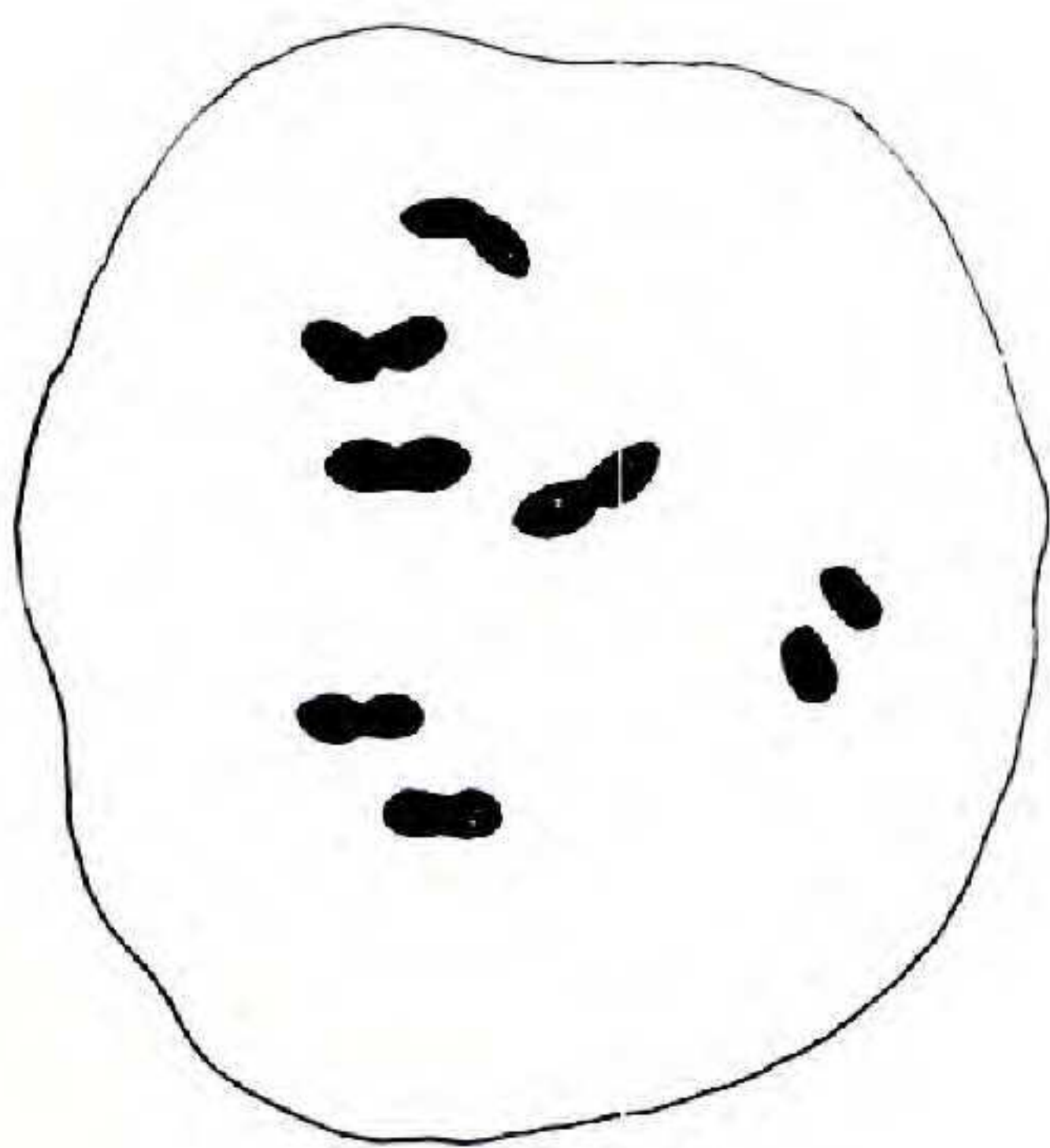
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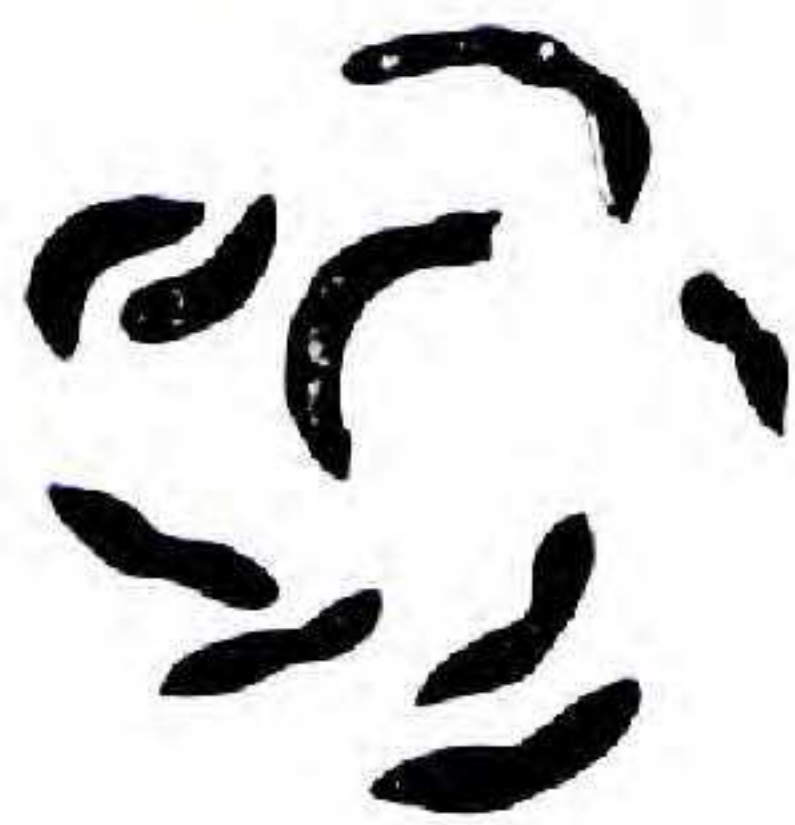
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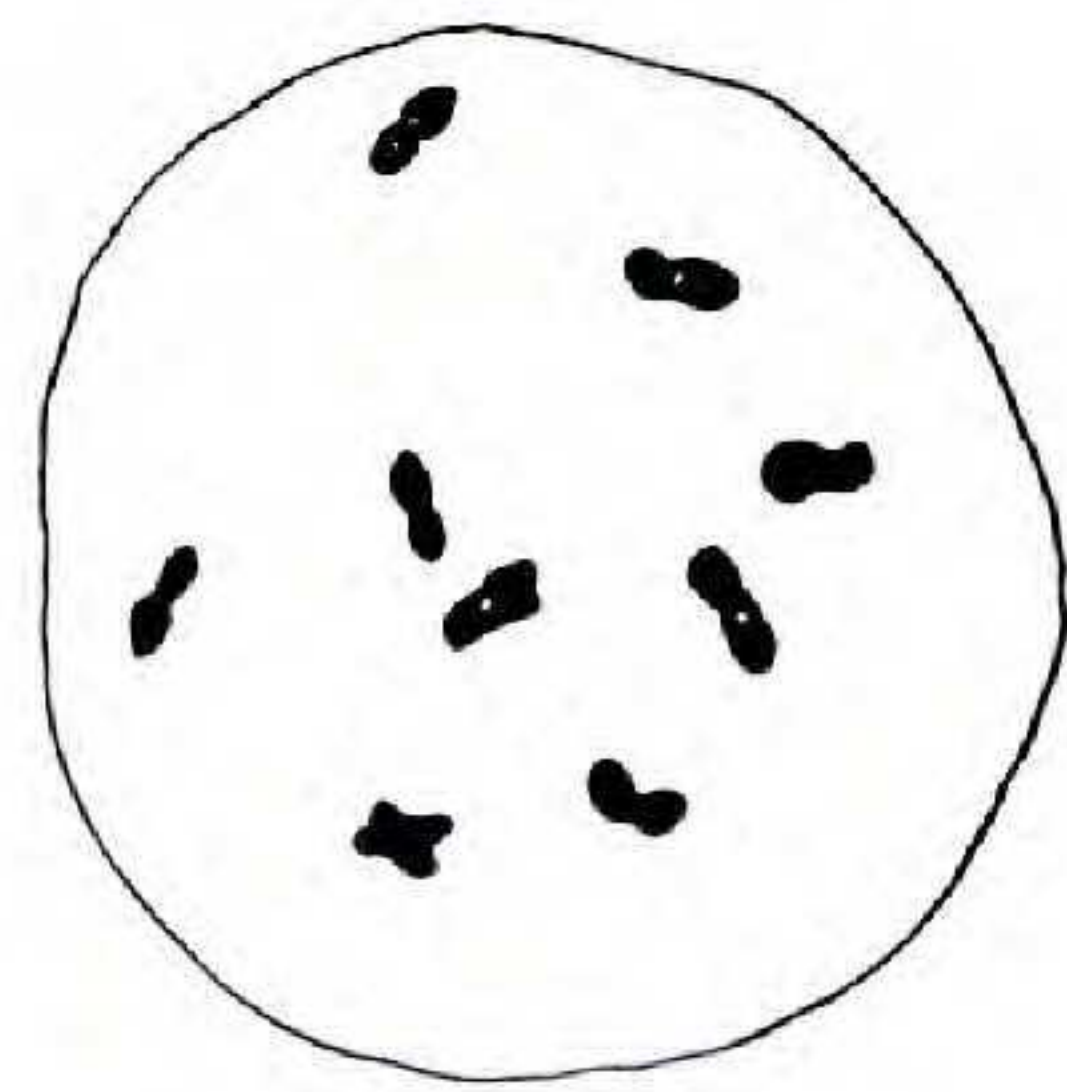
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MEIOTIC CHROMOSOMES OF XYRIS. 23. *X. iridifolia* (metaphase I). 24. *X. iridifolia* (prophase I). 25. *X. fimbriata* (metaphase I). 26. *X. smalliana* (prophase I). 27. *X. stricta* (prophase I). 28. *X. difformis* var. *curtissii* (metaphase I). 29. *X. difformis* var. *floridana* (metaphase I). 30. *X. difformis* var. *difformis* (metaphase I).

12. *Xyris serotina* Chapm. FLORIDA. ESCAMBIA CO.: Kral 17725; LIBERTY CO.: Kral 15687; BAY CO.: Kral 15652.
13. *Xyris smalliana* Nash. FLORIDA. ESCAMBIA CO.: Kral 17733; LIBERTY CO.: Kral 15713.
14. *Xyris stricta* Chapm. FLORIDA. ESCAMBIA CO.: Kral 17733; LIBERTY CO.: Kral 15713.

For location of voucher specimens of the above numbers, please consult the mimeographed list of exsiccatae. The writer will be happy to lend specimens of any or all of the above to any other person interested in this genus.

ECOLOGY

As mentioned already, all species of *Xyris* thrive in warm climate, on high hydroperiod soils which are at least slightly acid; thus the most ideal situation for them in North America is the Atlantic and Gulf Coastal Plain of the southern United States. One notices, in travelling the Coastal Plain (exclusive of the Mississippi Embayment) east toward the Atlantic or from the upper terraces toward the lower terraces that the character of soil texture of the majority of wetlands habitats becomes progressively coarser. There are, to be sure, islands of coarser soil inland, as well as interruptions toward the present coast produced by floodplains and deltas of river systems, but the overall trend is toward larger particle sizes in the lower, more recently emergent terraces. Thus, in the lower parts of the Gulf and Atlantic Coastal Plains and in almost all of the Florida peninsula the soils are almost exclusively sands or sandy peat. Of the *Xyris* some (*X. baldwiniana*, *X. difformis* var. *difformis*, *X. scabrifolia*, *X. drummondii*, *X. torta*, *X. serotina*, *X. stricta*, *X. iridifolia*) appear to show an affinity for finer textured, heavier bog soils and are thus more abundant inland or to the west in the Coastal Plain or appear on wet, fine-textured alluvial situations toward the coast (*X. difformis* var. *difformis*, *X. serotina*, *X. stricta*, *X. iridifolia*). Others (*X. brevifolia*, *X. flabelliformis*, *X. elliotii*, *X. longispala*, *X. smalliana*, *X. difformis* var. *floridana*, *X. platylepis*, *X. fimbriata*) appear to be most concentrated on coarser textured, sandier, substrata, hence are usually found closer to the present coast or in peninsular Florida. Still others are not yet well enough known even for such speculative comment, or appear to occur with frequency in either sort of situation (*X. caroliniana*, *X. difformis* var. *curtissii*, *X. ambigua*, *X. jupicai*).

In view of the above statements about soil texture, the greatest number of species of *Xyris* ought to be found in any area of the lower Coastal Plain which has the most diversity of acid lowland soils; this would logically be where sandy pine flatwoods are crossed by one of the major rivers of the Gulf or Atlantic Coastal Plain east of the Mississippi. Some of my best collecting localities have been: George County, Mississippi, along the Escatawpa River; Escambia County, Florida, to-

ward the bay from Pensacola; Franklin County, Florida, in the pine flatwoods and titi swamps along the Apalachicola River, where Dr. Chapman once sought *Xyris*; McIntosh County, Georgia, in the pine flatwoods of the lower Altamaha basin; Bryan County, Georgia and Jasper County, South Carolina, in the pine and cypress flatwoods adjoining the Ogeechee and Savannah Rivers. One locality from any of the areas mentioned above should reward a thorough collector with a majority of the species treated in this work, particularly if the locality has undergone some mechanical disturbance exclusive of draining. One cannot help but wonder at the subtleties of habitat which would enable this many species to occupy an area which superficially seems so monotonous. Is it possible that man, by disturbing such habitats through logging, road building, and bulldozing, has created some additional niches? If he has not, at least he has created situations in which large numbers of niches are contracted into a small space.

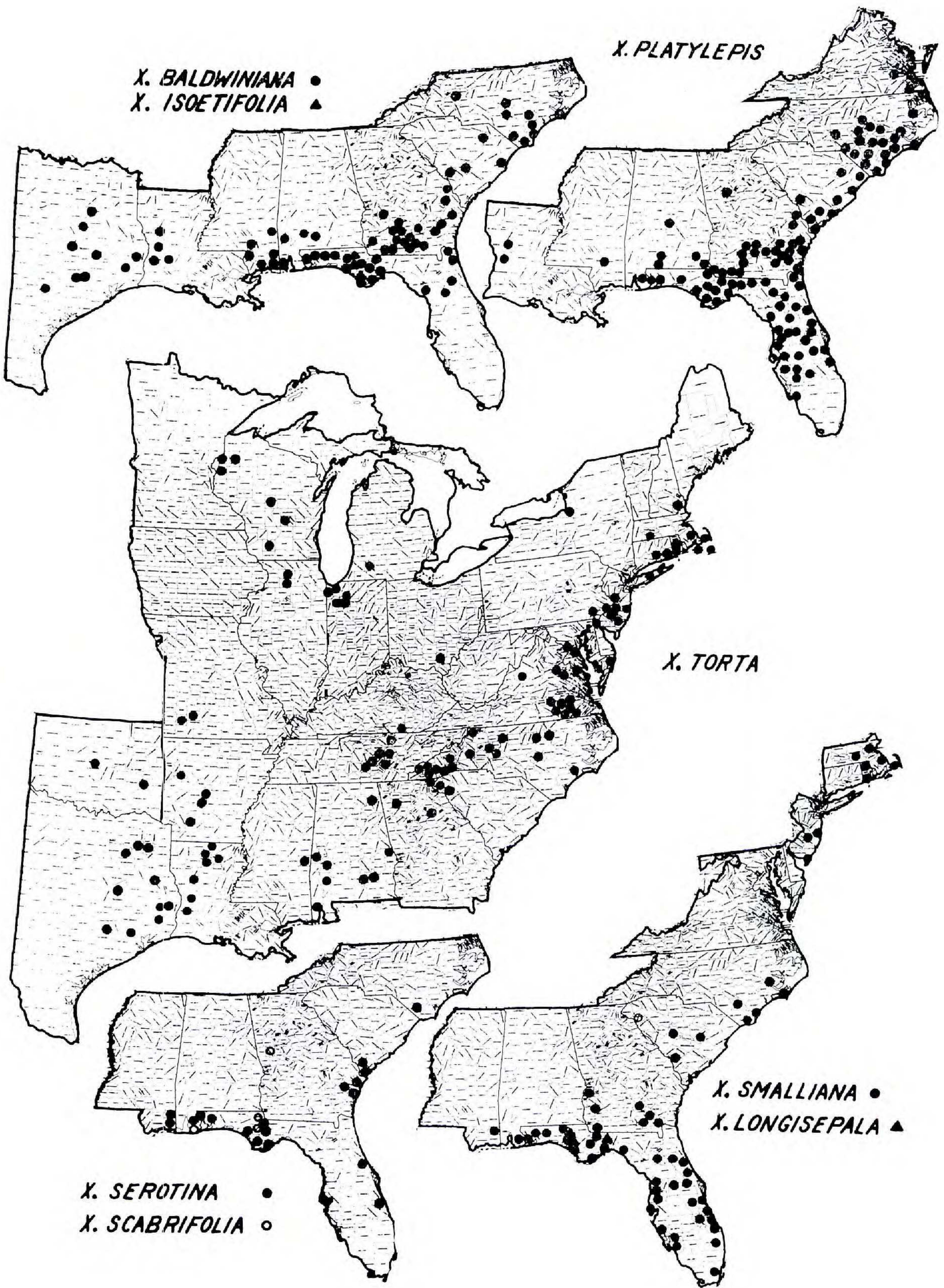
An excellent example for ecological study would be a locality which I encountered in the vicinity of Myrtle Grove, on the west side of Pensacola (ca. 2 mi. s. junction US 98 and county 289A near Myrtle Grove, w. of Pensacola, Escambia County, Florida). This locality is being engulfed rapidly by the City, much of it being converted into suburbia. The substratum is a sandy peat or peat muck. Borrow pits are frequent and provide considerable acreages of exposed, shallow, maroon-tinted water. Roadside ditches and drainage ditches are deep in order that the superabundant groundwater may drain adequately and are of particular interest ecologically because they traverse extremes of habitat, namely cypress domes, hardwood bottoms, titi and pine flatwoods, all of which have their own communities of species of *Xyris*. Before construction of such ditches a few inches of relief would probably have had a lineal expression of hundreds of yards; after construction, many ground-water environments are brought into such close proximity that plants of very high hydroperiod soils are brought within a few feet of plants of relatively low hydroperiod soils because of the production of a relief that did not previously exist. An additional factor is developed in that woody plants which ordinarily form dense thickets along flatwoods streams (*Lyonia*, *Cliftonia*, *Cyrilla*, *Magnolia*, *Osmanthus*, *Persea* etc.) and form a shade barrier to the mixing of streambank and flatwoods plants, are removed. In short, the result of all this man-made activity is the production of a habitat so composite and complex that the difference of as much as a few inches of elevation of ditchbank may mean the limit between the zone of one species of *Xyris* and that of another. In this particular locality, a line from one edge of a ditch to the other (approximately 15 feet wide and 6 feet deep) would traverse the habitats of 16 entities of *Xyris*, many of which are beautifully zoned along the ditch. According to my field notes the species zones crossed from the rim of the ditch to the submersed centre are as follows:

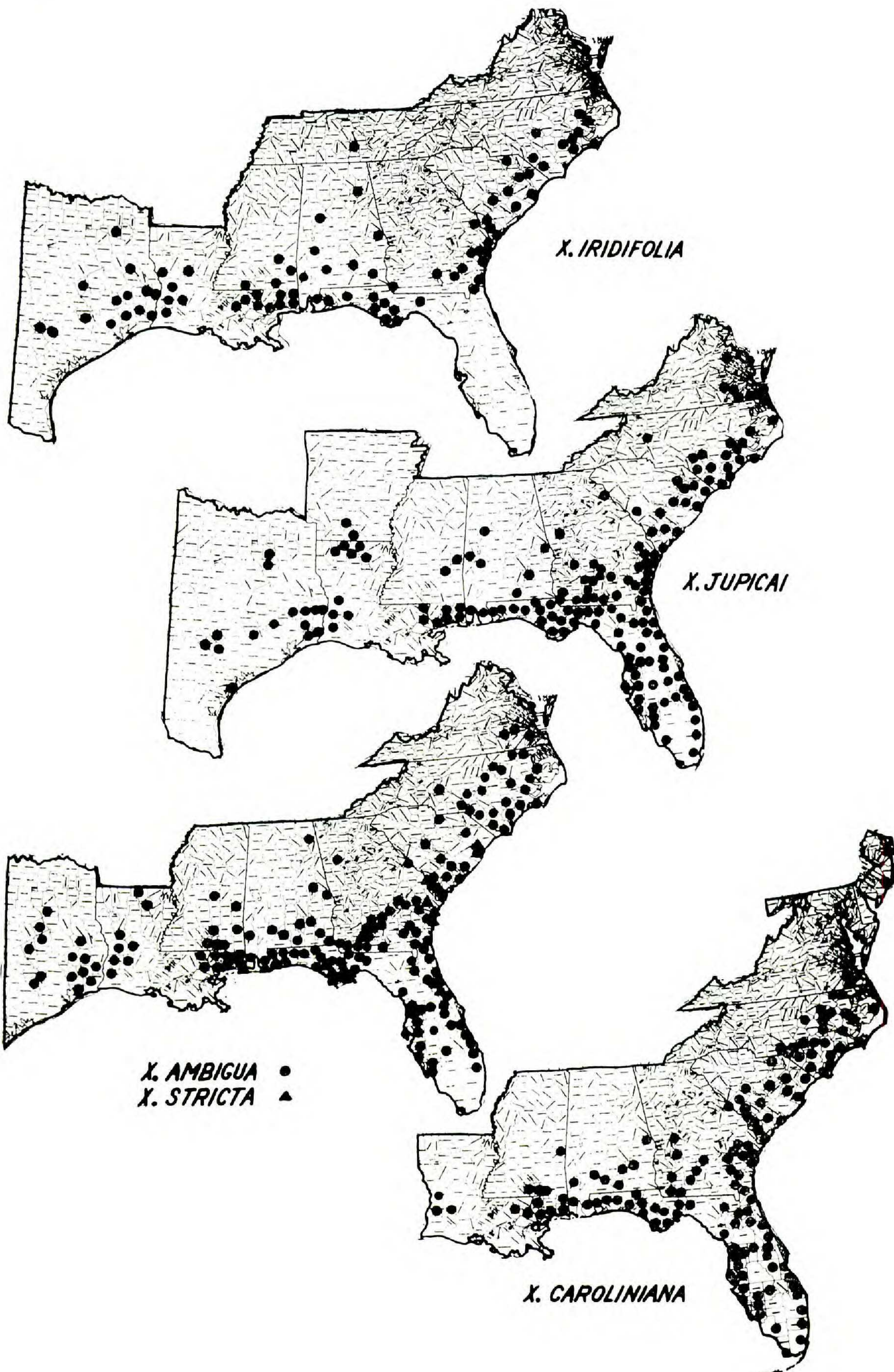
- a. *Xyris caroliniana* (high bank)
- b. *Xyris flabelliformis*, *X. brevifolia* (moist upper bank & seepage)
- c. *Xyris elliottii*, *X. baldwiniana*, *X. ambigua* (lower bank)
- d. *Xyris difformis* var. *curtissii*, *X. drummondii*, *X. ambigua*, *X. jupicai* (bank)
- e. *Xyris jupicai*, *X. stricta*, *X. smalliana*, *X. serotina* (shallow water)
- f. *Xyris smalliana*, *X. stricta*, *X. fimbriata* (deeper water)
- g. *Xyris iridifolia* (deepest water), sometimes accompanied by *X. smalliana* or *X. fimbriata*.

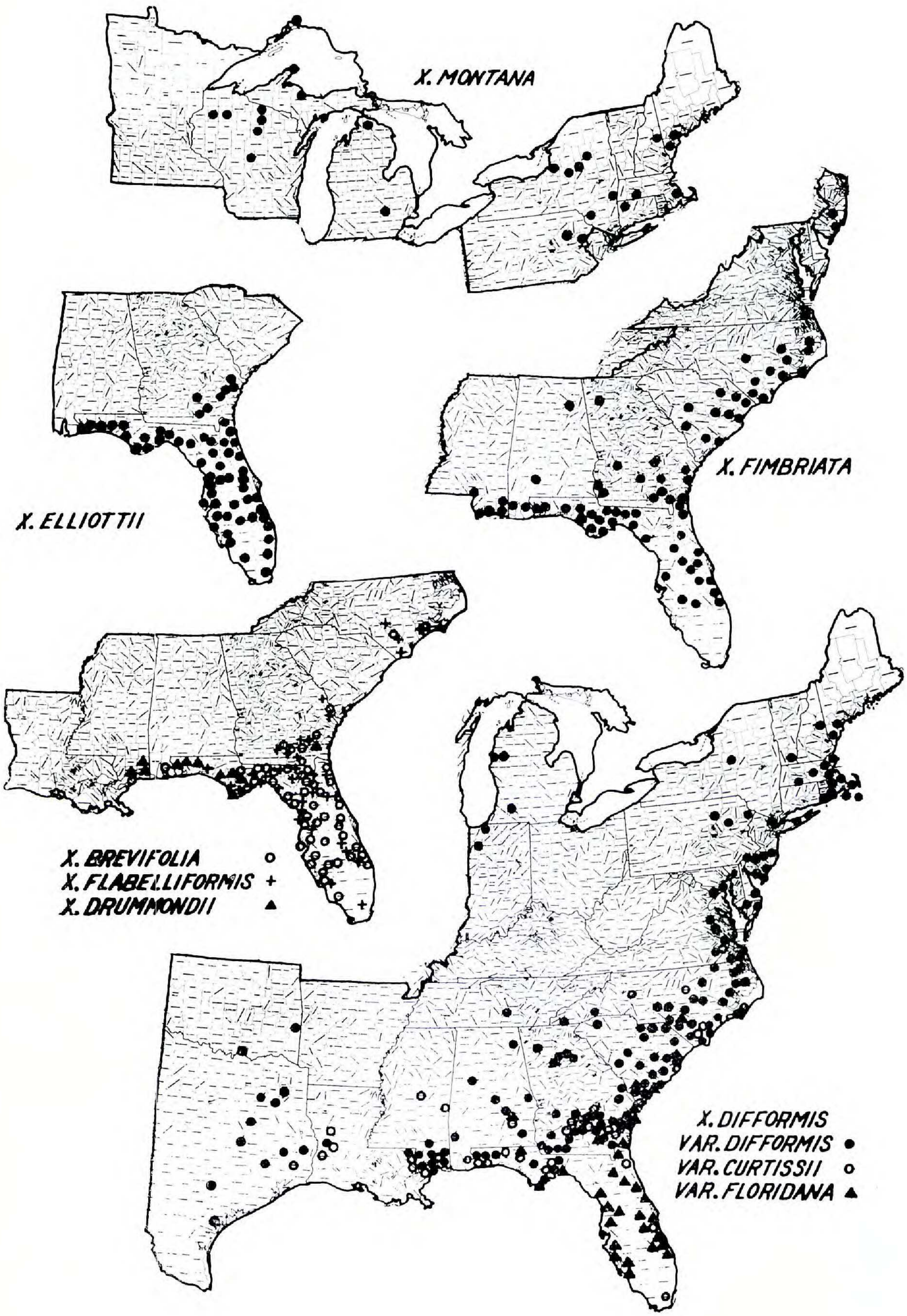
Such areas are interesting enough to study for days on end; I spent the better part of a day watching these plants noting that all during that time some species or another was opening or closing its flowers and that even these flowers showed differences not remarked on since the time of Dr. Chapman.

However, in retrospect and after having seen many such localities, I am most of all impressed by the fact that all of these cohabitants are so amazingly uniform despite the fineness of the characteristics which distinguish them. In short, hybrid swarms appear to be rare in this genus. A year previously I had suspected that *X. stricta*, invariably in association with *X. ambigua* and *X. iridifolia* in such disturbed sites, and so intermediate in its morphology, must be an F-1 hybrid of the two. Yet seed of it, germinated successfully in the greenhouse, grew up to flowering size in a year to produce an astoundingly similar set of plants rather than the expected segregates; progeny tests of *X. serotina* Chapm., another entity suspected of being hybrid, will probably be quite uniform. Thus I am treating both as species for the time being, while suspecting them as possible apomicts. Later studies will be made of these two, also the complex here treated as *X. difformis* Chapm. If evidence develops that apomixis is frequent in *Xyris*, it would have to be the sort that generates amazingly similar populations over a range extending from at least southern North Carolina south to north Florida and west to Mississippi.

A field study of southern *Xyris* is insight into the fact that some are rapidly increasing their range. These appear to be species which a) have the broadest tolerances as to substratum and moisture and which would b) most quickly occupy disturbed areas of wet ground such as roadside ditches or drainage canals along which great distances could be covered rapidly. Such a species is *X. jupicai*, which appears equally at home on silty or clay alluvium or wet sands. It is not unlikely that, since the creation of our extensive system of roads and canals which interconnect the wetlands of the Coastal Plain, the total area of *X. jupicai* has increased many times. I have so far seen this plant in quantity in undisturbed situations only in peninsular Florida (a possible center for its dispersal in the U.S.); elsewhere it is most commonly found in borrow pits, around farm ponds, but especially in roadside ditches where it may actually be the only species found for miles. Other







species of alluvial substrata which appear to be rapidly moving are *X. iridifolia* and *X. difformis*. Still others, capable of being weeds on sandy substrata (*X. flabelliformis*, *X. brevifolia*, *X. elliottii*) fade out of the picture on heavy substrata. Much yet remains to be learned about the mode of dispersal of such plants.

BASES FOR THE CATEGORISATION OF XYRIS

As commented on earlier, in other sections of this paper, the *Xyris* of the southern Coastal Plain of the United States appear to be quite similar cytologically, are often weedy and prone to cohabit disturbed areas, and are in many regards very similar in floral morphology. Yet it also appears to be true that the differences in morphology which do exist are seemingly unaltered when the species do mix populations. It is possible that they are prevented from hybridisation by external isolating barriers such as the following:

1. Differences in flowering times. Some species (*X. flabelliformis*, *X. brevifolia*, *X. baldwiniana*, *X. elliottii*, and *X. torta*) are usually through flowering and are setting fruit by the time the others begin to bloom. Some species flower in the morning; others bloom later in the morning at a time when early bloomers are closing up, while still others bloom in midday or afternoon. Of course, still more needs to be discovered about time of day of flowering in that many species doubtlessly change their time in relation to change in day length.

2. Differences in habitat. These have been discussed in the section on ecology.

3. Differences in distribution. E.g. *X. torta* has a center of distribution well inland from that of most of the other species; of the dwarf species of *Xyris*, *X. drummondii* is the only one occurring mainly on the higher terraces of the Gulf Coastal Plain, the other two being seldom far from the present coast. Where populations of all three do overlap (in the vicinity of Pensacola) it is separated from the other two by being distinct in its season of flowering.

The above and doubtlessly many more factors must certainly influence the number of opportunities for exchange of pollen between species, and play a prominent role in influencing the philosophy of this study.

The criteria on which designation of rank of taxa is based are as follows:

- a. Species of *Xyris* are those entities which appear to have the same range of characteristics whether they be in pure stands or mixed with populations of other species.

- b. Species of *Xyris* are those entities whose reactions to the vagaries of external environment have been observed many times over to move in predictable (if not precisely measurable) patterns. This rules out the designation as species of such natural variations as disturbance reactions.

- c. Varieties of *Xyris* are those entities which have an ecological or geographical correlation to their morphologies but which nonetheless

maintain their character under the influence of a contrived, uniform, habitat (Greenhouse).

The above criteria are few, but demonstrable.

CITATION OF SPECIES EXAMINED

A complete citation of all specimens examined during the course of this study would be exhaustively long and quite expensive. I am therefore compiling a separate, mimeographed list of specimens recently collected and distributed by Godfrey, Demaree or myself. The reason for such a move is to make available to the reader a large, recently collected, store of carefully documented specimens. My own samples are often of 25 or more plants; many exceed 10; each specimen represents a separate plant in a population, not a splitting up of a few large plants. Sampling was done in short strips through dense stands; along such strips all plants were pressed which had reached flowering and fruiting size, regardless of their size or quality. Therefore some recipients of exsiccatae may not be overjoyed, but they might write the holders of the other duplicates and thus have the entire sample on loan.

A list of specimens loaned to the author and which also form a part of the basis for this study is being prepared and will eventually be available upon request.

SYSTEMATIC TREATMENT

XYRIS (Sect. *Xyris*) L., Sp. Pl. 42. 1753.—Gen. (ed. 5) 25. 1754. (There credited to Gronovius.)

Kotsjilettia Adans., Fam. Pl. 2: 60. 544. 1763.

Perennial, tufted or solitary, scapose herbs from short, soft, fibrous or bulbous bases, the roots fibrous, but fleshy. Leaves basal, tufted, equitant, distichous, the blades linear or terete-filiform, the bases abruptly or gradually dilated. Inflorescence a contracted, compact, bracteate, cone-like spike, the bracts spirally arranged. Flowers perfect, zygomorphic, in the axils of leathery or chaffy, imbricate, bracts, the perianth members all separate, the corolla ephemeral. Calyx of three members; the inner two boat-like, chaffy, keeled, and persistent, the outer one membranaceous, and covering the flower in bud. Corolla of three subequal members each comprised of a broad, yellow or white blade, and a long narrow claw which is concealed by the subtending bract. Stamens three, adnate to the corolla by their filament bases, the anthers divided into two thecae by the broad connective; staminodia three, alternating with the petals, bifid, their margins simple or lined with multicellular trichomes. Ovary superior, 3-parietal, with the placentae somewhat intruding toward their apices; style 3-branched above, the branches each conduplicately folded and terminating in a truncate, short-bearded, stigma. Fruit capsular, oblong-compressed, the thin pericarp with valvular or irregular dehiscence. Seeds small, striate or striate-reticulate, ovoid, ellipsoidal, or fusiform, usually apiculate or caudate.

Type Species. *X. indica* L.

1. Keel of lateral sepals ciliate or fimbriate.
2. Tips of lateral sepals exerted beyond the subtending bract, fimbriate (usually crisped); spikes seldom shorter than 1 cm.; seeds seldom shorter than 0.8 mm. fusiform, with broad, flat, longitudinal ridges; sheathes of the scape exceeded by the leaves.
3. Scape ridges conspicuous, harsh to the touch; spikes ovoid or broadly ellipsoidal, dull brown; bases of leaves soft, straw-coloured to pale green or pinkish; flowers opening in the morning; plants of very wet substrata, the bases often submersed.
 14. *X. fimbriata* Ell.
3. Scape ridges lower, less conspicuous, smooth (minutely tuberculate or papillose under magnification); spikes narrowly ellipsoidal or lance ovoid, comparatively lustrous; bases of leaves swollen, bulbous, a lustrous chestnut-brown, deeply sunken in the substratum; flowers usually opening in the afternoon; plants of moist, but certainly not wet, substrates.
 10. *X. caroliniana* Walt.
2. Tips of lateral sepals not exerted beyond the subtending bract and not fimbriate (in old or dried spikes the lateral sepals may separate from the bracts and appear to be exerted, but exertion is supposed to mean that bracts are shorter than sepals); seed lengths and shapes various, but the seeds without broad, flat, longitudinal ridges; sheath lengths various.
4. Sheathes of the scapes longer than, or equal in length to, the longer leaves.
5. The sheathes of the mature scapes as long as or slightly shorter than most of the main foliage leaves.
6. Leaf bases with tinges of pink or lavender, the surfaces papillose or tuberculate-scabrid; seeds fusiform or narrowly ovoid-caudate, 0.8-1.0 mm. long; leaves narrowly linear, ascending, the margins prominently papillose or tuberculate; lateral sepals slightly curved, narrow, the narrow keel smooth below, sparsely ciliate toward its apex; plants of coldwater sphagnous situations of the boreal forest region.
 22. *X. montana* Ries
6. Leaf bases marked by dark, chestnut-brown basal "patch," the leaf surface usually smooth; seeds ovoid, ca 0.5 mm. long; leaves broadly linear, usually flabellately arranged; lateral sepals strongly curvate, the keel regularly ciliate almost from the base to the apex; bog plants, very local, from the Gulf Coastal Plain. 1. *X. drummondii* Malme
5. Sheathes of the scapes surpassing most or all of the larger leaves.
7. Leaves flabellately arranged or ascending, usually narrowly

- linear; plants characteristically in brown-based clumps of a large number of scapes, the living leaves characteristically green above a stramineous, brown, green or pinkish base; spikes broadly ovoid, but more often globose or hemispherical or turbinate, the bracts with thin, erose, maroon or reddish-brown, lacerate borders, keelless; lateral sepals linear-curved, the keels entire or with distant papillae or ciliae (tips of lateral sepals may resemble tips of upper bracts in being thin, erose, and coloured). . . . 2. *X. brevifolia* Michx.
7. Leaves flabellately arranged, broadly linear-curved; plants characteristically solitary or in small tufts of few scapes (often the leaves are curved toward or flattened against, the sandy substratum, or buried partially in it); living leaves characteristically maroon, save for a pale, scarious margin along the equitant portion; spikes ovoid, acute, the bracts often keeled, the bract margins not differently coloured or coloured only at the very apex, entire or subentire; lateral sepals curved or sigmoid, the wings broad, the keel ciliate-scabrid (this species may be distinguished during the winter rosette stage by its deep maroon, diminutive, curved fans of leaves in contrast to the straighter, narrower, usually greener, leaves of *X. brevifolia*). . . . 3. *X. flabelliformis* Chapm.
4. Sheathes of the scape definitely exceeded by the main foliage leaves.
8. Mature spikes 1 cm. long or longer, the larger leaves 10 cm. long or longer; sheathes of the scape with short-cusplike blades.
9. Leaves ascending, twisted, strongly grooved; spikes ovoid, the bracts and lateral sepals with a small apical tuft of short, reddish-brown hairs; bases of leaves abruptly expanded, pinkish or purplish, becoming dark brown, the bases of the plants therefore bulbous and the outermost leaves often scale-like. 13. *X. torta*. J. E. Sm.
9. Leaves spreading, scarcely twisted; spikes narrowly ovoid, ellipsoidal or oblong; bracts and sepals not as above; bases of leaves longitudinally striate (the innermost fresh leaf bases white, the striae in sharp dark contrast) and with the bases of the plants often invested by a stubble or ramentum of fibrous dead leaf bases.
10. Seed farinose, dark when dry and ripe; spikes oblong-cylindric; plant bases maroon, purplish, dark-brown or reddish-brown, usually caespitose on muddy, often submersed substrata; leaves narrowly linear, gradually tapering from the equitant base to tip; petal blades sharply cuneate, 0.5 cm. long, or less, opening about midday. 8. *X. stricta* Chapm.

10. Seed translucent, usually paler when dry and ripe; spikes lance-ovoid or ellipsoidal; plant bases usually paler in colour, usually in small clumps or solitary on moist but seldom mucky substrata; the leaves shorter, broader, more flabellately spreading; petal blades obovate, about twice the size of those of *X. stricta*, opening in early morning, closing toward midday. 7. *X. ambigua* Beyr.
8. Mature spikes never 1 cm. long, usually few-flowered; leaves seldom 10 cm. long; blades of scape sheathes short or elongate.
11. Leaf bases pinkish, the leaf surfaces papillose and/or tuberculate-scabrid; seeds 0.8-1.0 mm. long, fusiform; blades of scape sheathes elongate; plants of coldwater, sphagnous, northern bogs. 22. *X. montana* Ries
11. Leaf bases generally brownish or tan, lustrous, smoothish; seeds not longer than 0.5 mm., ellipsoidal; densely tufted, filiform-leaved plants similar in general appearance to *X. baldwiniana* and so far known only from Washington and Bay counties, Florida. 6. *X. isoetifolia* Kral
1. Keel of lateral sepals lacerate, usually quite thin, rarely entire.
12. Leaves narrowly linear or filiform, the blades gradually expanding below into lustrous, rich-brown or tan, hard bases; the plants densely caespitose, the spikes ovoid and seldom longer than 1 cm.
13. Leaves linear, flattened in the cross-section of the blade, and with an evident, paler and incrassate, pargin; scape usually narrower than the leaf blades (save for some filiform-leaved populations in southern peninsular Florida), often 2-edged above; staminodia bearded; seeds ellipsoidal, seldom longer than 0.6 mm. 4. *X. elliotii* Chapm.
13. Leaves filiform, terete to broadly elliptic or blocky in the cross section of the blade and without an evident, incrassate pale margin; scape at least as broad as, usually broader than, the leaf blades, and terete or but slightly edged at one spike-length below a spike; staminodia beardless; seeds narrowly ellipsoidal, nearly 1 mm. long. 5. *X. baldwiniana* Schultes
12. Leaves broader or not as above, the leaf bases softer or of a different colour; the plants or spikes not as above.
14. Lateral sepals exerted beyond the tips of subtending bracts.
15. Plants densely caespitose, the plant bases pinkish, tuberculate scabrid or papillose, the leaf blades seldom broader than 2 mm., the scape ridges tuberculate-scabrid or papillose; plants of sphagnous boreal lakes and bogs, the spikes usually less than 7 mm. long. 22. *X. montana* Ries
15. Plants not densely caespitose, the plant bases, if pinkish, smooth, the leaf blades not often as narrow as 2 mm., the scape ridges smooth or remotely papillose; more robust plants of sandy bogs and lakeshores of the Atlantic and Gulf coastal plain.

16. Ripe seeds ellipsoidal, dark amber, not longer than 0.6 mm., the longitudinal and cross-lines conspicuous and fairly regular; thus the alveolae regularly rectangular; keel of the lateral sepals tending to be ciliate toward its base, lacerate above toward the tips. 16. *X. longisepala* Kral
16. Ripe seeds narrowly ovoid or oblong, never as short as 0.6 mm., the longitudinal and cross-lines conspicuous but not so regularly disposed and generally forming broader alveolae; base of keels of lateral sepals lacerate.
. 15. *X. smalliana* Nash
14. Lateral sepals included, hidden by the subtending bracts.
17. The bases of the leaves rather abruptly expanded into thickened, flaring, equitant zones, thus the plants bulbous-based (the outer leaves are often shorter, darker, scale-like); scapes often flexuous, usually quite twisted; green, upper portion of leaf blades often conspicuously twisted; flowers opening in the afternoon.
18. Leaf and scape surfaces smooth or scabrous only along the margins and ridges; petals blades obovate; spikes commonly oblong or narrowly ovoid; plant bases pinkish; seeds ovoid, seldom longer than 0.6 mm. 11. *X. platylepis* Chapm.
18. Leaf and scape surfaces prominently papillose or tuberculate-scabrid, thus the foliage having a "glazed" look; bases of young or flowering plants pinkish or purplish; petals blades suborbicular; seeds narrowly ovoid or narrowly ellipsoidal, about 1 mm. long. 12. *X. scabrifolia* Harper
17. The bases of the leaves and the plant bases not as above; scapes usually not flexuous, the blades not conspicuously twisted; flowers opening in the early or late morning.
19. Plant bases pinkish or purplish.
20. Summit of scape quite evidently flattened and broad relative to the spike (at least on living specimens); scape ridges few, usually 2 or 3, the 2 most prominent ones along the scape edges . . . therefore the upper scape narrowly ellipsoidal or fusiform in the cross section; plants commonly of wet situations, sunny or shaded, in creek or river bottoms, titi swamps, cypress swamps, or rooted in muck of flowing water ditches, in fact almost always on fine-textured wet substrata; foliage of the plants smooth, a very deep, rich green, save for the reddish or purplish color of the leaf bases.
21. The two principal scape ridges noticeably and abruptly flattened and wing-like below the spike and in the plane of the flattened scape, their combined width (on live specimens) broader than the scape, thus the outline of

- the cross section of the scape bi-caudate (from N.J. north, the scape ridges become narrower); fruiting spikes seldom longer than 1.5 cm., ovoid, acute; seeds translucent, ovoid or ellipsoidal, seldom longer than 0.6 mm.
- 19. *X. difformis* Chapm. var. *difformis*
21. The two principal scape ridges not abruptly flattened, the scape itself flattened and 2-edged and, in cross section narrowly elliptic; fruiting spikes seldom shorter than 1.5 cm., broadly ellipsoidal or oblong, blunt; seeds farinose, dark when ripe, fusiform or narrowly oblong and never as short as 0.6 mm. (when this species is mixed with the above, as it often is, it is a noticeably larger, broader leaved and scaped, plant).
- 17. *X. iridifolia* Chapm.
20. Summit of scape not flattened and broad relative to the spike, the scape ridges usually more than 3 and therefore the upper scape broadly oval or almost round in outline (save for projecting ridges); habitats diverse, usually not alluvial; foliage pinkish or purplish-based but the surfaces, particularly of the outermost leaves papillose or tuberculate-scabrid.
22. Seeds farinose or very dark, thus opaque; mature spikes ovoid, acute; plants, (save for depauperate specimens) seldom shorter than 2 dm.; solitary or in small tufts; an entity of low, acid pine flatwoods and pine flatwoods ditches, but particularly on recently disturbed, acid moist sands of the lower terraces of the Coastal Plain, n. to N.C., west to eastern La.
- 21. *X. difformis* Chapm. var. *floridana* Kral
22. Seeds not farinose, translucent (save on extremely old herbarium specimens); mature plants seldom taller than 2 dm. (sometimes taller in northern U.S.), usually in large tufts; mature spikes narrowly to broadly ellipsoidal or ovoid, blunt or acute.
23. Leaves broadly linear, usually with the blade above the equitant portion gladiate; keel of lateral sepals wide, fairly thin, its margin lacerate at least toward tip; seeds ca. 0.5 mm. long, ovoid.
- 20. *X. difformis* Chapm. var. *curtissii* (Malme) Kral
23. Leaves narrowly linear, usually with the blade above the equitant portion almost linear or tapering gradually to a narrow tip; blade of scape sheath elongate; keel of lateral sepals narrow, rather thick and dark brown, its margin entire or subentire; seeds nearly 1 mm. long, narrowly ellipsoidal and caudate.
- 22. *X. montana* Ries

19. Plant bases greenish, pale to dark-brown, or stramineous.
24. Surfaces of leaves and scape roughened, the foliage therefore dull green, save for dark brown or charcoal coloured dead leaf bases; ridges of the scape (1 spike length below spike) at least 4; lateral sepals lacerate, dark brown; seeds farinose; plants in pale or brown-based, rigid leaved tufts on very wet substrata, the scapes seldom a third longer than the longer leaves. . . . 9. *X. serotina* Chapm.
24. Surfaces of leaves and scape smoothish, the foliage therefore lustrous, and of a pale or deep green colour; scape ridges rarely as many as 4, the upper scapes 2-edged.
25. The two primary scape ridges 1 spike length below a spike commonly flattened, often scabrous, in combination as broad as or broader than the scape (on living plants); perennial save in drought; leaves commonly spreading, the upper, non-clasping portion elliptic-linear; mature spikes ovoid to subglobose, blunt or acute; plants primarily of river swamps (often in shaded situations) of the Coastal Plain.
. . . . 19. *X. difformis* Chapm. var. *difformis*
25. The scape ridges not as above, hardly distinguishable from the somewhat flattened scape and certainly not, in combination, as broad as the upper scape; plants often annual, save on moistest warmest situations; leaves commonly ascending-linear; mature spikes narrowly ovoid to oblong, blunt; plants primarily of sunny disturbed situations or of sandy open swamps in the Coastal Plain; undoubtedly the most abundant *Xyris* of roadside ditches and comprising the weediest, most rapidly spreading species. . . . 18. *X. jupicai* L. C. Rich

1. XYRIS DRUMMONDII Malme, Ark. Bot. 25A: 14. 1933.

In large tufts, rarely solitary (these are usually seedlings), perennating by means of low-set lateral buds, the plant bases and often the leaf bases buried in a sandy substratum. Principal leaves broadly linear or linear-lanceolate, 3.0-8.0 (-10.0) cm. long, 1.5-5.0 mm. broad, flabellately spreading but not curvate, mostly a lustrous green, but toward the base becoming stramineous and at the very base marked with a conspicuous, dark brown or castaneous "patch." Apex of leaf acute but not curvate. Surface of leaf smooth or with low, short lines of papillae. Margin of blade above the equitant portion papillose or smooth. Sheathes of the scapes about as long as most of the leaves, tightly clasping the scape below, expanding about mid-way up into a narrow, blade-like structure, the margins joining at about 1.0 mm. below the tip. Scapes linear-filiform, sometimes flexuous 4.0-20.0 cm. long, terete and with many, low ribs

below, flattened and 2-edged above. Spikes at seed bearing time lance-ovoid, of many, rather rightly imbricated bracts of which the lowest few are barren with elongate green dorsal areas. Fertile bracts suborbicular or broadly obovate, 4.0-5.0 mm. long, definitely keeled, the apex rounded or obtuse, the exposed margin thin and subentire, the outer surface tan or pale brown with a narrowly elliptic, greenish, dorsal area nearly as long as the bract (on leaf-like lowermost bracts, this dorsal area is sometimes prolonged into a pseudo-blade). Lateral sepals included, broadly curvate, the sides broad, thin, brownish, the keel broad, thickened, a lustrous brown, eventually ciliate for most of its length. Petal blades obovate, about 3 mm. long, unfolding in the morning. Seeds ellipsoidal, slightly longer than 0.3 mm., lustrous, translucent, with 18-20 fine, evenly spaced longitudinal lines and numerous faint cross lines.

Low, moist acid sands or sandy peats of sphagnous peats of roadside ditches, pine flatwoods or disturbed lowlands, Coastal Plain, southeastern Georgia, northwestern Florida, southern Alabama and southern Mississippi.

Type. U.S.A. "ALABAMA"; collected by Drummond. Holotype deposited at K of which a phototype was examined by this writer. Some question as to the actual type locality exists in that there appears to be no actual proof that the itinerary of Drummond included Alabama. It is the opinion of Dr. L. H. Shinnars and of Dr. S. W. Geiser (oral communication) that the original label or documentation could have been modified from one of two abbreviations, i.e., "Fla." or "La." During the first part of the 19th century the boundaries of Florida, Alabama, Mississippi and Louisiana underwent considerable change in that large portions of these territories comprised Indian lands whose administration vacillated between at least three governments and it was during this period that Drummond was in the country.

Ecology and Identification. While it is evident that the morphology of this species is very similar to that of *X. brevifolia* and *X. flabelliformis* it does not often mingle with these species. I have seen evidence of all three cohabiting moist sphagnous sands in the vicinity of Pensacola; however *X. drummondii* flowers in mid summer at a time well past the flowering time of most populations of the other two. It is most commonly a part of the hillside bogs so common to the rolling, longleaf pine country of northwest Florida above the lowest terraces.

(Opposite) 1. *Xyris drummondii*. 2. *X. brevifolia*. 3. *X. flabelliformis*



X. drummondii is readily separable from other *Xyris* on the basis of its having subequal scape sheath and leaf lengths and also its having, toward or at the base of each leaf a dark, lustrous, patch. In addition, its spikes show in the fresh condition a very noticeable flattening; thus, when the spikes are turned edgewise, they show a narrowly ovoid or lance-ovoid outline. A slight clinal variation may exist within the known range of *X. drummondii*, this having to do with leaf margin and epidermis. The plants from the eastern part of the range tend to have papillate leaf margins and surfaces while those from the western part of the range tend toward smoothness. According to Malme (1925A) the only then existing material of this species comprised the type specimen at Kew, so that the reader must be assured of the rareness of this species, or at least of its scarcity in collections.

2. XYRIS BREVIFOLIA Michx., Fl. Bor. Am. 1:23. 1803. (Figs. p. 219).

In large tufts, rarely solitary, perennating by means of low-set lateral buds. Principal leaves linear to linear-lanceolate, 2.0-5.5 (-7.0) cm. long, 0.3-2.0 mm. broad, the equitant portion from 1/4-2.3 the total leaf length, ascending to flabellately spreading, not curvate, often maroon, purplish, or pinkish during the overwintering or seedling stage, progressively browning and dying toward the centre of the plant as anthesis is reached, then passed, narrowing progressively from the greenish or brownish (sometimes slightly fibrous) equitant base to the acute, slightly incurved apex. Surface of leaf smooth or low-papillose. Margin of blade above the equitant portion incrassate, papillose or smooth. Sheath of the scape longer than the leaves, tightly clasping the scape below, expanding about mid-way up into a blade-like structure (which however is still equitant), the margins joining at from 1.0-3.0 mm. below the tip. Scapes filiform, twisted but rarely flexuous, many-ribbed below, terete and one-to-many ribbed above or sometimes slightly flattened and bicarinate just below the spike. Spikes at seed-bearing time globose (rarely ovoid) to depressed-globose or obovoid, 4.0-8.0 mm. long, 4.0-7.0 mm. broad, of comparatively few, rather loosely imbricated, bracts of which the lowermost are usually barren. Fertile bracts broadly obovate to suborbicular, 3.0-5.0 mm. long, slightly or not at all keeled, the apex rounded, the exposed margin with a thin, narrow but conspicuous reddish or maroon, lacerate, sometimes squarrose, border, the outer surface at anthesis tan with a narrowly elliptic subapical, reddish-brown dorsal area. Lateral sepals included, about the length of the subtending bract, linear, straight or slightly curvate, the sides narrow, thin, pale brown, the keel narrow, thickened, entire or papillate or rarely low-ciliate, a deep lustrous reddish-brown. Petals with obovate blades, 2.5-3.0 mm. long, unfolding in morning. Seeds ellipsoidal, 0.3-0.4 mm. long, with 20-24 evenly distributed, low longitudinal lines, the cross lines not evident.

Low, moist acid sands or sandy-peats of pine flatwoods, pineland pond-shores, lakeshores or particularly abundant on disturbed sandy moist areas, Coastal Plain, eastern North Carolina south to southern Florida and the Florida Keys (south beyond our range into the Caribbean Islands and South America), west to southern Alabama.

Type. U.S.A. GEORGIA. "Wet meadows, coastal Georgia"; collected by Michaux. Holotype at P; this particular specimen does not show the plant bases but consists only of a number of spikes and scapes. However, the spikes show both the globose outline and the fringed, coloured, bracts unique to the species.

Habitat and Identification. *X. brevifolia* is one of the weedier *Xyris*, often forming solid stands on bulldozed pine flatwoods sands of the Florida peninsula. It actually appears to be confined in its distribution to soils which are very high in sand but which are rarely flooded and thus is commonest within its range on the lowermost terraces of the Coastal Plain. Its range is very similar to that of *X. elliotii* and *X. flabelliformis*, the former also being found in the Caribbean islands. It is often found on exposed seepage sands along roads, usually in association with such species as *Lycopodium alopecuroides*, *L. carolinianum*, *L. inundatum*, *L. cernuum*, *Eriocaulon* spp., *Lachnocaulon* spp., *Syngonanthus flavidulus*, other *Xyris* such as *X. ambigua*, *X. elliotii*, *X. flabelliformis*, *X. jupicai*, *X. platylepis*, *Aletris* spp., orchids such as *Pogonia*, *Calopogon*, *Habenaria*, *Spiranthes*, dicots such as *Drosera* spp., *Sarracenia* spp., *Pinguicula* spp., *Utricularia* (particularly *U. subulata*, *U. cornuta*, *U. juncea*), and a multitude of grasses, sedges, rushes and composites. It is similarly abundant on the fluctuating shorelines of pineland ponds and lakes or on recently burned sandy savannas but a removal of pyrrhic or mechanical disturbance factors will mean that this short lived, low, species will give way to an increase of the grass-sedge complex.

The winter rosettes of *X. brevifolia* were collected on 28 December 1962 from a bulldozed flatwoods area 8 mi. w. of Tallahassee, Florida, by the writer and Dr. R. K. Godfrey. These were transplanted to the greenhouse at Louisiana Tech during the first week of January 1963 and in two months had reached anthesis. Seed was gathered and planted shortly thereafter and by June of 1963 these had developed to flowering size, certainly proof that this species is a precocious germinator which can probably produce at least 2 generations during a favorable growing season. In fact *X. brevifolia* may bloom the year round in southern Florida.

X. brevifolia resembles *X. flabelliformis* most closely and has frequently been so identified. It is also true that the two are very often cohabitants of disturbed areas, that they both come into flower at about the same time, and that their flowers are open at the same time of day. In spring of 1958 I made a series of strip samples through mixed populations of the two in Hamilton, Jefferson, and Wakulla counties, Florida,

and compared these with similar population samples of *X. brevifolia* from southern Florida where it could be found in pure populations: Hamilton Co., *Kral* 6397; Jefferson Co., *Kral* 6430, 6434, 6438; Wakulla Co., *Kral* 6442; De Soto Co., *Kral* 6522; Charlotte Co., *Kral* 6530; Orange Co., *Kral* 6561. Each sample consists of at least 50 individuals, none from the same clump, an easy matter for a collector in that these *Xyris* formed a turf in the areas sampled. On the basis of a study of the above cited samples, together with an examination of many subsequent but smaller ones and of loan specimens, the following comments are appropriate:

X. brevifolia and *X. flabelliformis* differ in that:

a. The leaf length-leaf breadth ratios for the two are significantly different; those for the former are larger than are those for the latter.

b. The bract margins of the two are significantly different in that those of *X. brevifolia* are purplish, ragged, while those of the latter are not coloured and tend to be entire.

c. The keel of the lateral sepals of the former is entire or remotely papillate; that of the latter is ciliate.

d. The leaf habit of the former is more ascending and the plants tend to be more tufted than is the case with the latter.

e. Maroon pigmentation is less copious in the former than in the latter.

f. Spikes of the former have a lower length-width ratio than do those of the latter.

When large populations of both *X. brevifolia* and *X. flabelliformis* are mixed:

a. Some individuals may closely resemble either of the species.

b. More, however, exhibit intermediate characteristics in regard to leaf length-breadth ratio, bract margin, keel of lateral sepal, habit, and pigmentation.

Thus it would appear that some intergradation is happening, at least in northern Florida, between the two species and that it ought to be studied wherever the ranges of the two overlap. The expressiveness of populations of both species does appear related to whether or not they cohabit an area. A majority of the specimens from these samples has not been distributed, although they have been mounted; these same specimens are available on loan to anyone who wishes statistically to verify my observations.

3. XYRIS FLABELLIFORMIS Chapm., Fl. S. US. 499. 1860. (Figs. p. 219).

Solitary or in small tufts, perennating by means of low-set lateral buds or behaving as an annual. Principal leaves linear-lanceolate, (1.0-) 2.0-3.0 (-4.0) cm. long, 1.0-3.0 (-4.0) mm. broad, usually slightly curvate, the equitant portion from 1/3-1/2 the total leaf length, the surface of the leaf papillose in short transverse lines, often maroon, purplish, or pinkish during the overwintering of vegetative stage, progressively browning and dying toward the centre of the plant as anthesis is reached, then passed; margin of blade above the equitant portion slightly increas-

sate, papillose or finely tuberculate-scabrid. Sheath of the scape longer than the leaves, tightly clasping the scape below, expanding about midway up into a blade-like structure (which however is still equitant), the margins joining at about 1 mm. beneath the tip. Scapes filiform, twisted, sometimes flexuous, many-ribbed below, terete and 4-many ribbed above just below the spike. Spikes at seed-bearing time ovoid (rarely globose), 4.0-8.0 (rarely 10.0) mm. long, 3.0-5.0 mm. broad, of a comparatively few loosely imbricated bracts. Fertile bracts broadly obovate to suborbicular, 3.0-5.0 mm. long, often low-keeled, the apex rounded or acute, the exposed margin entire or shallow erose, becoming somewhat lacerate with age, the outer surface at anthesis tan with an elliptic subapical, pale green, dorsal area but at fruiting time becoming a darker brown, the dorsal area inconspicuous or reddish-brown. Lateral sepals included, usually about 1 mm. shorter than the subtending bract, bent-curved, the broad sides thin, lustrous, pale brown, the keel narrow, thickened, ciliate, and deep lustrous reddish-brown. Petals with obovate blades, 2.5-3.0 mm. long, unfolding in the morning. Seeds broadly ellipsoidal, 0.3 mm. long with 20-24 evenly distributed longitudinal low ribs, the cross-lines not evident.

Low, moist acid sands or sandy-peats of pine flatwoods, pineland pondshores, lakeshores or particularly abundant on disturbed sandy moist areas, lower terraces of the Coastal Plain, North Carolina south to Peninsular Florida and west, close to the Gulf Coast, to eastern Louisiana.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. The holotype, deposited at NY, bears an undated annotation by Chapman which reads "*X. brevifolia* Michx. var. *subcarinata*." Isotype at GH.

Ecology and Identification. In regard to habitat and associated species *X. flabelliformis* is very similar to *X. brevifolia*, which see. Over a large part of its range it is found in mixed populations with *X. brevifolia* but it does appear in apparently pure populations and evidently gets farther west than does *X. brevifolia*. However, it is never far from the present coast.

Populations of *X. flabelliformis* have extremely short, curved, maroon-coloured leaves and narrowly ovoid, fringeless spikes; the lateral sepals are bent-curved and with a conspicuously ciliate keel. As was explained in the discussion under *X. brevifolia*, these distinguishing characteristics are somewhat modified when *X. flabelliformis* and *X. brevifolia* occur in mixed populations (at least in north Florida.)

4. XYRIS ELLIOTTII Chapm., Fl. S. US. 500. 1860. (Figs. p. 225).

In large tufts, the bases brownish, lustrous, perennating by means of pale, elongated, fleshy lateral buds. Principal leaves linear to narrowly linear (rarely filiform), 10-30 cm. long, 1-2 (2.5) mm. broad, flat to slightly twisted; margins minutely tuberculate, incrassate, pale; surface above the equitant portion green or reddish-green, smooth; tip acute to acuminate, slightly incurved; base hard, brown, abruptly but not broadly

dilated, often persistent as chaffy fragments. Sheathes of the scape shorter than the leaves, tight and lustrous brown toward the base, slightly looser toward the oblique, short-tipped, orifice. Scapes 40-60 (-70) cm. long, slightly twisted, or straight, terete with one to several low ridges below, oval or somewhat flattened above in cross section and smooth (or with up to four low ridges, the ridges minutely tuberculate). Spikes of seeding time ovoid to broadly elliptic, acute, 6-15 mm. long, of dull, sometimes appearing shaggy, with several closely imbricate bracts. Fertile bracts 5-6 mm. long, obovate, shreddy at the apex at maturity, the surfaces pale to dark brown, dull, with gray-green, dull, oval or oboval, papillose dorsal areas. Lateral sepals included or slightly exerted, the keel increasingly ragged or ascending fimbriate toward the apex. Blades of petals obovate, ca. 5 mm. long, yellow, opening in the morning. Seeds 0.5-0.6 mm. long ellipsoidal, translucent, with about 12 distinct, straight, longitudinal lines, the vertical lines faint, at irregular intervals.

Moist sands or sandy peats of savannas, pineland pond margins, lake-shore, and roadside ditches, Coastal Plain, South Carolina south to Florida and west near the coast to southern Mississippi.

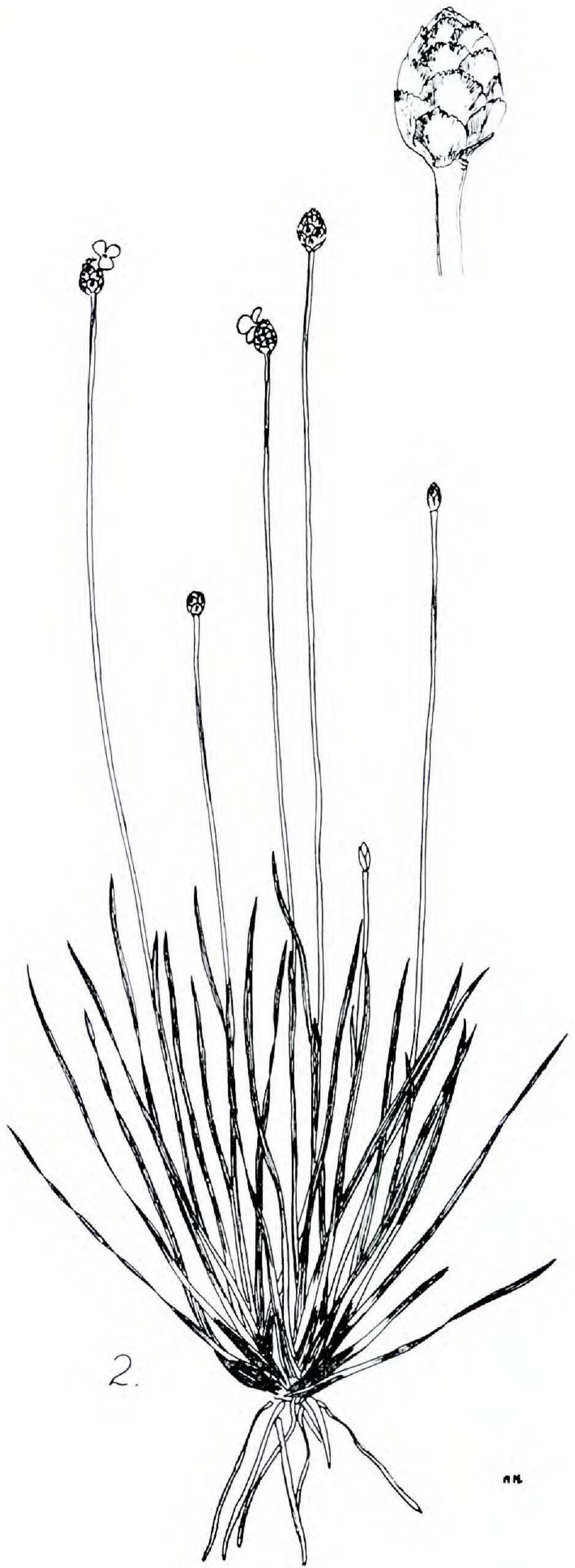
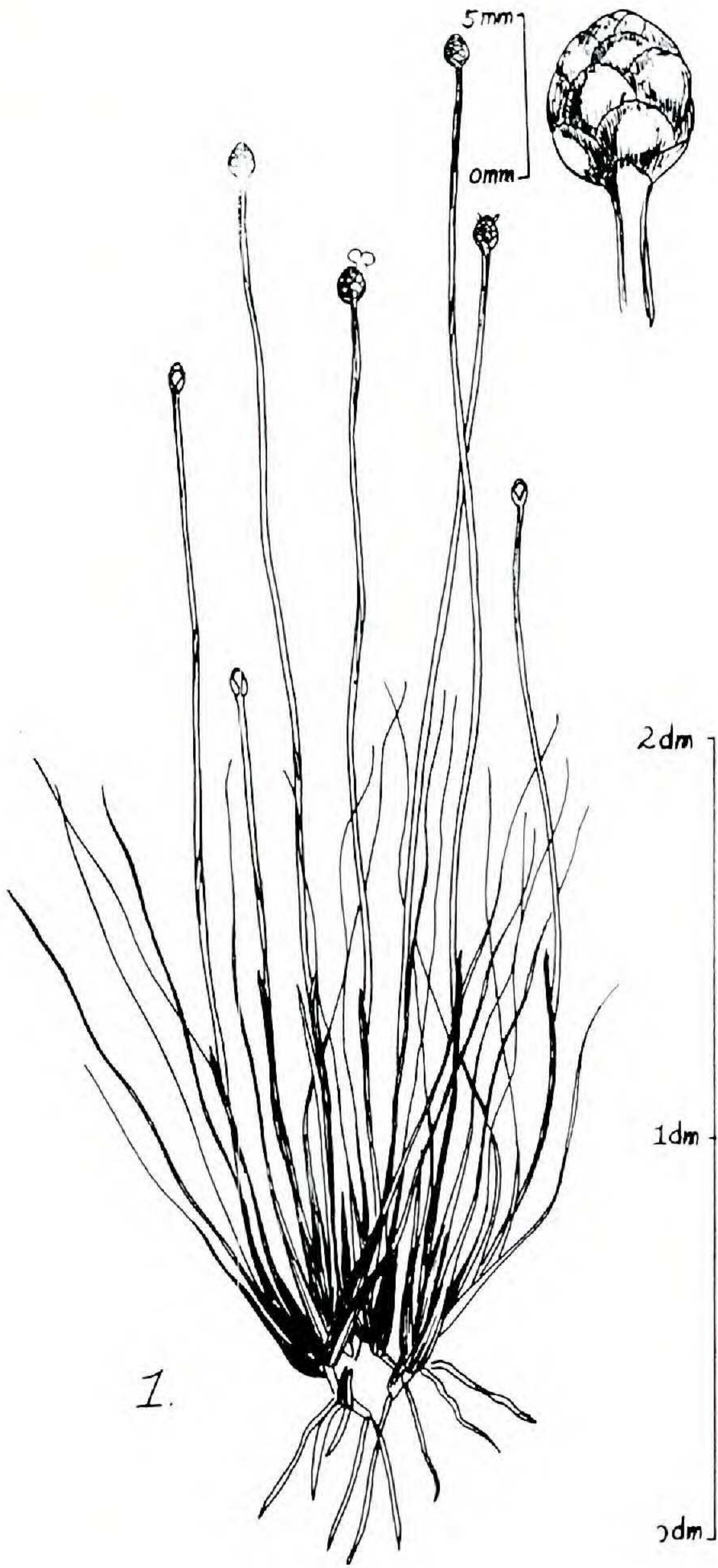
Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY.

This *Xyris* appears to be confined to moist soils which are high in sand; therefore, outside the state of Florida which is primarily sandy, it appears to be commonest on the very lower terraces of the Coastal Plain. Its commonest associated species of *Xyris* are *X. ambigua*, *X. brevifolia*, *X. flabelliformis*, *X. platylepis*, *X. caroliniana*. To the west it appears to grade into a narrower leaved form; there it is often found in association with *Xyris baldwiniana*. To the south, in the lake-dotted central highlands of Florida, it is often narrow (sometimes even fili-form) leaved.

Narrow leaved *X. elliotii* (the variety *stenotera* Malme?) and wider leaved *X. baldwiniana* (the variety *tenuifolia* (Chapm.) Malme) are best distinguished on the basis of bearded staminodia in flowers of the former, vestigial staminodia in flowers of the latter; another good difference consists of the smaller seed of the former. Both species flower at the same time of the year and day, and occur as mixed populations in North Florida, Georgia, and South Carolina. I have observed bees visiting the flowers of both and therefore would not be surprised to discover intermediates, although none have so far been found.

The bulk of populations of *X. elliotii* are easily distinguished on the basis of the incrassate, pale, papillose leaf margin which is usually in sharp contrast to the deeper colour of the blade proper. No other species

(Opposite) 1. *Xyris baldwiniana*. 2. *X. elliotii*.



of *Xyris* grows in such large tufts, save *X. baldwiniana*, from which it is generally distinguished by its bearded staminodia and by its scapes which, though flattened above, are usually narrower than the leaves.

5. XYRIS BALDWINIANA Schultes, in R. & S. Syst. Veg. Mant. 1: 351. 1822. (Figs. p. 225).

X. juncea Baldwin ex Ell., Bot. S.C. & Ga. 1: 53. 1816. Not *X. juncea* R. Br. 1810.

X. setacea Chapm. Fl. S. U.S. ed. 2, 658. 1883.

In large tufts, the leaf bases usually brownish, lustrous (rarely pinkish, this usually on very wet sites), perennating by overwintering, fleshy, pale yellow buds. Leaves filiform to linear-filiform, 10-30 cm. long, straight or slightly twisted, green, terete or oval, or blocky in the cross section above the equitant portion, expanding more or less abruptly toward the lustrous base. Sheath of the scape from $\frac{1}{2}$ as long to nearly as long as the principal leaves, tightly investing the scape save for the loose orifice and a short blade. Scape 20-40 (-50) cm. long, usually broader than the leaf, terete below, one-ridged and tending to be terete above. Spikes at seed-bearing time ovoid or ellipsoidal, 4-7 mm. long, acute or blunt, of a few, tightly imbricate bracts. Fertile bracts ovate to obvate, 4-5 mm. long, not keeled, the apex rounded, the exposed margin entire, becoming erose with age, the matrix dull to dark brown or reddish brown, the dorsal area, elliptic, dull green. Lateral sepals included, slightly shorter than the bracts, linear but slightly curvate, reddish brown, the keel lacerate from the tip to about the middle or slightly beyond. Petal blades cuneate-obovate, ca. 3-4 mm. long, unfolding in morning. Seeds oblong or narrowly ellipsoidal 0.8 mm. to nearly 1 mm. long, the longitudinal lines evident, the whole seed translucent, yellowish or pale amber.

Moist sands or sandy peats of pine flatwoods, hillside bogs, roadside ditches, and savannas, Coastal Plain, North Carolina south into northern Florida and west to eastern Texas.

Type. U.S.A. GEORGIA. "St. Marys R., Ga."; collected by Dr. Baldwin. The specimens, deposited at PH, is now missing its spikes, but the filiform leaves and relatively broad scape mark it well as an example of the species. The type of *X. baldwiniana* var. *tenuifolia* (Chapm.) Malme, deposited at NY, is simply a flatter-leaved version of the same.

Habitat and Identification. *X. baldwiniana* is typical of grass-sedge bogs throughout its range, but it appears to be more abundant on the somewhat heavier wetlands soils of the higher coastal plain terraces than it is on more newly formed land. Therefore it is quite rare in peninsular Florida, in fact has not been collected from south of Levy Co., Florida. It appears to be most abundant as one travels west in the Coastal Plain, and is probably the most abundant *Xyris* in the bogs of Mississippi and Alabama. It begins to bloom very early in the season, hence is fairly effectively isolated from the pollen of most of the other species in that

it has largely ceased to flower by the time most of the others get going.

X. baldwiniana most closely resembles *X. elliottii* and *X. isoetifolia*. It may be distinguished readily from either on the basis of its lack of a staminodial beard, and by its much larger and longer seed.

6. **XYRIS isoetifolia** Kral, sp. nov. Figs. p. 252.

Dense caespitosa filifolia, foliis basin versus brunnescentibus nitidis. Semina parva (paulum minus quam 0.5 mm. longa).

In large tufts, the leaf bases usually brownish, lustrous, perennating by overwintering lateral buds. Leaves filiform to linear-filiform, somewhat flattened in the cross-section, 4.0-15.0 cm. long, smooth, ascending, straight or slightly twisted, green above the equitant portion, pale or brownish below at the very expanded base. Sheath of the scape from $\frac{1}{2}$ as long to nearly as long as the principal leaves, tightly investing the scape save for the loose orifice and short (2.0-4.0 mm.) blade. Scape 15.0-30.0 cm. long, very slightly twisted, occasionally flexuous, linear-filiform, ridgeless, oval or even terete in the cross section above. Spikes at seed-bearing time ellipsoidal to obovoid, 5.0-7.0 mm. long, of few, rather loosely imbricated, bracts. Fertile bracts broadly oblong to obovate, the longer about 4.5 mm., not keeled, the apex rounded, the exposed margin subentire or erose with age, the matrix scarious and pale brown, the dorsal area narrowly to broadly elliptic, pale green. Lateral sepals included, ca. 4.0 mm. long, linear-curved, reddish brown, the keel ciliate. Petal blades obovate, ca. 4 mm. long, opening in the morning. Seeds ellipsoidal, slightly less than 0.5 mm. long, translucent, the 12-14 longitudinal lines distinct and straight, the horizontal lines much fainter.

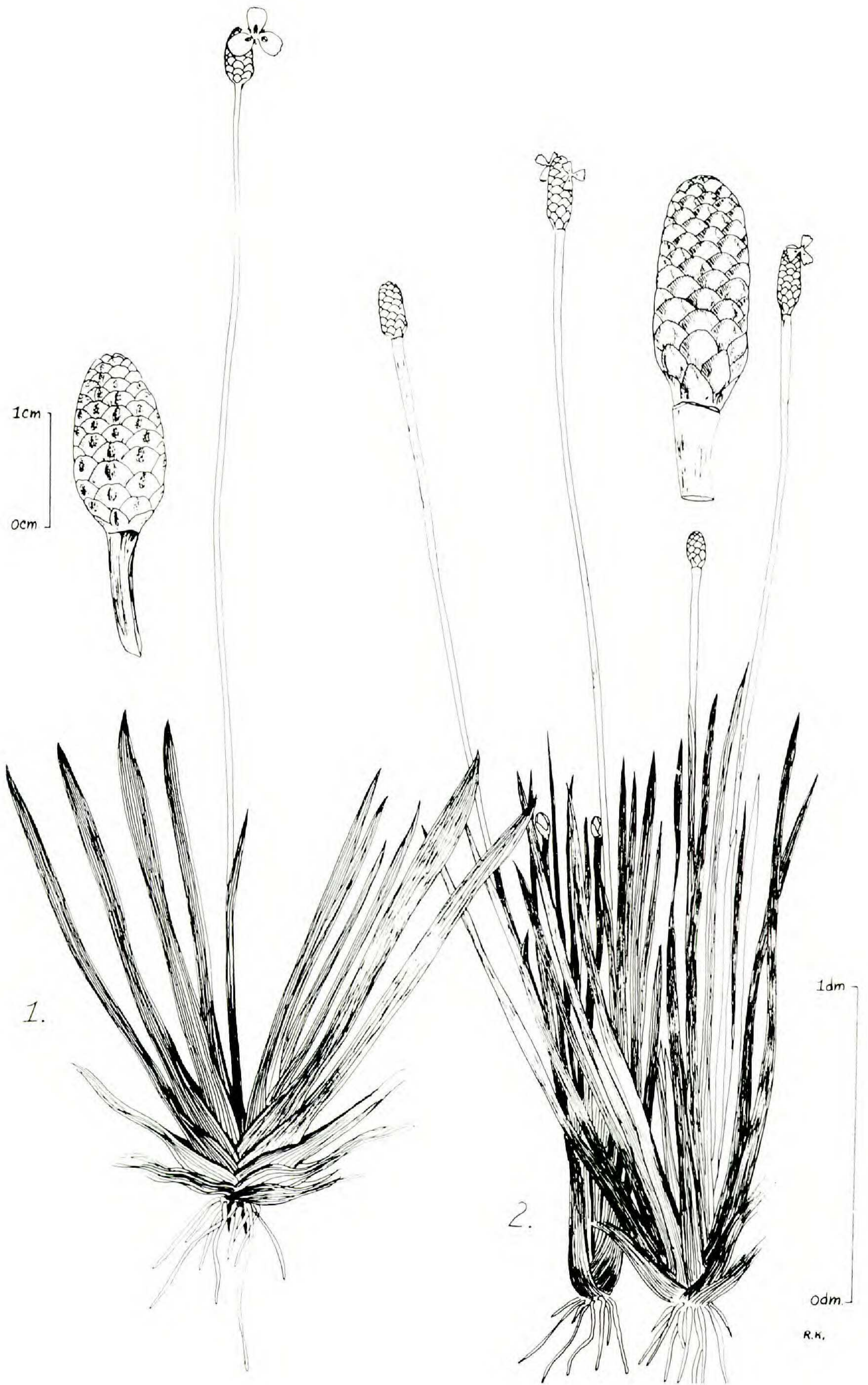
Moist sands or sandy-peat of savanna bogs, flatwoods pond margins and lakeshores, northwest Florida (Bay & Gulf Counties).

Type. U.S.A. FLORIDA. BAY CO.: 5 mi. n. Youngstown; sandy peat of boggy clearing in longleaf pine flatwoods-savanna, *Kral 15651*. Deposited at SMU. Isotypes at: BM, DS, DUKE, F, FLAS, FSU, GH, IA, ILL, ISC, K, LPI, MICH, MSC, NCSC, NY, P, PH, PUL, RS, SMU, US, USL, VDB.

Habitat and Identification. *X. isoetifolia* is locally abundant on moist sands or sandy peats but has not been found on wet situations. On the type locality it was in association with the extremely rare *X. scabrifolia* Harper, together with *X. ambigua*.

X. isoetifolia most closely resembles *X. baldwiniana*; in fact I recorded it as such in my field notebook. However, *X. isoetifolia* has bearded staminodia, a loosely imbricated spike, small seed, and ciliate lateral sepals in contrast to the beardless staminodia, tightly imbricated spike, lacerate lateral sepals, and seed nearly 1 mm. long of *X. baldwiniana*.

Seedlings of this and of *X. baldwiniana* are green, with very slender, straight, fleshy leaves, but I have been unable as yet to bring material of either to maturity in the greenhouse.



7. XYRIS AMBIGUA Beyr. ex Kunth, Enum. Pl. 4: 13. 1843.

Solitary or in small tufts, the base hard, often fibrous, perennating by both terminal and lateral overwintering buds. Leaves broadly linear, spreading, 10.0-40.0 cm. long, 0.3-2.0 cm. broad (tending to be more ascending and linear-leaved on heavier soils), a dark and lustrous green above the equitant portion (ca. 2/3 the total leaf length), the basal, equitant portion stramineous, brownish, or pinkish, narrowing more or less gradually to and abrupt, slightly incurved, tip. Surface of the leaves smooth or slightly papillose; margin of the leaves papillose, rarely harshly scabrous. Sheathes of the scapes from 1/3 to nearly as long as the principal leaves, rather loosely investing the scape save for a distal, blade-like portion, the margins of which converge to form a short (ca. 2 mm.) tip; bases of the sheathes usually lustrous, stramineous to castaneous. Scape (15-) 70-100 cm. long, twisted but rarely flexuous, many-ribbed below, becoming flattened and 2-edged above. Spikes at seed bearing time ellipsoidal to lance-ovoid, 1.0-3.0 cm. long, of many tightly imbricated bracts. Fertile bracts broadly obovate or suborbicular, 5.0-8.0 mm. long, not keeled, the apex rounded, the exposed margin sub-entire or erose with age, the matrix reddish-brown or pale brown, the dorsal area roughly rectangular, olive to dark brown. Lateral sepals included, curvate, a dark lustrous brown, the thickened keel nearly as broad as the sepal sides, ciliate-scabrid. Petal blades yellow, obovate, ca. 8 mm. long, unfolding in morning. Seeds ellipsoidal to broadly ovoid, caudate at one end, 0.5-0.6 mm. long, lustrous with 20-22 distinct, papillose longitudinal lines and several faint cross lines.

Moist sands or sandy-peats of bog margins, savannas, pine flatwoods, lakeshores and roadside ditches, Coastal Plain, Virginia south into Florida and west to eastern Texas.

Type. U.S.A. GEORGIA: "Margins of swamps, Georgia"; collected by Beyrich. I have never seen this type but understand that it was destroyed during the air raids of Berlin. A neotype is hereby designated: U.S.A. FLORIDA. LIBERTY CO.: 2 mi. n. Sumatra; black sandy peat of grass-sedge, longleaf pine savanna, *Kral 15694*; deposited at SMU, isotypes at: BM, DUKE, FSU, GH, IA, ISC, K, MICH, NCSC, NY, PH, RSA, UC, US, USF, USL, VDB.

Habitat and Identification. *X. ambigua* is perhaps the most abundant of all the *Xyris* which frequent the huge expanses of savanna or grass-sedge bog so common to the Gulf and Atlantic Coastal Plain. As a rule it is not found in sites where its bases would be submersed for any

(*Opposite*) 1. *Xyris ambigua*. 2. *X. stricta*.

length of time. It is to be looked for along the *upper* edges of wet places and in association with such other *Xyris* as *X. flabelliformis*, *X. brevifolia*, *X. elliottii*, *X. caroliniana*, therefore it is above the wetter situations occupied by *X. iridifolia*, *X. fimbriata*, *X. smalliana*, *X. jupicai*, *X. difformis*, *X. serotina*, *X. stricta*.

X. ambigua is closest in its external appearance to *X. stricta*, but the bases of the latter are invariably darkly pigmented, the leaves narrower and more ascending, the scape broader and flatter, the spike oblong. While the petal blades of *X. ambigua* are obovate, nearly 1 cm. long, and open in the morning, those of *X. stricta* are cuneate, about 0.5 cm. long or less, and open about midday. *X. ambigua* appears to develop two forms to the west in Mississippi, Louisiana, and eastern Texas; one form has a large stature and appears the same as the eastern plant while the other has more maroon pigmentation of leaf bases and is a much smaller plant with smaller flowers. Both forms may cohabit a single area and the difference between them is therefore quite striking.

A very good means of field identification of this species consists of stripping the outer, often fibrous, leaf bases away and examining the surfaces of the bases of the inner leaves. Here, very prominent, dark, longitudinal veins are evident in sharp contrast to the white or pale intervening tissue.

This species often takes two years to reach flowering size. Seedlings are very similar to *X. flabelliformis* in appearance, being short, flabellately spreading, curvate and maroon-based.

8. XYRIS STRICTA Chapmn., Fl. S. U.S. 500. 1860. (Figs. p. 228).

Tufted, usually in large, rigid-leaved, clumps, whose brown, fibrous bases are set on muck or wet sand in shallow water. Leaves narrowly linear, (15-) 20-50 cm. long, 2-5 mm. broad, gradually tapering to a slender, incurved tip, green above the equitant portion (rarely maroon), but reddish-brown or maroon toward the base (old leaves are very often persistent as brown, almost black scales or shreds); margins tuberculate or papillate, incrassate; surfaces smooth, very rarely papillate. Sheathes of the scapes shorter than the leaves, tight and brownish or castaneous below, becoming maroon or green toward the oblique, short-bladed orifice. Scapes linear, (40-) 45-85 cm. long, roundish toward the base, with a few low, tuberculate, spiral ridges, definitely flattened above toward the spike, the two marginal ridges papillate or tuberculate, sometimes accompanied by 2-4 lower ridges between the margins. Spikes oblong, narrowly ellipsoidal or lance-ovoid, 1.0-2.0 (-2.5) cm. long, blunt, of very many, tightly imbricate scales. Fertile bracts suborbicular, ca. 5-6 mm. long, the outer surface castaneous save for the greenish, rectangular dorsal area, the margins entire. Lateral sepals curvate, about the length of the bracts, a lustrous reddish brown, the wings broad and thin, the keel thicker and ciliate from base to apex. Blades of petals cuneate 3.0-3.5 mm. long, yellow, unfolding in the late morning, closing

in the early afternoon. Seeds ellipsoidal, ca. 0.8 mm. long, caudate at one end, opaque, with 18-20 longitudinal rows of dark, contiguous papillae and somewhat less distinct, irregularly disposed cross lines, all imparting a dark colour to the seed which may also be farinose.

Wet sandy peat, sandy clay, peat muck, or alluvium, often with the bases submersed, cypress flats, roadside ditches, pineland ponds, southern Mississippi east to northern Florida and north in the Coastal Plain (primarily the lower terraces) to South Carolina.

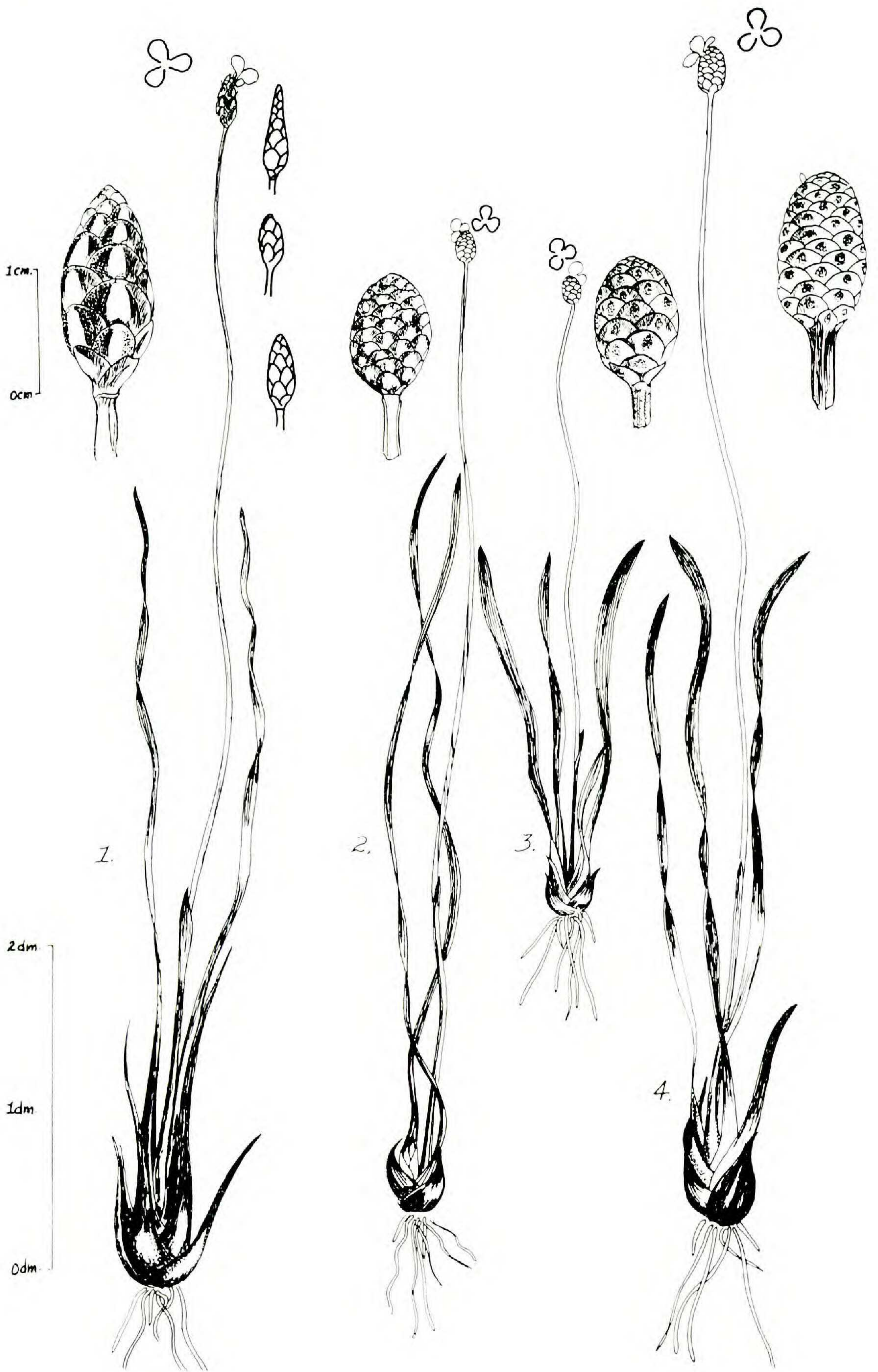
Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY; isotype at GH.

Remarks. *Xyris stricta* is definitely an entity of wet sites, its commonest associates among the *Xyris* being *X. iridifolia*, *X. smalliana*, *X. jupicai*, *X. fimbriata*, *X. serotina*. However, it most closely resembles either *X. iridifolia* or *X. ambigua* the latter almost invariably present on higher ground somewhere nearby. Differences between these three entities are therefore expressed in tabular form below:

<i>X. ambigua</i>	<i>X. stricta</i>	<i>X. iridifolia</i>
Old leaf bases persistent as brownish shreds.	Ditto.	Old leaf bases not persisting, not fibrous.
Bases of leaves brownish or stramineous, very rarely purplish.	Bases of leaves purplish.	Bases of leaves bright pink or purple.
Plants solitary or in small tufts.	Plants caespitose, in large tufts.	Plants solitary or in small tufts.
Leaves spreading widely, broad-linear, often curvate, dull green above the equitant base.	Leaves spreading-ascending, very rigid and narrow, tapering, deep-green above the equitant base.	Leaves spreading-ascending, very broad-linear, a deep lustrous green above the equitant base.
Scape somewhat flattened and 2-edged above, but narrow in relation to spike.	Scape conspicuously flattened above, broad in relation to the spike.	Scape conspicuously broadened and flattened below the spike.
Spikes lance-ovoid or narrowly ovoid, acute, the dorsal area pale green, the rest of the outer surface pale brown or tan.	Spikes usually oblong, blunt, the dorsal area deep green, the rest of the bract deep shining brown.	Spike broadly oblong, blunt, with dark brown scales and a dark green dorsal area.
Petal blades obovate, sometimes nearly 1 cm. long, opening in early morning.	Petal blades cuneate, less than 0.5 cm. long, opening in late morning.	Petal blades cuneate, less than 0.5 cm. long, opening in early morning.
Lateral sepal curvate, the keel narrower than the broader wing, ciliate-scabrid.	Lateral sepals curvate, the keels as broad as the wing or broader, ciliate.	Lateral sepal almost straight, its keel lacerate, thinner.
Seeds translucent, ovoid, ca. 0.5 mm. long or slightly longer.	Seeds usually farinose, opaque, dark-lined, ca. 0.7-0.8 mm. long, narrowly ovoid.	Seed farinose, fusiform, usually 0.8-1.0 mm. long.

Chapman, in the first (1860) edition of his *Flora*, described *X. stricta* as follows:

Scape flattened and broadly margined, rough-edged above, smooth and 1-2 angled below, slightly striate; leaves long, linear, smooth; spikes oblong or cylindrical, obtuse, many-flowered; bracts dark brown, orbicular, crowded on the spike; lateral sepals broadly winged above the middle, narrowed below; petals small, wedge-obovate;



seeds ovoid.—Shallow ponds in the pine barrens, West Florida. July-Sept.—Scapes slender, clustered, 2-3 feet high. Leaves 1-1½ feet long. Spikes 9-12 lines long. Petals 2 lines long.

This is in contrast to his description of *X. ambigua* which is as follows:

Scape rigid, finely furrowed, rough, 2-edged above, 1-angled below; leaves linear-lanceolate, rough on the edges; spike ovate-lanceolate or oblong, even, often acute, many-flowered; bracts light brown, oval, not crowded on the spike; lateral sepals lanceolate, tapering at each end, shining, narrowly winged; petals round obovate; seeds ovoid.— Open grassy pine barrens, Florida to North Carolina. July-Sept.—Scape 2-3 feet high, mostly solitary. Leaves 6-12 inches long. Spikes 9-15 lines long. Petals ½ inch long.

I have examined and measured hundreds of the above entities and yet am unable to draw a much more accurate description than did Chapman. In succinct fashion, he quickly states the essential differences between the two entities which include for the former a flatter scape, longer and narrower leaves, narrower more oblong spike outline, darker bracts, broader sepals, smaller petals and a wetter habitat, together with a caespitose habit. The only characteristic he did not note consists of farinosity of seed. However, despite the clarity of Chapman's description, *Xyris stricta* has since been treated as *X. ambigua*. The reason for this ignorance is probably that no other worker had seen *X. stricta* in its natural habitat, nor had later workers bothered to look at the seeds.

Franklin County Florida still has broad areas of marsh, bog, pine flatwoods and savanna that are little changed from Chapman's day. When one takes the narrow state highway which extends north from Apalachicola toward Telogia in Liberty County it is not difficult to appreciate why Chapman developed an interest in the genus, for certainly this road must traverse more habitats for it than any other comparable length of road in the United States. In the gum and cypress pond pine swamps along the way are countless tufts of this peculiar *Xyris*, while the neighboring pinelands support large populations of *X. ambigua*. It is not surprising that Chapman quickly noted the difference in habitat of the two.

My interest in *X. stricta* was first aroused during the examination of a large collection of a robust, maroon-based, *ambigua*-like *Xyris*, the specimens gotten by Dr. Godfrey (No. 55724) from the edge of a cypress-gum swamp 7 mi. n. of East Point. All of the specimens showed flattened, dilated upper scapes farinose seed, and maroon pigmented narrowly linear leaves in addition to many *ambigua* characteristics such as tightly imbricate, narrow spikes, ciliate sepal keels and long-persistent, fibrous

(Opposite) 1. *X. caroliniana*. 2. *X. torta*. 3. *X. scabrifolia*. 4. *X. platylepis*.

leaf bases. After examination of the type specimen for *Xyris stricta* kindly sent from the New York Botanical Garden, I concluded that it was the same sort of plant as the Godfrey collections and that, whatever the biological status of *X. stricta*, it is certainly not the same as *X. ambigua*. In fact, *X. stricta* appeared to me to have so many characteristics of *X. iridifolia* in addition to those of *X. ambigua* that it could be a hybrid between the two (1960).

In July 1963, Dr. Godfrey and I returned to the locality from which his collection came in order to get further samples of this apparently uniform population. During the summer of that same year several more populations of it were observed along the same road, one particularly fine one in Liberty County south of Telogia. In almost every instance *X. stricta* was found in association with *X. ambigua* and *X. iridifolia*, the former invariably on higher, comparatively drier sites, the latter always rooted in the muck of adjoining cypress-gum swamps, while *X. stricta* would occupy the ecotone.

During December of 1962 and January 1963 seeds and transplant material of *Xyris stricta* and other *Xyris* was gotten. From the seeds of *X. stricta* sown, a very large number of maroon leaved seedlings developed (similar in pigmentation to those of *X. iridifolia* but narrower leaved). Of these 25 survived to flower and set seed by fall of 1963. The uniformity of the progeny of what I had suspected to be an F-1 hybrid of course led to my present treatment of this entity. Future tests will be made to determine whether *X. stricta* is apomictic. In the summer of 1963 I was fortunate in finding several more populations of *Xyris stricta* in Florida as well as in Mississippi, Georgia and South Carolina. There is an astounding similarity between all of these populations. Therefore if *X. stricta* is apomictic, it is apparently very well established and is showing no observable tendency to produce intermediates with any associated species of *Xyris*.

9. XYRIS SEROTINA Chapm., Fl. S. U.S. 500. 1860. (Figs. p. 252).

Tufted, usually in large, dark brown or charcoal-based clumps of spreading-leaved plants, the bases of which are set on muck or wet sand and in shallow water. Leaves broadly linear, 20-50 cm. long, 3-12 mm. broad, stiff, dull green, broadening gradually from the incurved tip to a pale green, pale-brown or stramineous base (old leaves very often persist as dark gray-brown scales); margins tuberculate scabrid, incrassate; surfaces, particularly of outer leaves, tuberculate scabrid in short, diagonal lines. Sheathes of the scapes much shorter than the leaves, tight and lustrous brown below, looser above and with a broadly expanded, blade-like orifice, which terminates in a short, cusp-like blade. Scapes linear, 24-60 cm. long, straight, usually not much longer than the longer leaves, several-angled below, the angles ridged, scabrous, becoming somewhat flattened above, the two most prominent scabrous ridges comprising the edges, with from 1 to 6 additional but less conspicuous ridges.

Spikes ovoid or broadly ellipsoidal, 1.0-1.8 cm. long, acute or blunt, of several tightly imbricated bracts, the lower ones barren. Fertile bracts suborbicular, reniform or broadly obovate, 5-7 mm. long, entire (save in age), the outer surface a dull brown, the dorsal area deltoid, greenish or greenish-brown or reddish-brown. Lateral sepals slightly curvate, linear, about the length of the bracts, dark-brown, the thin keel lacerate from at least the middle to the apex. Blades of petals cuneate, 3.0-3.5 mm. long, yellow, unfolding in the late morning, closing in the early afternoon. Seeds ellipsoidal, ca. 0.6 mm. long, caudate, opaque and farinose, with 2 0-24 dark, longitudinal lines of contiguous papillae and several, slightly less conspicuous, less regular, cross lines.

Wet sandy peat, sandy clay, peat-muck, or alluvium, often with the bases in shallow water, cypress flatwoods, roadside ditches, pineland pond edges, southern Mississippi east to northern Florida and north in the Coastal Plain into North Carolina.

Type. U.S.A. FLORIDA. (Apalachicola?); collected by Chapman. Holotype at NY; isotypes at GH.

The plant here treated as *X. serotina* was described by Chapman (l.c.) as follows:

Scapes clustered, twisted and mostly spiral, rough-angled and 2-edged above, striate; leaves linear-lanceolate, rigid, rough on the edges; spikes many-flowered, ovoid, obtuse, dark brown, even; bracts round-obovate, closely imbricated; lateral sepals linear, narrowly winged above, fimbriate and at length incised; petals small, obovate; seeds ovoid, pulverulent.—Varies with shorter leaves (2-3 inches), and smaller globose or ovate heads.—Pine-barren swamps, West Florida. Sept. and Oct.—Scapes 1-1½ feet high. Leaves 8-12 inches long. Spikes 6-9 lines long. Petals 2 lines long.

I have seen it, usually in association with *X. stricta*, *X. iridifolia*, in the cypress-pond pine country from southern Mississippi to central Florida and north to eastern North Carolina and, as is the case with *X. stricta*, there is a remarkable uniformity of populations over this large range. Its scabrosity quickly distinguishes it from one farinose seeded entity, *X. iridifolia*; its lack of maroon pigmentation and more robust, broader-leaved, habit distinguish it from *X. difformis* var. *floridana*, the third farinose-seeded entity.

It is evident from the above quoted description that Chapman included in his *X. serotina* the smaller maroon based plant here treated as a variety of *X. difformis*. Evidence in favor of the present treatment is developed in the discussion accompanying *X. difformis*.

X. serotina is slow to develop from seed. Seedlings from a sowing made in March 1963 have still not attained flowering size (Jan. 64). From the beginning they were singularly lacking in the maroon pigmentation common to the other farinose seeded Xyrids.

10. XYRIS CAROLINIANA Walt., Fl. Car. 69. 1788. (Figs. p. 232).

Xyris flexuosa Muhl. ex. Ell. Sk. Bot. S.C. & Ga. 1: 51. 1816.

X. torta Kunth, Enum. Pl. 4: 14. 1843, not *X. torta* Sm. 1818.

X. arenicola Small, Fl. SE. U.S. 234. 1903, not *X. arenicola* Miq. 1844.

Solitary or in small tufts, the bases deeply set in the substrate, perennating by means of pale, elongated, fleshy lateral buds. Outer leaves scaly, castaneous; principal leaves linear, 20-50 cm. long, 2-5 mm. broad, twisted and flexuous, fleshy, minutely tuberculate along the margins, otherwise smooth and lustrous; tip blunt to acute; base abruptly dilated, dark brown, shiny, long-persistent as scales. Sheathes of the scapes shorter than the leaves, tight below, loose toward the oblique orifice which is tipped by a short (2-4 mm.) blade. Scapes linear, 50-110 cm. long, twisted, flexuous, smooth, terete and minutely ridged below, becoming oval in cross section and smooth to 1-ridged above, the ridges if present minutely tuberculate. Spikes (1.3-) 1.5-3.0 cm. long, elliptic to narrowly oblanceolate in outline, blunt to broadly acute, of few to many closely imbricate bracts. Fertile bracts 0.5-1.0 (1.3) cm. long, oblong to obovate, entire or emarginate, becoming erose, the matrix reddish-brown to tan with an elliptic or rectangular gray-green or brown dorsal area. Lateral sepals linear, slightly to conspicuously exserted, tan to reddish-brown with a broad keel which is entire below but fimbriate at its exserted apex. Petal blades obovate, 8-9 mm. long, yellow or white, in most populations opening in the afternoon. Seeds fusiform, narrow, 0.8-1.0 mm. long, translucent with about 20 pale, strip-like, longitudinal lines, the vertical lines not evident.

Moist sands of pine flatwoods or savannas; well drained sands or lower reaches of scrub oak-pine barrens, New Jersey to Florida, west to Texas.

Type. U.S.A. "de la Caroline Meridionale" *Fraser*. In the Herbarium Lamarck, P.

The Muhlenberg name *X. flexuosa* (1813) was taken up by Elliott (1816) and specimens conforming to the Elliott description are to be found at both PH and CHARL. Dr. Shinnars, in reading the Elliott reference, discovered an error on the part of Elliott which I (and several others before me) had not noticed, namely that that author listed *X. caroliniana* as a synonym of his *X. flexuosa*. Admittedly, the name "*X. caroliniana*" is earlier but the difficulty had always been one of associating the brief Walterian description with any one species. According to Rendle (1899) the specimen on which Walter had based the name was no longer extant, or at least this inference was made plain. Dr. Shinnars then suggested the possibility that such a specimen might be a part of the collections sent to Lamarck by Fraser. I sent a complete series of specimens of *Xyris* to Paris for comparison. Dr. Alicia Lourteig, who obligingly made the comparisons with material in the Lamarck herbarium, assures me that, of the specimens sent, the material of *X. flexuosa* (*Demaree 32511*) matches perfectly with a specimen there which bears the caption "de la Caroline Meridionale. 2. "Fraser" "*Xyris caroliniana*. Lam. Gen." Thus, at last, a positive identification of Walter's

Xyris caroliniana is possible! The mystery is in how this particular specimen could have escaped the attention of so many for such a long time, and I wish now to give grateful credit to Dr. Shinnars for calling an error to my attention as well as for suggesting a solution. A phototype is deposited at SMU, another at VDB.

Ecology and Identification. *X. caroliniana* survives on relatively dry pineland soils and is never found in permanently wet soils. In grass-sedge bogs it is usually in association with *X. ambigua* and, in peninsular Florida, with *X. brevifolia* and *X. elliottii*. Its evidently succulent leaf bases, together with the deepset habit of rootstock no doubt are the reasons for its success on higher ground than that occupied by other Xyrids. To the north, in the Atlantic Coastal Plain, specimens of *X. caroliniana* get shorter and have smaller spikes. In southern Georgia, southern Mississippi, but especially southern Florida, is a white flowered form (*X. pallescens* Small) which characteristically flowers earlier in the day than does the yellow flowered form.

Since the time of Kunth (1848) *X. caroliniana* has been confused with another bulbous-based *Xyris*, *X. torta*. Some of the authors who have confused the two are Chapman (1860 and later eds.), Gray (1868), Ries (1892), Britton & Brown (1896, and Rendle (1899). It was not until Harper (1904) pointed out this error that the name "torta" was properly applied to the plant for which it originally was intended. The differences between these two Xyrids are:

1. *X. caroliniana* (*flexuosa*) is a plant primarily of the lower terraces of the Atlantic and Gulf Coastal Plain while *X. torta* is primarily in the interior or north Atlantic provinces save west of the Mississippi River; the former is on drier soils, while the latter is on wet, often sphagnous, substrates.

2. *X. caroliniana* has deepset, very broad and castaneous, leaf bases in contrast to the smaller, more shallowly set leaf bases of *X. torta*.

3. *X. caroliniana* has narrower, usually longer, spikes and exserted lateral sepals in contrast to the shorter, broader spikes of *X. torta* whose lateral sepals are included.

4. The lateral sepals of *X. caroliniana* are almost linear, the keel very long-fimbriate toward its apex, while the sepals of *X. torta* are very curvate with keels ciliate from the base to the apex which bears a small tuft of fimbriae.

5. The bracts of *X. caroliniana* lack the apical tuft of short hairs present on the apex of the bracts of *X. torta*.

6. The seed of *X. caroliniana* are narrowly oblong, almost twice as long as the plump seed of *X. torta*.

7. *X. caroliniana* flowers later in the season than does *X. torta*.

8. *X. caroliniana* usually opens its flowers in afternoon; *X. torta* flowers in the morning.

11. XYRIS PLATYLEPIS Chapm., Fl. S. U.S. 501. 1860. (Figs. p. 232).

Solitary or in small tufts, the bases shallowly set on the substrate,

perennating by means of pale, fleshy, lateral buds. Outer leaves scaly, pinkish, becoming a dull gray-brown; principal leaves linear 20-40 (50) cm. long, 5-10 mm. broad, twisted, ascending, flexuous, fleshy, minutely tuberculate or smooth along the margin, otherwise smooth; tip blunt to acute; equitant portion dilated, fleshy, ivory white or pink or purplish toward the base. Sheathes of the scape shorter than the leaves, castaneous or a paler brown and tight toward the base, looser toward the oblique, short-bladed orifice. Scapes 50-110 cm. long, twisted, flexuous, smooth to minutely ridged and terete below, oval in the cross section and smooth to 1-ridged above the ridges, if present, papillate. Spikes elliptic to ovoid or oblong, 1.5-3.0 (-4.0) cm. long, of numerous, closely imbricate bracts. Fertile bracts obovate, 5-7 mm. long, entire (becoming slightly erose with age), brownish or pale tan with an oblong to deltoid, dark green dorsal area. Lateral sepals included, light brown, about the length of the subtending bracts, linear, the keel narrow save toward the apex where it is lacerate. Blades of petals broadly obovate, ca. 5 mm. long, yellow or white, opening in the afternoon. Seeds ellipsoidal, ca. 0.5-0.6 mm. long, translucent, with 10-12 rather irregularly longitudinal lines together with a scattering of less distinct vertical lines.

Moist to wet sands or sandy peats of pineland pond margins, savannas, bogs, and roadside ditches, Coastal Plain, Virginia south to southern Florida and west to central Louisiana.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY.

Remarks: This species, because of its coloured, fleshy and scale-like, leaf bases could be confused with *X. torta* or *X. scabrifolia*. From the former it is distinguished by its lacerate sepal keels; from the latter it is distinguished by its smaller seed and its smooth leaf and scape surfaces.

Xyris platylepis is seldom found with its bases in water; rather, it is found with such species as *X. ambigua*, *X. flabelliformis*, *X. brevifolia*, on moist sites which are seldom if ever inundated. It is a rather weedy species, being quick to occupy moist sands of bulldozed pine flatwoods, or areas which have been heavily logged, or sandy seepage areas along roads. In such places its reproduction may form a turf, the rosettes maroon and curvate-leaved, thus strongly resembling *X. flabelliformis*. Seed sown in fall or early spring will develop into plants of flowering size by the following fall. Dr. Fosberg reports it from Hawaii (there in association with the old world *X. complanata*).

12. XYRIS SCABRIFOLIA Harper, Bull. Torrey Club 30: 325. 1903. (Figs p. 232).

Solitary, or in very small tufts, bulbous-based, the bases shallowly set on the substratum, perennating by elongate, fleshy, corn-coloured, lateral buds. Outer leaves scaly, pinkish, later brown; principal leaves linear, 10-40 cm. long, 5-10 mm. broad, twisted, striate-scabrid throughout, the blades dull green, the equitant portion fleshy and pinkish, later brownish and fibrous. Sheathes of the scapes shorter than the leaves, tight below,

and castaneous, looser and greenish above toward the oblique orifice which is tipped by a short blade. Scapes linear, 30-60 cm. long, twisted and sometimes flexuous, terete and multicarinate toward the base, 2 to 4 ridged above, striate-tuberculate throughout, but particularly harsh on the ridges. Spikes 10-20 mm. long, obovoid or ellipsoidal, of many, tightly imbricate bracts. Fertile bracts 6-8 mm. long, obovate, subentire, tan with a broadly elliptic or rhombic gray-green dorsal area, becoming somewhat erose, dark reddish brown with a red-brown dorsal area. Lateral sepals included, linear, about the length of the subtending bracts, brown, the margin of the narrow keel lacerate below, fimbriate toward the apex. Blades of petals ca. 5 mm. long, suborbicular, yellow, opening in the afternoon. Seeds oblong to ellipsoidal from 0.6 mm. to nearly 1.0 mm. long, caudate, translucent with 12-14 distinct, smoothish longitudinal lines and scattered, indistinct, irregularly disposed vertical lines.

Moist to wet sandy peats of acid sphagnous bogs or sandy seepage areas in the pinelands, northwest Florida and central Georgia.

Type. U.S.A. GEORGIA. MERIWETHER CO.: open bog near Woodbury, *Harper 1254*. Holotype at NY.

Remarks. This is unquestionably the rarest entity of *Xyris* in the southeastern United States, being known only from a few scattered localities in northwest Florida and only from the type locality in Georgia. In fact, it has not been again collected from the type locality. The species with which it is associated are *X. flexuosa*, *X. ambigua*, *X. baldwiniana*, *X. drummondii*; however it most closely resembles *X. platylepis*, a far commoner plant with similarly pink, fleshy, bulbous bases and twisted scapes, being distinguishable from it primarily by its scabrousness, its much longer, more oblong-and-caudate seeds, and its generally lower stature.

Seeds of *X. scabrifolia* were gathered from a locality 5 miles n. of Youngstown, Bay County, Florida, in January 1963 and planted in March of the same year in the greenhouse. A crop of plants of flowering size developed by mid-summer of the same year, these showing considerable variation in papillosity, leaf character, and spike shape with some individuals being suspiciously close to *X. jupicai* Rich. Further progeny tests will therefore be made of this peculiar entity.

13. XYRIS TORTA J. E. Sm., in Rees Cycl. 39: Xyris no. 11. 1819. (Figs. p. 232).

Xyris Indica L., Sp. Pl. 42. 1753. In part.

Xyris bulbosa Kunth, Enum., Plant. 11: 1843.

Xyris flexuosa Chapm., Fl. S. U.S. 500; Ries, Bull. Torrey Club 19: 37. 1892; Rendle, Journ. Bot. 37: 499. 1899.

Kotsjelottia flexuosa Nieuwl., Am. Midl. Nat. 3: 99. 1913.

Solitary or in tufts of a few individuals, bulbous-based, perennating by pairs of stout, fleshy, lateral buds which arise from two of the innermost leaf axils. Leaves of two sorts, the outer scale-like (from the bud

scales), the inner elongate-linear. Principal leaves linear, ascending, 20-50 cm. long, 2-5 mm. wide, twisted, grooved longitudinally, the upper (blade) portion dark green, lustrous, narrowing rather abruptly to a blunt, incurved, thickened tip, the equitant portion pinkish, purplish or yellow green, flaring rather abruptly to the fleshy, pale or castaneous base. Leaf surfaces smooth or papillose; leaf margins narrowly incrassate, smooth or papillose. (Outer leaves are usually much shorter than the inner, are maroon or more commonly a dark, lustrous brown, are often scale-like with very dilated bases and slender, often acuminate, tips.) Sheathes of the scape shorter than the principal leaves, tightly clasping the scapes below, becoming looser toward the orifice which has a short, erect, slightly divergent blade at its tip. Scapes 15.0-80.0 (-100) cm. long, 1.0-1.5 (-2.0) mm. broad, slightly to very twisted and flexuous and many-ridged below, 2-4 (-6) ridged above and somewhat flattened above toward the spike. Spikes at seeding time broadly ovoid or ellipsoidal to lance-ovoid or rarely oblong, 0.8-2.5 cm. long, 0.6-1.0 cm. broad, of many, tightly imbricated bracts. Fertile bracts broadly obovate to suborbicular, 5.0-7.0 mm. long, a deep lustrous brown within, a dull brown on the outer surface save for a pale, gray-green, elliptical, subapical dorsal area; exposed margin of the bract entire or sparingly ciliate save for a short-fimbriate, usually slightly emarginate, apex. Lateral sepals included, slightly shorter than the subtending bract, a lustrous brown, lunate, the broad, thickened keel ciliate-scabrid from near the base to the apex where appears a small tuft of reddish-brown or blonde trichomes. Blades of petals obovate, ca. 4 mm. long, unfolding in the morning. Seeds ellipsoidal, ca. 0.5 mm. long, caudate, with 14-18 prominent longitudinal lines (these under high magnification a series of contiguous papillae) and indistinct, narrower, cross-lines, translucent save for the region of the embryo.

Sphagnous bogs, streambanks, lake and pondshores, wet sandy swales, and acid sandy swamps primarily above the Coastal Plain (save at its northern extremities or toward the west) from the Canadian Shield west to the limit of coniferous forest, south in the Atlantic United States to Piedmont, Georgia, and west in the Piedmont and Coastal Plain to Texas and Oklahoma.

Type. "North America"; collected by Peter Kalm. Holotype in the Linnaean Herbarium, London.

Remarks. Many species of *Xyris* are confined to purely sandy or sandy-peat soils. *Xyris torta*, however, appears upon a wide spectrum of soils, providing they are moist and acid enough. In the northern part of its range it is very often luxuriant in sphagnum bogs as well as on the various substrata created by road or railroad construction. In the Piedmont province it may be either in boggy pockets amongst the red clay hills or in seepage areas generally. Throughout its range it appears to quickly come into artificially created moist areas such as quarries, gravel

pits, farm pond margins. The genera it is often associated with are: *Sphagnum*, *Lycopodium*, *Dulichium*, *Cyperus*, *Eleocharis*, *Eriophorum*, *Scirpus*, *Fimbristylis*, *Rhynchospora*, *Panicum*, *Paspalum*, *Juncus*, *Polygala*, *Sarracenia*, *Drosera*, *Pinguicula*, *Rhexia*, together with several other genera of grass-sedge or sphagnous bog communities. It is one of the earliest to bloom of the *Xyris*, usually being past anthesis by the middle of summer in the southern states and certainly well before most *X. jupicai* and *X. difformis* reach their prime. Thus far, I have not seen intermediates between it and other species with which it may associate, which in addition to the above mentioned species may occasionally include *X. iridifolia*, *X. ambigua*, *X. baldwiniana*, *X. platylepis*. It is not one of the species which thrives in water; rather it tends to grow either with its bases set deeply in sphagnous hummocks or on the upper edges of shores or seepage areas.

X. torta is one of the elements upon which Linnaeus based *X. indica* (Sp. Pl. 42. 1753). The other element of *X. indica* is East Indian and from the illustrations on which it is partly based (Pluk. Alm. t. 416, f. 4; Pis. Bras. 238) it is not this bulbous-based, twisted-leaved plant. The East Indian specimen, collected by Hermann, upon which *X. indica* is also partly based is no longer extant (Rendle, 1899).

That *X. indica* was based upon discordant elements has long been known. The first to take action was Sir J. E. Smith (in Rees' Cycl. 39, 1818), who designated the east Indian element as being the actual *X. indica* and who named the North American element *X. torta*. Two specimens of this entity were available to Smith; one Clayton 219 (at BM), the other a collection by Peter Kalm from "North America" (at LINN). This latter specimen (according to Rendle, 1899) bears the following comment by Smith: "X. indica of Pursh? torta J. E. S." This latter specimen was long ago decided upon as the type (Nilsson 1892). It would appear to me that J. E. Smith acted in accordance with our present Code of Nomenclature and that no further argument about his decision ought to exist today.

Because of its several resemblances to the Coastal Plain bulbous-based *Xyris* (here treated as *X. caroliniana* Walt.) the history of the epithet "torta" has been tortuous since the time of its inception. Rather than follow the lead proscribed by Smith which was followed by Roemer & Schultes (Mant. Pl. I, 1822, Mant. Pl. Additam. II, 1827), Kunth (1843) confused the inland "torta" with the Coastal Plain *caroliniana* (*flexuosa*). Therefore the identity of the two different species ought to be taken up here.

Xyris torta, in addition to being unusual in the southeastern Coastal Plain, has, within its usually ovoid spikes, curvate lateral sepals which are ciliate-keeled save at the very apex where the ciliae are longer and form a small tuft. Its ellipsoidal or ovoid seed are about 0.5 mm. long. It is a plant of wet soil.

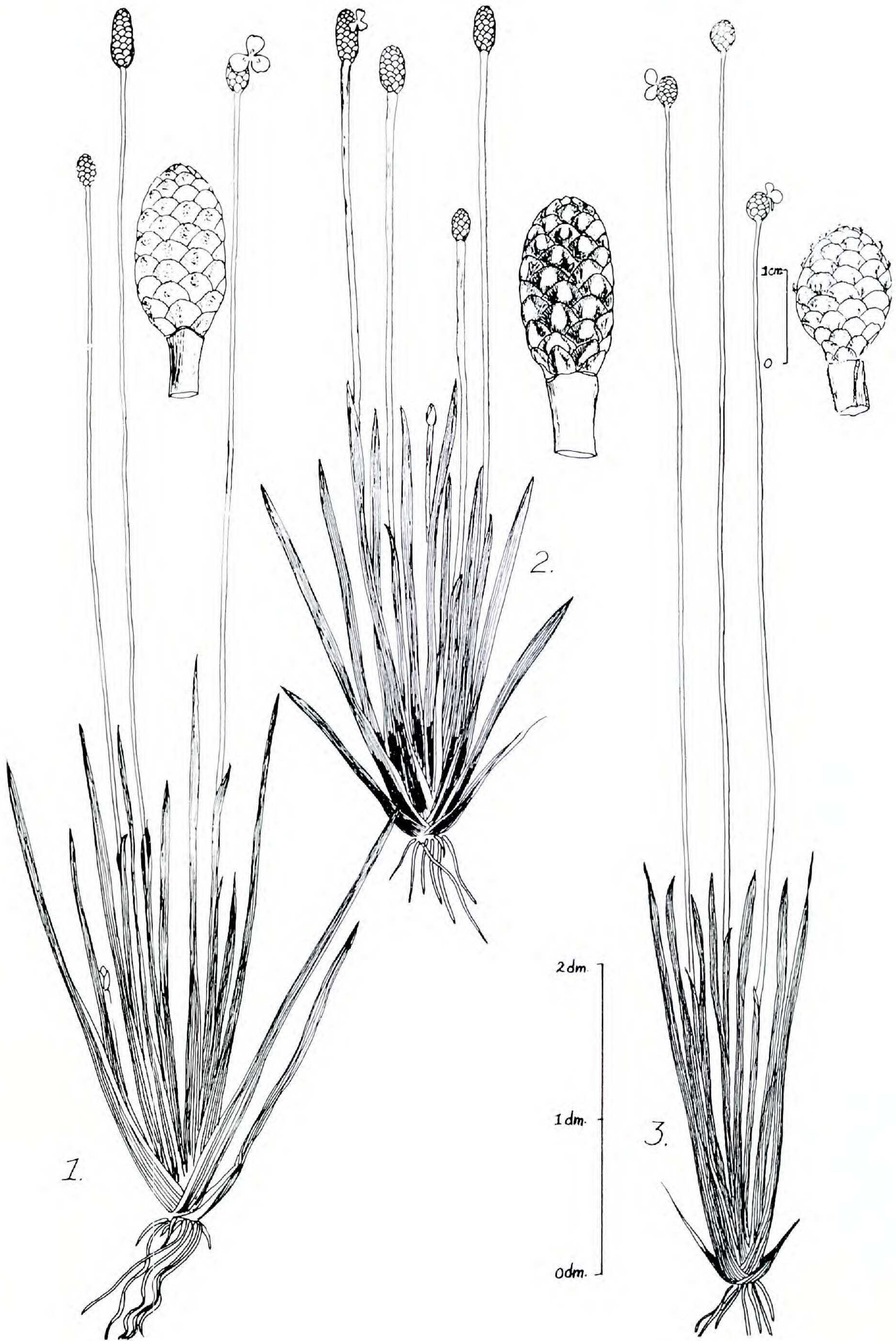
Xyris caroliniana, a species confined to the Coastal Plain, has within its narrowly ellipsoidal or lance-ovoid spikes, relatively straight, elongate lateral sepals whose keels are ciliate toward the base, long-fimbriate at the apex. Its oblong or narrowly elliptical seed are well in excess of 0.5 mm. usually at least 0.7 mm. long. It is a plant of damp to relatively dry sands, certainly not of wet soils.

No specimen of the former *Xyris* is in the Elliott Herbarium at Charleston; the presence there of a specimen of the latter certainly constitutes evidence that the Muhlenberg name *flexuosa* was definitely applied to the Coastal Plain entity by Elliott. However, subsequent authors such as Chapman (1860), Ries (1892), Britton & Brown (1896) and others confused the two in the same manner as Kunth (l.c.). For further clarification see the discussion under *X. caroliniana*. Also see Harper (1904).

14. XYRIS FIMBRIATA Ell., Bot. S.C. & Ga. 1: 52. 1816.

Solitary or in small tufts, perennating by means of low-set lateral buds (these therefore usually buried in and overwintering in a mucky substratum). Principal leaves ascending, linear, 4.0-70.0 cm. long, 0.5-2.5 cm. broad, flat or slightly twisted, ascending, the upper part green, lustrous, becoming pale green, stramineous or even pinkish toward the base, narrowing progressively from the broad, sheathing equitant portion to the acute, slightly incurved apex, the equitant portion not more than 1/6 the total leaf length. Surface of the leaf smooth; margin of the blade papillose. Sheathes of the scape shorter than the fully developed leaves, (15-40 cm. long), short bladed, rather loose above. Scapes linear 80-150 cm. long, twisted and multicarinate below, flattened and 2 to 3 ridged (-4 ridged) above, the ridges tuberculate-scabrid. Spikes at seed bearing time ellipsoidal to short-oblong, less commonly ovoid, 1.2-2.5 cm. long, of many, rather tightly imbricated bracts, the lowest barren. Fertile bracts broadly obovate to suborbicular, 5.0-8.0 mm. long, not keeled, the apex rounded, the exposed margin subentire, the other surface tan or dull brown with a broadly ovate or triangular, silvery-green or pale-green subapical dorsal area about 1/2 the length of the bract. Lateral sepals prominently exserted, linear-cuneate, the broad sides thin, a pale lustrous yellow-brown, the keel slightly thickened, a darker brown, broad, the margin long-fimbriate, particularly toward its apex. Blades of petals 5-6 mm. long, obovate, opening in the morning. Seeds narrowly fusiform or oblong, 0.8-1.0 mm. long, pale but lustrous, with about 12 broad, pale, flattened, longitudinal, wavy lines which are nearly as broad as the intervals.

(Opposite) 1. *X. smalliana*. 2. *X. iridifolia*. 3. *X. fimbriata*.



Sand, sandy-peat, sandy-muck or peat-muck of pineland pools, cypress ponds, river and streambanks, lakeshores, ditches and swamps, Coastal Plain, New Jersey south to southern Florida and west in lower coastal plain to Mississippi.

Type. U.S.A. GEORGIA. "sent from Georgia by Dr. Baldwin"; presumably collected by Baldwin. Holotype at CHARL.

Ecology and Identification. *X. fimbriata* is definitely a wetland *Xyris*, forming sometimes pure stands in the countless cypress domes, gum swamps, and ditches of the Atlantic and Gulf Coastal Plain. Often the plants are submersed for up to nearly half their length, and it is not unusual to see luxuriant reproduction completely submersed in a foot or more of water. It is a definite perennial, but evidently requires a constantly moist, if not wet, substratum in that both adult plants and reproduction die out by thousands if the substratum dries. Its commonest associates among the *Xyris* are *X. smalliana*, *X. jupicai*, *X. iridifolia*, *X. stricta*, *X. serotina*, *X. difformis*, but usually only *X. smalliana* accompanies it into the wettest situations.

Any drainage ditch or roadside ditch through the swamp-infiltrated pinelands of the lower coastal plain provides a contraction of habitats by providing additional, compressed, relief (as stated in the section on ecology). Thus, on such an artificial habitat a wet ground species such as *X. fimbriata* may be within a yard of other *Xyris* of much lower hydroperiod soils. A similar situation could arise naturally where large trees have toppled to leave small potholes in which drainage water accumulates. Yet, in spite of artificial or natural compression of habitat, I have yet to see what appears to be a hybrid swarm involving *X. fimbriata*. A possible explanation for this may lie partly in the very late flowering season of this species, which is probably the last of them all to come into bloom. In addition, this species flowers in the morning while its most common cohabitant, *X. smalliana*, flowers in the afternoon.

X. fimbriata is one of the few of our *Xyris* which is very quickly distinguishable from the others; its scape ridges are always harsh to the touch, its spikes are dull and appear fuzzy from the numbers of exerted, fimbriate, lateral sepals, and its very tall, willowy appearance make it easily distinguishable from a distance. A testimonial to the ease with which it may be identified is in its singularly uncomplicated nomenclature.

15. XYRIS SMALLIANA Nash, Bull. Torrey Club 22: 159. 1895.

Xyris caroliniana Walt. var. *olneyi* Wood, Classbook ed. 2: 564. 1847.

Xyris congdoni Small; Britton, Man. Ed. 2: 1057. 1905.

Xyris smalliana Nash var. *congdoni* Malme, Mull. Torrey Club 64: 45. 1937.

Xyris smalliana var. *olneyi* (Wood) Gleason ex Malme, N. Am. Fl. 19: 13. 1937.

Solitary or in small tufts, perennating by pairs of lateral buds whose scales quickly become green, elongate. Principal leaves linear (19-)

30-50 (-60) cm. long, 0.5-1.5 cm. broad, usually pinkish, sometimes pale green toward the base, the rest of the leaf a deep lustrous green, flat or slightly twisted, and more or less evenly tapering to a slightly incurved acute tip. Sheathes of the scape shorter than the leaves, the oblique orifice terminating in a cusp-like blade. Scapes 50-150 cm. long terete and very low ribbed below, 1-2 ridged and somewhat flattened toward the spike, smooth. Spikes 1-2 cm. long (rarely to 2.5 cm.), ellipsoidal or narrowly ovoid, of many, closely imbricated, bracts. Fertile bracts 5-8 mm. long, ovate, entire, the matrix a lustrous brown, the dorsal area gray-green, elliptic. Lateral sepals slightly to conspicuously exserted, pale brown, the keel lacerate toward its apex, entire below. Blades of petals obovate, 5-6 mm. long, yellow, unfolding in the afternoon. Seeds narrowly ellipsoidal to ovoid, 0.7 mm. long or somewhat longer, the longitudinal ribs few, often irregular; cross lines evident, irregularly distributed.

Sands, sandy peats, peat-mucks of pineland pools, roadside ditches, riverbanks, ponds, cypress ponds and lakeshores, primarily not far from the seacoast, Maine south to peninsular Florida, west in the Coastal Plain to Mississippi.

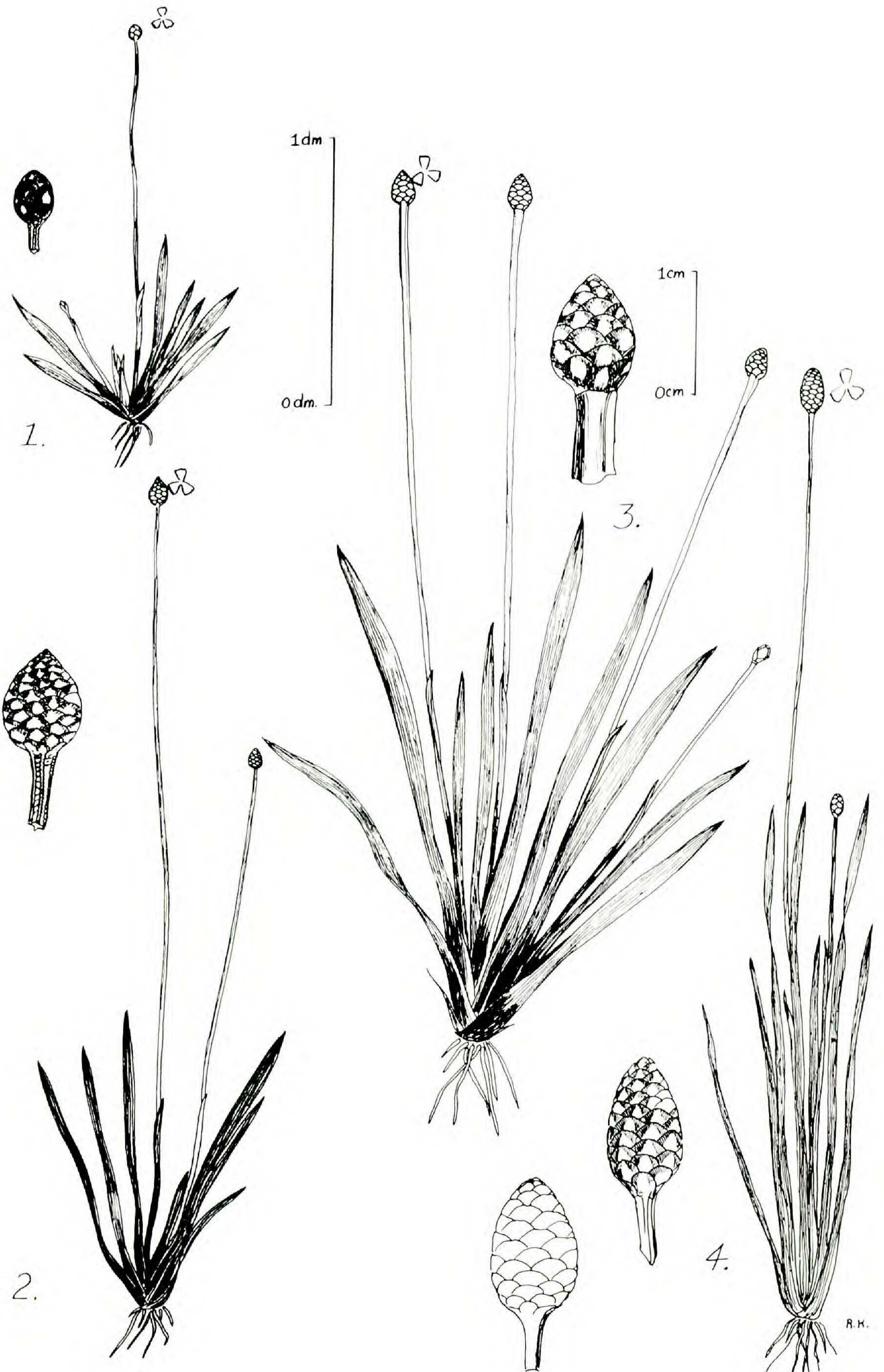
Type. U.S.A. FLORIDA. LAKE CO.: in water at Lake Ella, vicinity of Eustis, Nash 1584. *Holotype* at NY.

Remarks. This tall *Xyris* is most often in association with *X. fimbriata* and *X. jupicai* throughout its range, but does not appear to get as far inland. It is quickly discernable from the former by its smooth scape edges (in contrast to the scabrous ones of *X. fimbriata*) and from the latter by its exserted sepals and larger seed.

16. **XYRIS longisepala** Kral, sp. nov.

Caules singulares vel subcaespitosi laeves. Planta post meridiem florens. Semina ellipsoidea alveolata usque 0.5 mm. longa.

Solitary or in small tufts, smooth. Leaf linear (6.0-) 8.0-25.0 cm. long, 1.0-2.0 mm. broad, acute, (in drying indistinctly nerved, the marginal nerves thickened and pale-cartilaginous) pinkish or pale-brown or greenish below, a dull green above, sometimes with some reddish-brown streaks of pigmentation. Scape (30.0-) 40.0-80.0 (-82.5) cm. long, 0.7-1.0 mm. broad (measured at 1 spike length below the spike base) twisted but not flexuous, terete and many-ridged below, somewhat flattened in the cross-section and 1-ridged above. Sheathes of the scapes 5.0-15.5 cm. long, dilated above, but narrowing to very short, cusp-like blades. Spikes ellipsoidal to oblong, 1.0-1.6 cm. long, 0.5-0.8 cm. thick, blunt, of many somewhat loosely imbricated bracts. Fertile bracts broadly oblong, 4.0-6.0 mm. long approximately 3.0 mm. broad, at anthesis entire, in fruit somewhat erose, tan with a pale greenish or reddish-brown dorsal area. Lateral sepal linear-curved, approximately 0.5-1.0 mm. longer than the subtending bract, the keel lacerate-fimbriate or somewhat ciliate for 2/3 of its length toward the summit where the fimbriae are longest.



Blades of petals obovate, ca. 3.5 mm. long, opening in the afternoon. Seeds ellipsoidal, about 0.4-0.5 mm. long with about 12 prominent longitudinal nerves and several slightly less distinct cross lines.

Moist to wet sandy shores of limesink lakes and ponds, northwest Florida.

Type. U.S.A. FLORIDA BAY CO.: sandy shores of Merial Lake, n. of Panama City, R. Kral 15672. Holotype at SMU; isotypes at: BM, DS, DUKE, F, FLAS, FSU, GH, IA, ILL, ISC, K, MICH, MSC, NCSC, NY, PC, PH, RSA, UC, US, USL, VDB.

Ecology and Identification. *X. longisepala*, together with *Rhexia salicifolia* and *Hypericum lissophloeus*, appears to be confined in distribution to the rash of sinkhole ponds and lakes so characteristic of the karst topography of northwestern Florida. It is particularly abundant during low-water periods, when large expanses of almost pure sand are exposed along the lake margins. Here it may be in association with *X. smalliana* or *X. jupicai* or both, together with another new species of *Xyris*, *X. isoetifolia*.

It is immediately distinguishable from *Xyris jupicai* in that its flowers open in the afternoon, at a time when those of the latter are closed. However *X. smalliana* flowers are open at the same time of day and plants of that species bear many resemblances to this newly described one. Essentially the differences are in the lower stature, the different spikeshape, the character of the keel of the lateral sepal, the smaller petals, and especially the smaller seed with its regularly ridged testum.

I was unable to get a crop of *X. longisepala* to grow beyond the seedling stage in that the entire crop was allowed to dry out during my field tour of summer 1963. However, the seedlings are closest in character to those of *X. smalliana*, to which this species must be quite closely related.

17. XYRIS IRIDIFOLIA Chapm., Fl. S. U.S. 501. 1860. (Figs. p. 243).

Solitary or in small tufts, the pinkish or purplish, keeled, bases, shallowly set on a mucky substratum, perennating by means of lateral, overwintering shoots. Leaves linear, iridiform, 40-70 cm. long 10-25 mm. broad, flat or slightly twisted, smooth, and a deep, rich green; tip broadly acute to blunt, incurved; base slightly dilated, keeled, pink or pale maroon, with a broadly hyaline margin. Sheathes of the scape shorter than the leaves, deep brown or reddish brown and tight below, becoming somewhat looser and green above, the oblique orifice with a short cusp-like blade. Scapes 60-80 cm. tall, linear, straight or slightly twisted, terete and 2-ridged below, conspicuously broadened and flattened above, the edges smooth. Spikes oblong to broadly oblanceolate, rarely ovoid, 2.0-3.5 cm. long, blunt, of very many, closely imbricate bracts, the lower ones barren. Fertile bracts 6-7 mm. long, broadly obovate to suborbicular, entire, the outer surfaces dark purplish or reddish-brown, shining save

(Opposite) 1. *X. difformis* var. *curtissii*. 2. *X. difformis* var. *floridana*. 3. *X. difformis* var. *difformis*. 4. *X. jupicai*.

for a paler green or gray-green oval or triangular dorsal area. Lateral sepals included, linear, about the length of the bracts, castaneous, with a broad, lacerate keel. Blades of the petals cuneate, ca. 3 mm. long, yellow, opening in the morning. Seeds oblong-fusiform, 0.8-1.0 mm. long, opaque, dark, farinose, the regularly arranged longitudinal lines obscured by the farina.

Wet sands, but more commonly wet sandy clay, sandy peat or peat muck or alluvium of stream banks, cypress swamps, marshes or pine-land pond margins, the bases commonly submersed, Coastal Plain, southeastern Virginia south to northern Florida and west to eastern Texas.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "Apalachicola"; collected by Dr. Chapman. Holotype at NY.

Remarks. This is such a distinct species that it has no synonymy, a rare thing in *Xyris*. It is best developed on fine textured wet soils such as peat mucks, clays, or alluvium; it may survive for a season but will not perennate on a soil which dries out at any time. Its commonest associates are *X. fimbriata*, *X. smalliana*, *X. stricta*, *X. serotina*, *X. jupicai* and *X. difformis*. It, together with *X. difformis*, will often form belts of rich green along the creeks in southern Mississippi and in the pinelands of Louisiana. It may reach flowering size from seed in one season; the seedlings show the same high concentration of reddish pigment, often being a pure maroon from base to tip. *X. iridifolia* appears to be one of the *Xyris* whose distribution is confined to the heavier soils; it is therefore one of the more frequently encountered *Xyris* west of the Mississippi River. East of the Mississippi it becomes somewhat more scarce, save where belts of finer alluvial soil cross the sandy pinelands and it has yet to be found in peninsular Florida whose soils are almost exclusively sands.

Xyris iridifolia shares the characteristic of farinose seed with three other entities of *Xyris* namely *X. serotina*, *X. difformis* var. *floridana*, and *X. stricta*; it is usually in the same area with all of these in the southeastern Coastal Plain. However, *X. serotina* lacks the purplish leaf bases and has a much smaller spike; *X. difformis* var. *floridana* is a much more slender plant with a much smaller spike and seed; *X. stricta* has much narrower leaves and the keels of its lateral sepals are ciliate.

The field work of summer, 1962, 1963, has convinced me that *X. iridifolia* is a remarkably uniform entity throughout its considerable range and does not appear to produce hybrids with other species (contrary to my previous, less qualified, opinion in Rhodora, 1960).

A large quantity of seed of *X. iridifolia* was gathered in December 1962, planted in the greenhouse in March 1963 and by fall had grown into a large crop of seedling plants all of which were remarkably similar. This seed was from an area which also supported very large populations of *X. stricta*, *X. ambigua*, the former of the two being strongly suspect as a hybrid between *X. iridifolia* and *X. ambigua*.

18. XYRIS JUPICAI L. C. Rich., Act. Soc. Hist. Nat. Paris 1: 106. 1792. (Figs. p. 246).

?*X. anceps* Pers. Syn. Pl. 1: 56. 1805.

X. jupicae Michx. Fl. Bor. Am. 1: 23. 1803.

X. communis Kunth. Enum. Pl. 4: 12. 1843.

X. arenicola Miq. Linnaea 18: 75. 1844.

?*X. ekmanii* Malme, Ark. Bot. 19: 4. 1925.

Short lived perennial, solitary or in small tufts, dying completely after one year from seed or perennating from bulbous lateral overwintering buds. Leaves linear, 10-60 cm. long, 5-10 mm. broad, ascending, lustrous, yellow-green, pale or stramineous toward the base. Sheathes of the scape shorter than the principal leaves, somewhat loose toward the oblique orifice which terminates in a short, cusp-like blade. Scapes 20-70 (-90) cm. long, terete and many ridged below becoming somewhat flattened, narrower, and usually one or two-edged above. Spikes at seeding time ovoid, ellipsoidal or oblong, 5-15 mm. long of many (several in depauperate individuals) rather loosely imbricated bracts. Fertile bracts obovate to oval, 5-7 mm. long, the exposed margins subentire, the outer surface pale to dark brown, dull, the dorsal area rectangular to elliptic, green, or brownish on old spikes. Lateral sepals included, about the length of the bracts, linear and slightly curvate, the thin wings broad, the somewhat thicker keel lacerate for the upper 2/3 or 1/2 its length. Blades of petals cuneate, ca. 3 mm. long, yellow, opening in the morning. Seeds broadly ellipsoidal, ca. 4-5 mm. long, the longitudinal ribs numerous but faint; cross lines not evident.

Wet sands or sandy peat or alluvium of roadside ditches, flatwoods pond margins, cypress swamps and lakeshores, but particularly in mechanically disturbed wetlands, Coastal Plain, New Jersey south to Florida and west, chiefly in the Coastal Plain to Texas and Arkansas: this species probably adventive from Latin America.

Type. FRENCH GUIANA. "Cayenne"; collected by LeBlond. Holotype presumably at P. An isotype of what is probably this plant is the type of *Xyris communis* Kunth.

Remarks. This is probably the most expressive, morphologically and ecologically, of all the *Xyris* I have had field experience with. From all appearances it is spreading very rapidly in the Coastal Plain, in that it is certainly the commonest *Xyris* of roadside ditches; thus the proportion of it in collections appears to be growing in relation to that of other species. In the Florida Everglades I have seen it form on wet, mildly acid, sites, stands so extensive as to meet the horizon; there it makes up a very significant part of the sea of grasses and sedges and appears to be very effectively naturalised. This is in sharp contrast to its behavior in ditches which cut through very acid *Sphagnum-Sarracenia* bogs inland or to the north; here it appears not to spread beyond the limits of the ditches, leaving the bogs themselves to be held by such *Xyris* as

X. platylepis, *X. ambigua*, *X. torta*, etc. It appears to spread into the more acid sites only when these are disturbed, and then only when soil is directly exposed, later giving way to higher successional levels of plants. Thus it appears to me to be commonest, most natural, on less-acid marshy situations. This is at least the case in Florida where it is part of a mildly acid marsh complex made up of such species as *Dichromena colorata*, *Rhynchospora inundata*, *R. schoenoides*, *R. microcarpa*, *Fuirena breviseta*, *Fimbristylis caroliniana*, *Psilocarya nitens*, *P. schiedeana*, *Manisuris rugosa*, *Panicum hemitomon* and such plants as occupy the "twilight" zone between brackish marsh and acid marsh. Many of the above mentioned plants also thrive along roadside ditches in the lower coastal plain though they might not survive in the more acid wetlands adjacent unless these are disturbed. The above speculations are based upon countless observations, particularly in the Florida marshlands, and would make an interesting ecological proof.

In peninsular Florida, *X. jupicai* is most often associated with *X. elliottii*, *X. bravifolia*, *X. smalliana*, *X. difformis* var. *floridana*, *X. fimbriata*, but is most often in the same moisture zone as the latter three. Yet *X. jupicai*, unlike these species has a wider tolerance, apparently, to both soil texture and soil moisture (both of which are at least indirectly related to pH) and thus can find greater avenues of dispersion to the north and to the west. It can be equally at home on alluvium or sand, thus its broader "niche" plus its tropical distribution lead me to speculate further. Seeds of it could have been introduced with the introduction of rice culture (as is true of several of our sedges), or could have come to us through the Caribbean island arc. A southern oriental origin is not out of the question, but could more effectively be studied in the process of a world-wide revision. I would not be much surprised if material closely agreeing with *X. jupicai* could be found in southern Asia and that the Hermann collection on which *X. indica* was partly based (but which is now missing, according to Rendle, l.c.) may have been the same thing. Some pre and shortly post-Linnaean illustrations of plants which fall within this complex do bear resemblance to this species.

In such a genus as *Xyris*, whose species are often very close morphologically and cytologically, the nomenclature of the most widespread and weedy entities is naturally the greatest problem. That of *X. jupicai* has become almost inextricably interwoven with that of *X. difformis* so that an extremely large number of Old and New World names for both and for each has become involved. Several present authors, having decided that little consistent difference exists between the complex of forms representing both species, have designated all as *X. caroliniana*. Yet it has just been determined that true *X. caroliniana* belongs to an entirely different complex.

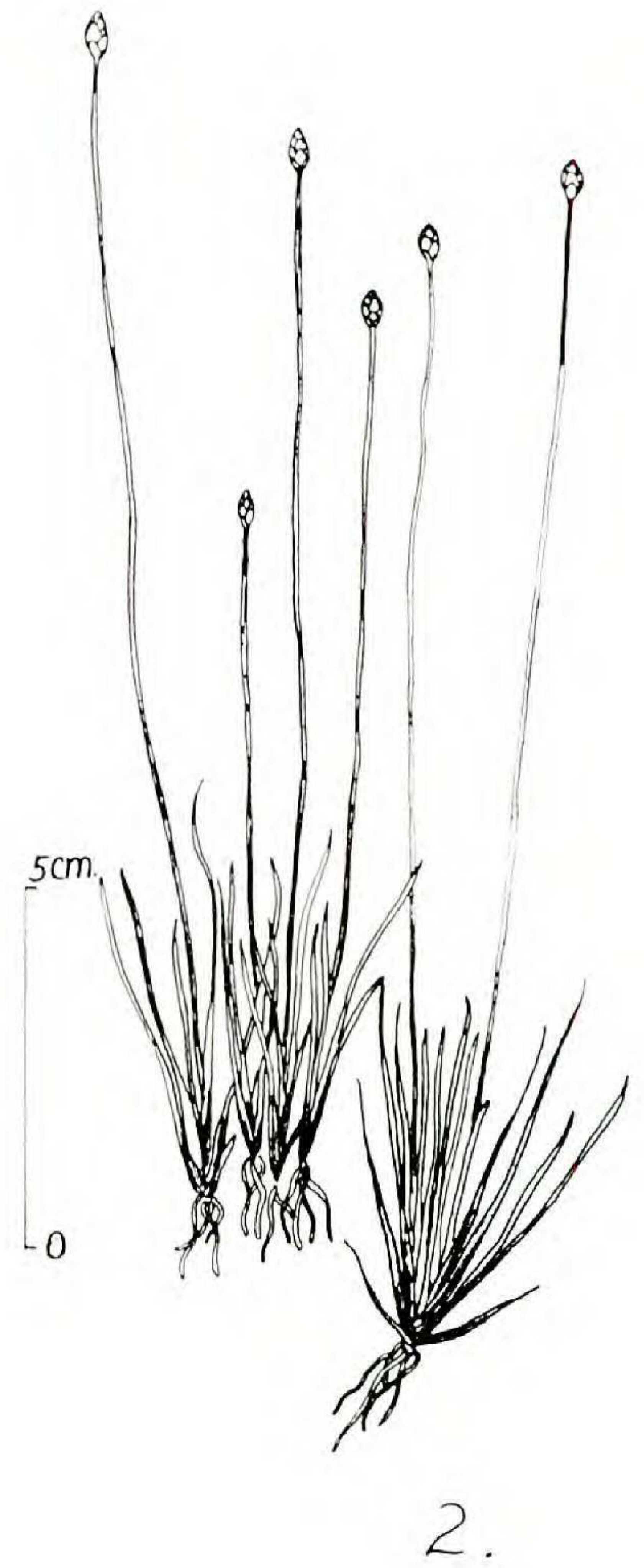
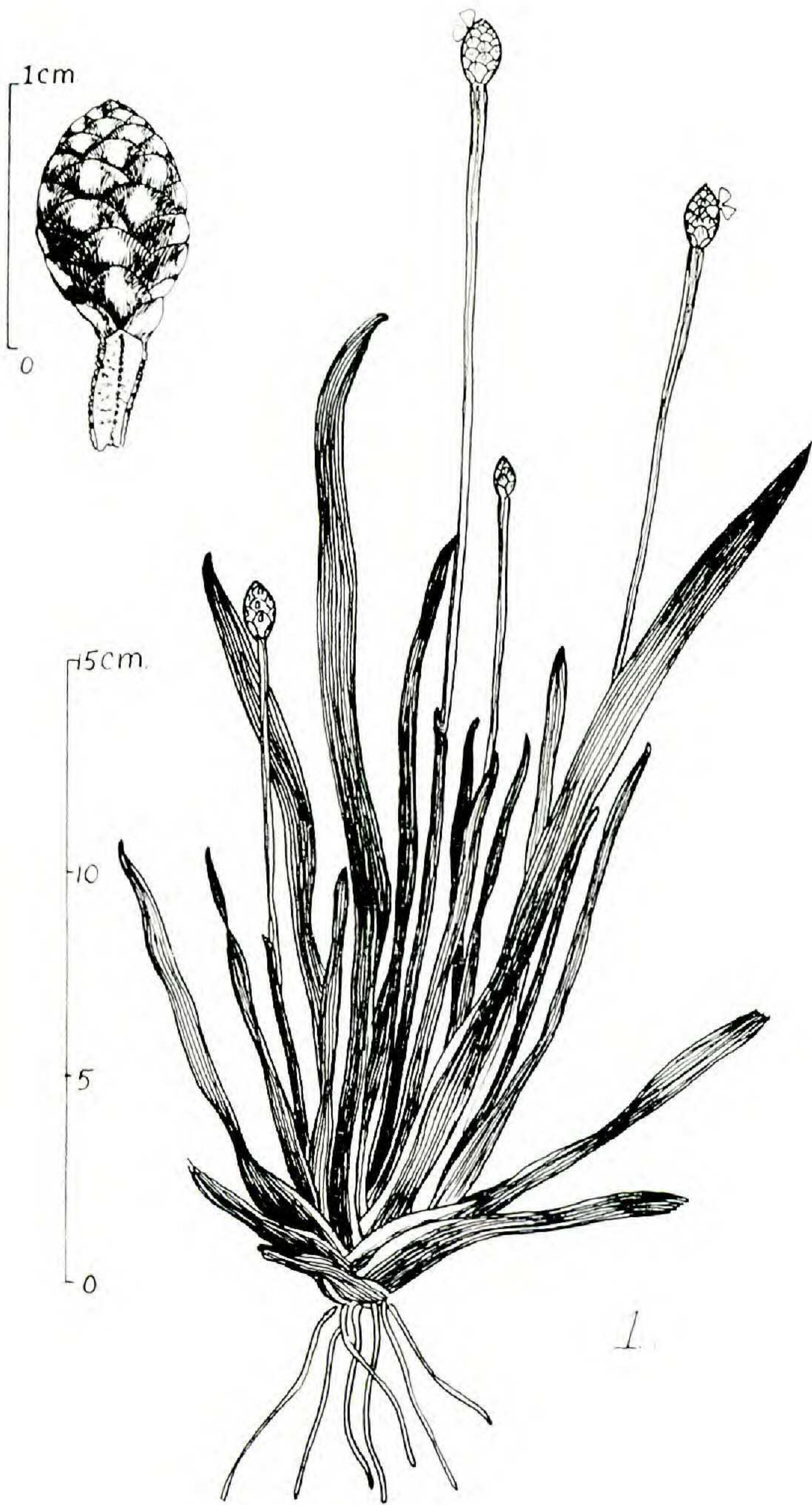
My own solution to the problem is predicated on what I believe to be a demonstrable difference between *X. jupicai* and *X. difformis* (see dis-

cussion under *X. difformis* and varieties). It is my contention that a weedy *Xyris* (*X. jupicai*) which lacks reddish or purplish pigmentation, which has narrow, ascending leaves, and which has very narrow scape ridges is presently contending for habitats in the southern U.S. with a less-weedy, reddish-pigmented, spreading-leaved, broad-scaped native *Xyris* whose northern range is as yet uninvaded. I have seen mixed populations of the two in Virginia, the Carolinas, Georgia, Florida, Mississippi, and eastern Louisiana and have yet to see examples of intermediates. After some practice in noting the differences between the two species any trained observer would find it an easy matter to sort them in the field and to note the frequency of occurrence of both on the same disturbed sites (i.e. bulldozed swampy woods, roadside ditches, farm pond margins, power line clearings through swamp forest) yet the absence of intergradation. The main problem is to attempt to convince a reader who then promptly goes to an herbarium collection of both species. Unfortunately the broad, scapes, reddish pigmentation and spreading-leaved habit of *X. difformis* are all modified through the process of pressing and drying. It is also true that late summer material, or seeding material which is beginning to die back, will not show the fine character of pigmentation and will look much like herbarium material in the other respects. Yet differences are there, consistent ones, should the student look for them in the field.

19. XYRIS DIFFORMIS Chapm., Fl. S. U.S. 500. 1860. (Figs. p. 246).

?*Xyris elata* Chapm. Fl. S. U.S. 501. 1860.

Solitary or in small tufts, the soft, pinkish or purplish (rarely greenish) bases rooted on wet sand or muck, perennating by pairs of pale, low-set, lateral shoot buds. Principal leaves broadly linear or linear-elliptic, 10-50 cm. long, 0.5-1.5 cm. broad, usually flabellately spreading, a dark and lustrous green but toward the bases becoming pinkish, purplish or reddish. Apex of the leaf acute, slightly incurved. Surface of the leaf smooth. Margin of the leaf above the equitant portion usually papillose, rarely smooth. Sheaths of the scapes shorter than most of the leaves, thin, tight, save at the slightly loosened, oblique orifice whose upper margin converges to a short, cusp-like blade. Scapes linear, 15-70 cm. long, terete, brownish and twisted below, straightening and becoming deep green and oval in the cross section above with two prominent, broad, thin ridges whose combined breadth is at least equal that of the scape (in southern specimens) and whose margins are papillose, together with occasional, lower ridges. Spikes at seed bearing time ovoid, ca. 1 cm. long (less in northern specimens), acute, dark, of many, usually tightly imbricated bracts of which the lower few are barren (to the north the spikes become shorter, broader, blunter). Fertile bracts 5-7 mm. long, obovate to oval, not keeled, the apex rounded and subentire, the outer surface usually deep brown, lustrous, the dorsal area greenish or gray green, rectangular to round or elliptic. Lateral



sepals included, about the length of the bracts, the wings very broad, thin and pale brown, the keel slightly thicker and darker, its margin jagged from about the middle to the apex. Blades of the petals cuneate, ca. 4 mm. long or less, yellow, unfolding in the morning. Seeds broadly ellipsoidal, ca. 0.5 mm. long, translucent, with 24-28 very fine, straight, longitudinal lines of small papillae, the vertical lines straight, but very indistinct.

Wet sands or sandy peats of flatwoods pond margins, ditches and lakeshores, but more often on alluvial situations (often in fairly heavy shade), primarily in the Coastal Plain from eastern Texas to its northern limits in New England and southeastern Canada, but inland into the Canadian Shield (by way of the St. Lawrence River?) and Great Lakes system.

Type. U.S.A. FLORIDA. FRANKLIN CO.: "marshes, Apalachicola"; collected by Dr. Chapman. Holotype at NY, as designated by Dr. Blomquist.

Remarks. A partial solution to the complex nomenclature engendered by many conflicting senses of *X. caroliniana* Walter could only come through considering *X. difformis* to be the same as the more weedy *X. jupicai*, whose range extends at the least over a large part of the warmer Americas. However, *X. difformis* does differ from *X. jupicai* in several, consistently demonstrable, ways. It is my belief (see discussion under *X. jupicai*) that two constellations of forms exist within the United States. One, here treated as *X. difformis*, is comprised of maroon-pigmented, sometimes roughened-or-papillose, spreading-leaved, natives. The other is composed of green and ascending-leaved, smoothish, weeds which may not be native to the country or are at least violently expanding their range in the nature of adventives. The two complexes overlap in range in the southern United States, but only the former extends out of the Coastal Plain into other physiographic provinces. If my viewpoint is used, then the earliest name applying to a *Xyris* in this complex is *X. jupicai* Rich (1792) and that for the maroon pigmented entities is *X. difformis*.

Convinced at last (1960) of the distinctness of *X. difformis*, I became involved with locating mixed populations of *X. difformis* and *X. jupicai*, for the purpose of seeing what effect these two similar entities might have on each other. In August of 1960 I did find such a situation in Nansemond County, Virginia, (Kral 13797, 13798). On muck, under heavy shade of bottomland hardwoods, was a large stand of *X. difformis* with its spreading, broad, deep-green but maroon-based leaves, broad scapes and ovoid spikes. Countless hundreds of individuals were present, but none of any other species of *Xyris*. However, less than ½ mile distant, the road I was travelling cut through the acid sands of loblolly pine flatwoods. In the ditches on both sides of the road was a super-

(Opposite) 1. *X. serotina*. 2. *X. isoetifolia*.

abundance, but in this case two kinds, of *Xyris*. One was clearly *X. difformis*; the other, while of about the same stature, lacked the reddish pigment, had narrower spikes and scapes, and narrower, paler-green, ascending, leaves, all characteristics of *X. jupicai*. No evidence of intermediate forms could be seen, although I examined many hundreds of individuals that day and the mixed population extended along the road for more than half a mile.

Curiosity still further aroused I decided to look at all available material of this complex in my own and in borrowed collections to see if the character of pinkish or maroon pigmentation could consistently be correlated with the other "difformis" type characteristics of scape and leaf. Almost invariably associated with the reddish pigmentation were deeper green foliage, broadened, flattened, upper scapes, and darker, more ovoid, spikes; conversely, all green or dull-based plants had paler foliage (probably because of lack of red pigment) narrower upper scapes, and spikes tending to be narrower. (On older or faded specimens it was often necessary to study leaf surfaces at high magnification so as to notice presence or absence of pigment-congested strands of cells.) By utilising the above mentioned characteristics, together with the more spreading-leaved habit character of *X. difformis*, I was able to sort rapidly, thus distinguish, specimens which previously had caused me much difficulty. Subsequent fieldwork with *Xyris* during summers of 1962, 1963, 1964, in the Carolinas, Florida, Georgia, Louisiana, and Mississippi was rewarding in concepts of habitats of the two entities. I began to look for *X. difformis* in hardwood bottoms, or along pineland streams and river systems, often under relatively undisturbed conditions and in fairly heavy shade, and it was never a problem to find *X. jupicai* along most of the wet roadsides or in other disturbed wetlands. I presently suspect that the entity most at home in undisturbed habitats is *X. difformis* and that *X. jupicai* is not evident or at least is less frequent, in such situations. On the other hand, *X. difformis* does appear on disturbed wetlands (seldom far from stream or river bottoms) but is less often encountered there than is *X. jupicai*. In that few instances of morphological intermediacy have as yet been encountered, and in that the two often do occur in mixed stands, these entities must be biologically distinct.

An examination of specimens from this complex borrowed from DUKE, SMU, WISC., has resulted in suspicion that *jupicai* characters appear to disappear north of New Jersey, while *difformis* characters persist. I have observed that the character of leaf papillae displayed in such entities as *X. papillosa*, *X. bayardi*, *X. curtissii*, and *X. serotina* (sensu Malme and later authors) is invariably correlated to the production of reddish pigment, and thus it appears to me that too many other characteristics are shared by the first four entities above for sensible, distinguishable, treatments of them to be rendered. I believe that the above constitute a natural assemblage of varieties and forms,

the central type of which is *X. difformis*, which includes an extremely wide range extending from the Gulf and southern Atlantic United States all the way along the coast to the southern and eastern fringe of the Canadian Shield.

20. XYRIS DIFFORMIS Chapm. var. **curtissii** (Malme), Kral, comb. nov.

X. neglecta Small, Bull. Torrey Club 21: 30. 1894; not *X. neglecta* Nilss. 1892.

X. curtissii Malme, Ark. Bot. 13: 24. 1913.

X. papillosa Fassett, Rhodora 39: 459-460. 1937.

X. serotina Chapm. var. *curtissii* (Malme) Kral, Rhodora 62: 310. 1960.

As the species but smaller (not often taller than 2 dm.), more tufted, and with the margins of the equitant portion of the leaves very broad and pinkish-translucent. Surfaces of the leaves papillose or low tuberculate, the papillae or tubercles in slightly diagonal lines, the leaf bases pinkish or purplish and similarly papillate. Sheathes of the scape looser, the bases a rich brown, sometimes castaneous. Scapes rarely as tall as 20 cm., terete with many low ridges below becoming 3-7 carinate and blocky or angled in the cross section above (save in northern forms which may be oval in cross section and with but 1 pair or only one of scape ridges), the margins of the scape ridges papillate or scabrid. Spikes at seeding time broadly ovoid to ellipsoidal, seldom longer than 0.5 cm., of but few bracts. Fertile bracts about 3-4 mm. long, suborbicular to broadly obovate, the outer surfaces pale to deep brown, lustrous, the dorsal areas ellipsoidal, gray-green, becoming brown and indistinct with age. Lateral sepals included, about the length of the bracts, linear-curved, a lustrous brown, the thin wings broad the slightly thicker keel broadened and somewhat lacerate toward its tip, or even entire. Blades of the petals obovate or cuneate, slightly less than 3 mm. long, yellowish, unfolding in the early morning. Seeds oblong or ellipsoidal, ca. 0.5 mm. long (longer in some northern forms), translucent, with 12-14 faint, longitudinal lines, the vertical lines even more faint.

Sandy peats of ditches and bogs, flatwoods or acid seepage areas, the Great Lakes system and southeastern Canada south, primarily toward the coast into the peninsula of Florida and west, primarily in the Coastal Plain to eastern Texas.

Type. U.S.A. FLORIDA. DUVAL CO.: "near Jacksonville"; collected by Curtiss (*Curtiss 4316*); holotype at NY.

Remarks. This little plant, often not taller than such Xyrids as *X. drummondii*, *X. flabelliformis*, *X. brevifolia*, is quickly recognisable by its pinkish, papillate bases, caespitose habit, round or scabrous-angled upper scapes, and small, translucent seed. It could be cursorily confused with depauperate examples of the variety *floridana* of *X. difformis*, but these are distinguishable by their farinose seed. Chapman (1860) could have been referring to either when he commented, in regard to

X. serotina:

“Varies with shorter leaves (2-3 inches), and smaller globose or ovate heads.”.

However, the plant described by Chapman as *X. serotina* most closely fits his specimens of a larger, greenish or stramineous (not pinkish) based entity which is here decided upon as type for *X. serotina*. Thus the pinkish or maroon based plants are here considered as varieties of *X. difformis*.

Papillose, clear-seeded, Xyrids to the north have been identified variously as *X. bayardii* Fernald, *X. montana* Ries, *X. papillosa* Fassett. I have examined the types of the former and the latter and specimens of all; the type of the first is indistinguishable from the Curtiss collection here called type for *X. difformis* var. *curtissii*; the second may have forms which have slightly larger seed, but its so-called “rhizomes” appear to be nothing more than the same sort of habitat reaction found in southern forms of “*curtissii*” and in other *Xyris*; the third is the result of a northerner’s first contact with a papillose-leaved *Xyris*.

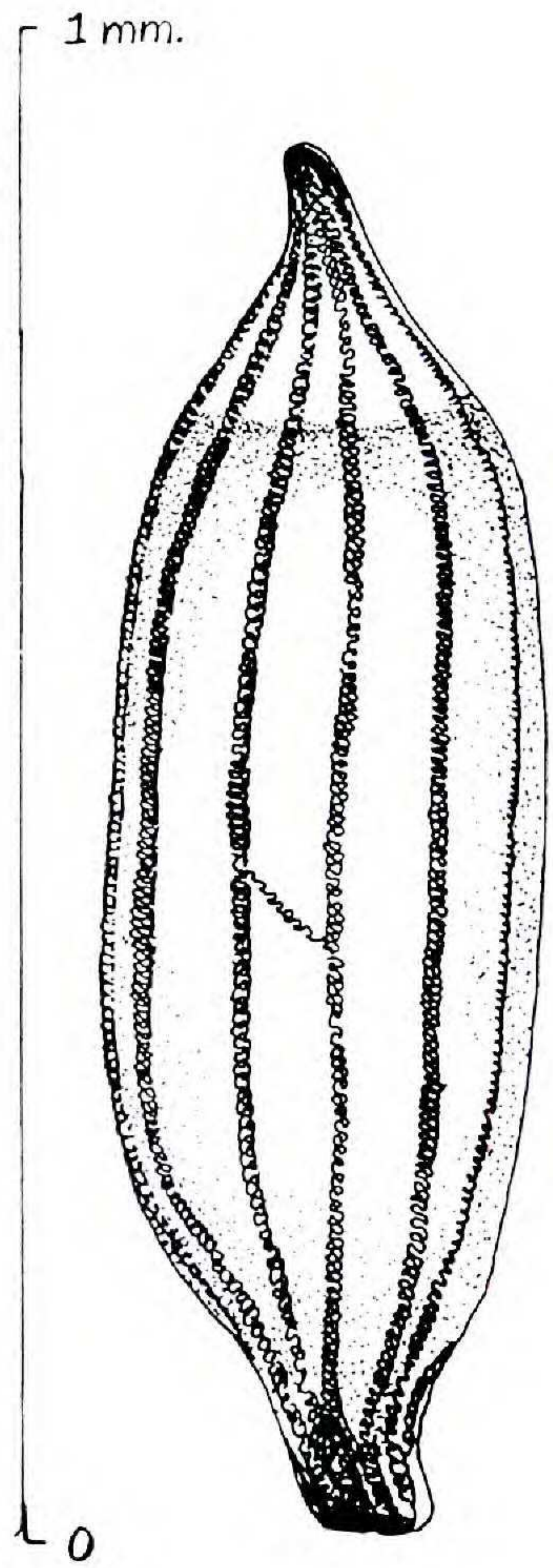
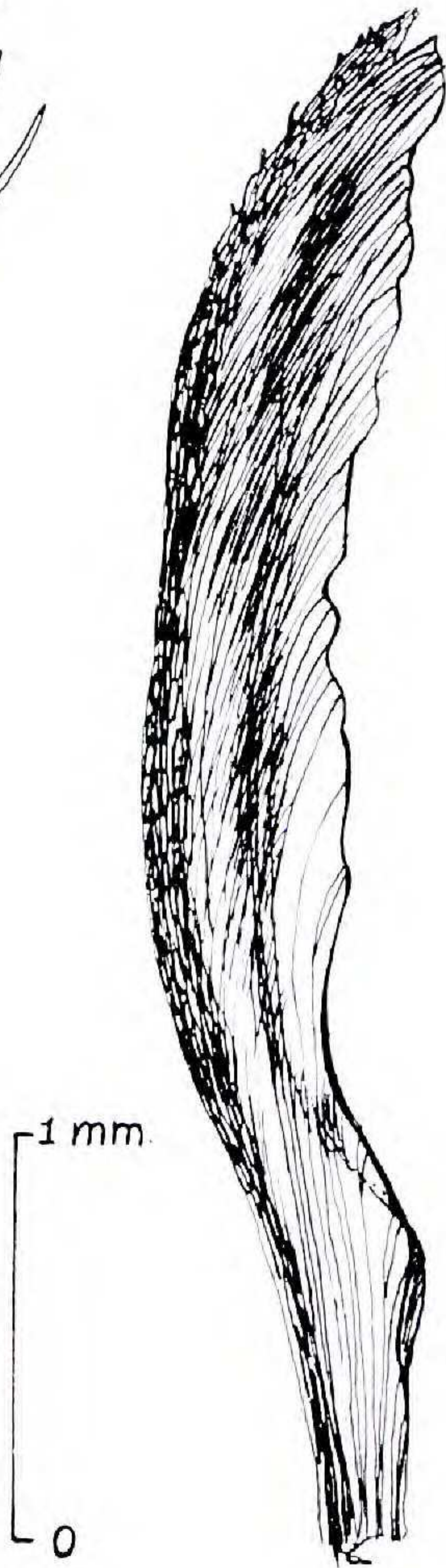
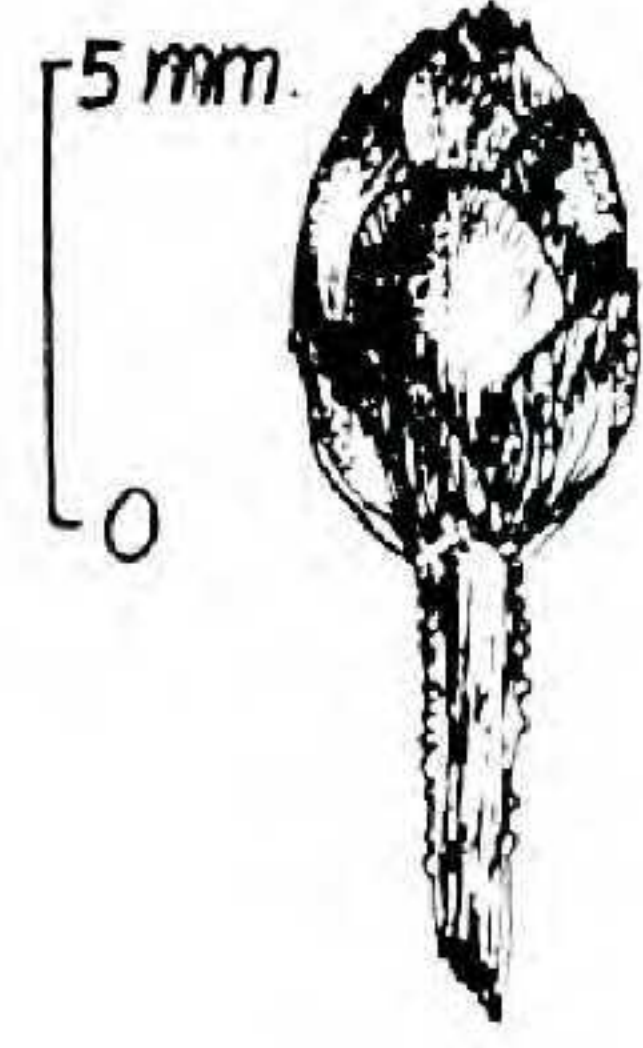
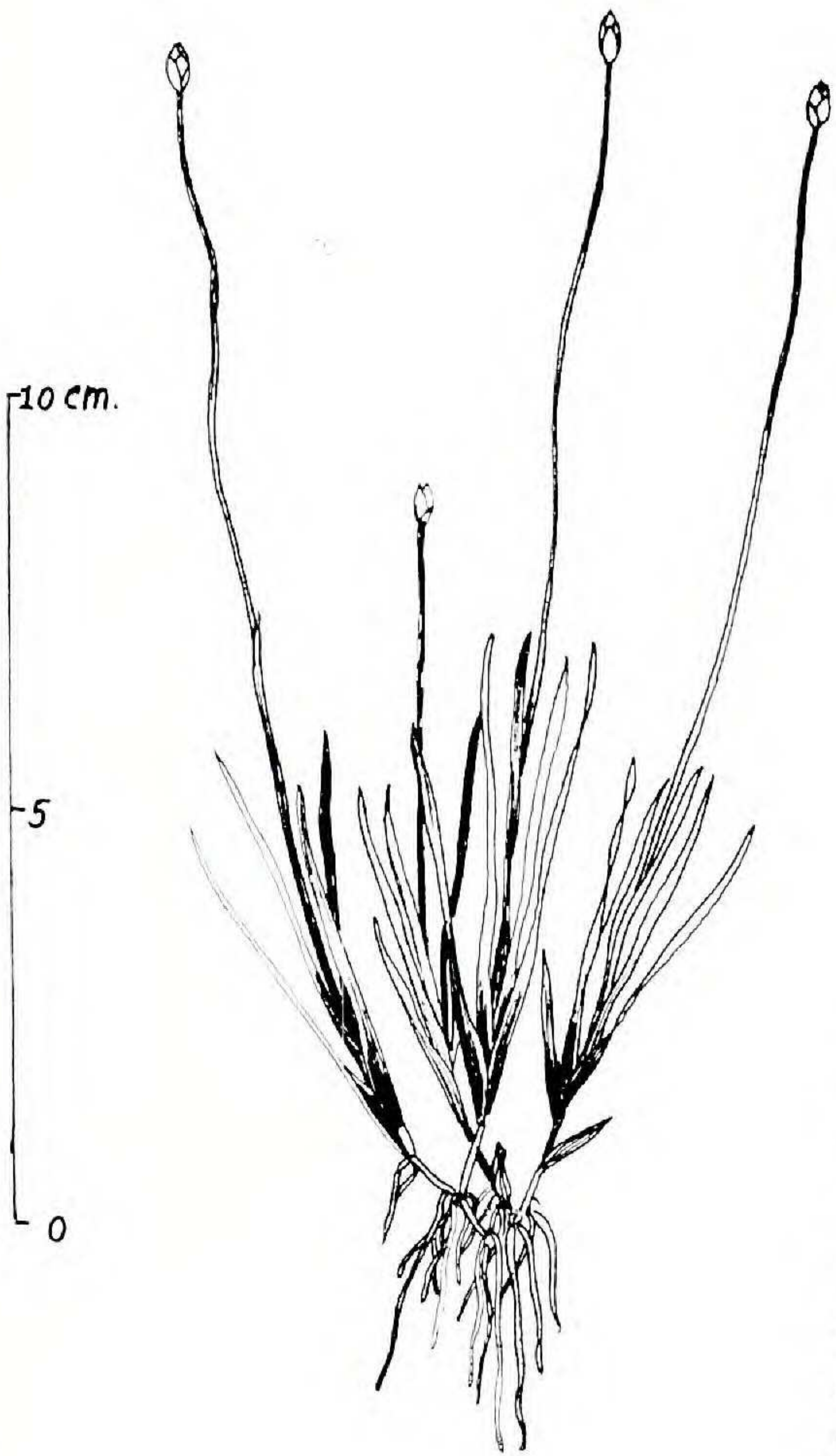
The variety *curtissii* is most abundant where moist seepage areas of sand are exposed in hillside bogs, pondshores, streambanks, roadbanks, or savannas; it also forms tufts on sphagnous substrata. The bases of the plants, because of the nature of such habitats, are often buried in detritus or wash, and are therefore often very pale, often colourless.

21. XYRIS DIFFORMIS Chapm. var. **floridana** Kral, var. nov.

Folia linearia 10-30 (rarius -50) cm. longa, 1.5-6.0 mm. lata, tuberculato-scabrida, vaginis laxis. Semina non translucida.

As the species but with surfaces and margins of the linear (10-30, rarely to 50 cm. long, 1.5-6.0 mm. broad) leaves tuberculate scabrid, dull green save for the pinkish or purplish or maroon, thin margined, equitant portion, the papillae or tubercles in short horizontal or oblique lines. Sheathes of the scape loose save at the very base, which is a deep rich brown, sometimes castaneous. Scapes linear, twisted and terete below, but straight, 20-50 (-75) cm. tall, becoming broadly oval or blocky or angled in the cross section above, with 3-7 (-13) prominent, tuberculate-scabrid ridges, the two broadest comprising the scape edges. Spikes at seeding time broadly ovoid, 1.0-1.5 cm. long, acute or sometimes acuminate, of many tightly appressed bracts, the lower barren. Fertile bracts 4-7 mm. long, obovate to suborbicular, the outer surface a dark lustrous brown, the dorsal areas dull green, oval or obovate, the exposed margin entire or becoming somewhat lacerate with age. Lateral sepals included, ca. 5 mm. long, castaneous, the keel lacerate from near the base to the apex. Blades of the petals cuneate, slightly less than 3 mm. long, yellow, opening in the morning. Seeds broadly ellipsoidal, slightly less than 0.5 mm. long, opaque, with 18-20 somewhat irregular longitudinal, raised

(Opposite) *Xyris montana*.



ridges together with equally prominent, irregularly disposed vertical cross ridges, these frequently obscured by a farinose substance.

Moist sands and sandy peats of pine flatwoods, roadsides and savannas, Coastal Plain south to southern peninsular Florida and west to the Florida parishes of Louisiana.

Type. U.S.A. GEORGIA. CHATHAM CO.: 7 mi. n. Richmond Hill, *Kral* 18941. Holotype at SMU; isotypes at BM, DS, DUKE, F, FLAS, FSU, GH, IA, ILL, ISC, K, LPI, MICH, MSC, NCSC, NO, NY, PC, PH, RSA, UC, US, USF, USL, VDB.

Remarks. In most treatments the farinose seed, lacerate sepal keel, and scabrosity of this plant link it with *X. serotina*. Chapm. However one has only to read the Chapman description of *X. serotina* and to examine his material of it deposited at NY to become convinced that he was primarily referring to a rather large, broad-leaved, plant of "pine barren swamps" whose leaves are quite long in relation to the scape lengths. There is no mention in Chapman's description of what seems to me to be a salient feature of the plant here treated as *X. difformis* var. *floridana*, namely the pinkish or purplish pigmentation of the leaf bases. Thus I designated the Chapman herbarium specimens of the robust, rigid leaved plant as the type material for *X. serotina* which leaves the maroon-based material in the Chapman collections to be designated as *X. difformis* var. *floridana*. Differences between it and *X. serotina* are shown in the table below, these based upon several large population samples of each, which were collected during the summers of 1962-1963, in Louisiana, Florida, Georgia, South Carolina, and North Carolina. Exsiccatae of all these are soon to be distributed.

X. serotina

Plant base greenish or stramineous, often invested in the dull brown leaf bases of the previous season; roots coarse, when fresh a good millimeter broad.

The plants in large, stiff-leaved, tufts, usually on muck or in shallow water; leaves often $\frac{3}{4}$ as long as the scapes, seldom narrower than 1 cm. at their broadest point above the equitant portion, the surfaces dull yellow-green.

Spike dull, broadly ellipsoidal, blunt.

Seeds ellipsoidal, caudate at one end, over 0.5 mm. long, usually closer to 6 mm., the longitudinal lines prominent but not much raised, 20-24.

X. difformis var. *floridana*

Plant base pinkish, purplish, or maroon, old leaf bases not persisting; roots finer, rarely 1 mm. broad.

The plants in smaller tufts or solitary, more willowy, usually on moist or wet sands or sandy peats, but not with the bases submersed or on muck; leaves seldom half as long as the scapes, seldom as broad as 1 cm., the surfaces dull but deep green.

Spike a dark, lustrous brown with sharply contrasting dark green dorsal areas, ovoid, acute.

Seeds ovoid to broadly ellipsoidal, about 0.5 mm. long, the longitudinal and vertical lines raised, giving the seed a somewhat cancellate look.

22. XYRIS MONTANA H. Ries, Bull. Torrey Club 19: 38. 1892. (Figs. p. 257).

X. flexuosa var. *pusilla* A. Gray, Man. ed. 5. 548. 1867.

Tufted, the soft pinkish or purplish bases often rooted in tufts of sphagnum or in muck, often with systems of ascending, rhizome-like buried stems. Principal leaves narrowly linear, 4-15 cm. long, 1.0-2.5 mm. broad, ascending, straight or slightly twisted, a dark green save toward the pinkish, purplish or reddish base. Apex of the leaf acute, slightly incurved. Surface of the leaf papillate or tuberculate-scabrid, the papillae scattered or in short, horizontal lines. Margin of the leaf above the equitant portion usually slightly thickened, papillose. Sheaths of the scapes shorter than most of the leaves, thin, tight, save toward the slightly loosened, long-bladed, orifice. Scapes linear or linear-filiform, slightly twisted, 5-30 cm. long, terete, brownish and readily disarticulating below, usually 2-4 carinate just below the spike, the ridges papillose. Spikes at seeding time broadly or narrowly ellipsoidal or ovoid, few-flowered, the lower bracts sterile ca. 4 to 5 mm. long. Fertile bracts 3-4 mm. long, narrowly obovate, not keeled; the apex rounded, slightly lacerate or low-fimbriate and with a narrow, reddish brown colour zone; the outer surface greenish-brown with the dorsal area narrowly ellipsoidal, indistinct, or at least not in sharp contrast. Lateral sepals about the length of the bracts, linear, slightly curvate or almost straight, a lustrous brown save for the darker, reddish-brown, narrow but thickened keel whose margin is entire or slightly ragged apically. Seeds narrowly ellipsoidal 0.8-1.0 mm. long, caudate with one of the "tails" truncate, translucent with 12-14 fine, usually straight longitudinal lines of small contiguous papillae, with frequent, somewhat less distinct, vertical lines.

Peat bogs, tamarack swamps, or sphagnous lakeshores, usually the plants rooted in tufts of sphagnum, Nova Scotia south (in the Appalachians) to Pennsylvania and west in the northern U.S. and southern Canada to the longitude of Minnesota.

Type. U.S.A. "Pocono Mountain Pennsylvania." Presumably at NY, but not seen by this writer.

Remarks. A visit to NY, where a fairly large set of specimens of this diminutive species exists, was sufficient to convince me that this is indeed an entity distinct from the *X. difformis* complex. It is distinct from papillose-leaved members of that complex by its narrower leaves, its much narrower and thicker sepal keels, and its much longer seed. I have never seen living populations of *X. montana* and hence have no information as to the time of day it flowers. A very large percentage of spikes of specimens of *X. montana* have few full seeds in their capsules, a phenomenon suggesting hybrid origin.

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