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VEGETATION SURVEY OF A RESTORED FLOODPLAIN IN NORTHERN MISSISSIPPI, USA

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ABSTRACT

This study documented base line data of the vascular plant community within a floodplain habitat of the Abiaca Creek drainage basin, Mississippi, USA. The study area has undergone construction of 17km of setback levees to enlarge the floodplain, restoring overbank flooding. The purpose of the construction is to naturally trap sediments entering Matthews Brake National Wildlife Refuge and create bottomland habitat. The floristic survey was conducted in the 1998 growing season at two 100-meter long transects at each of the following locations: 1) old floodplain, 2) ridge where the stream exits the Mississippi loess hills and enters the delta, 3) floodplain riparian zone, and 4) new floodplain. Species composition, frequency and percent cover were recorded using 40 quadrats (0.25m^2 each). The results revealed 45 different vascular plant families with representatives of 123 different species. One hundred twenty-one native species and two introduced species were collected along the established transects. In the woody versus herbaceous comparison, 102 herbaceous species and 21 woody species were collected. For the perennial versus biennial versus annual species comparison, 112 perennial, one biennial species, and 10 annual species were collected. Most species sampled were native herbaceous perennials. Similarity index comparisons of the four habitat areas revealed the greatest similarity occurred between the new floodplain and the riparian area. Additional studies are planned at appropriate intervals to evaluate habitat improvement in the context of sediment trapping.

PROJECT DESCRIPTION

The Demonstration Erosion Control (DEC) Project in the Yazoo Basin was initiated through Congressional legislation in 1984 to provide a means for the U. S. Army Corps of Engineers and the U. S. Department of Agriculture, Natural Resources Conservation Service (formerly Soil Conservation Service), to work cooperatively in areas of the Yazoo Basin in northwest Mississippi. Abiaca Creek watershed was not originally a part of the DEC project but was authorized by the Energy and Water Development Appropriation Act of 1990. Abiaca Creek watershed, a tributary of the Yazoo River, is located approximately 233 km south of Memphis, Tennessee, and approximately 137 km northeast of Vicksburg, Mississippi (Figure 1), with a drainage area of approximately 246 km^2 (Dept. of Army 1992).

The goal of this study was to provide base line data of the vascular plant community within a constructed floodplain habitat of the Abiaca Creek drainage basin. Problems in the watershed historically have included channel instability with channel degradation and bank, gully, and overland flow erosion which has caused or resulted in the erosion of channel bed and banks, as well as the loss of valuable agricultural land, transportation routes, and other cultural features (Watson et al. 1997). Currently, high sediment loads derived from gravel mining operations have caused major deposition in the lower reach of Abiaca Creek. These deposits reduced the conveyance capacity of the creek channel, causing flooding of agricultural lands and deposits of large quantities of sediment in Matthew's Brake National Wildlife Refuge (Figure 2). During the last three years, U. S. Army Corp of Engineers (Vicksburg District) has constructed 17km of setback levees to enlarge the floodplain, restored over-bank flooding and planted 48,000 *Quercus* (oak) seedlings in the new floodplain. The purpose of the construction was to naturally trap sediments entering the Matthew's Brake National Wildlife Refuge and create bottomland habitat (Dept. of Army 1992). Results of this study will provide baseline data for additional future surveys to monitor and evaluate the compatibility of sediment trapping and habitat restoration.

METHODS

The floristic survey was conducted in the 1998 growing season along eight 100-meter long transects oriented from east to west; two on the ridge where the stream exits the Mississippi loess hills and enters the delta (Lowe 1910), two in the old floodplain, two in the riparian zone, and two in the new floodplain (Figure 2). Species composition, frequency and percent cover were recorded from $0.25m^2$ quadrats every 20 meters along each transect. Standardized collecting procedures were followed (Barbour et al. 1987). Identifications were made in the field or from dried specimens, recorded, and were carried to the species level (Radford et al. 1968). Numbered specimens are filed by family name in preparation for mounting and storage at the National Sedimentation Laboratory, USDA-ARS, Oxford, MS, USA. Quadrat size selection was determined so the area samples would be small enough in relation to vegetation complexity for the entire quadrat to be viewed without shifting of the eyes to determine species percent cover and frequency (Daubenmire 1968). Species composition was determined by identifying all species within each quadrat (Radford et al. 1968). Species richness was calculated as the total number of species present within each site (Barbour et al. 1987). Species frequency was determined by calculating the fraction of all quadrats containing a given species and then totaled to determine frequency for each habitat (Barbour et al. 1987). Species percent cover was determined by the visual estimate of the percentage of the quadrat occupied by a given species and then totaled to determine percent cover for each habitat (Barbour et al. 1987). Importance values were calculated to combine relative cover and relative frequency for each species in each habitat (Barbour et al. 1987). The similarity index was calculated to show the overlap of species common to two habitats (Odum 1971).

RESULTS

The floristic study revealed 45 different vascular plant families (Appendix A), with 123 different species (Appendix B displays species collected by habitat location). Common herbaceous plant taxa of the ridge site (Figure 3) include species such as *Parthenocissus quinquefolia* (Virginia creeper), *Croton glandulosis* (croton), *Croton* *capitatus* (croton), *Echinochloa crusgalli* (barnyard grass), *Elaphantopus virginica* (Elephant's foot), *Tridens flavus* (purple top), and *Vitis rotundifolia* (muscadine), and woody species such as *Ulmus americana* (american elm), *Catalpa bignonioides* (catalpa), and *Fagus grandifolia* (beech). In the old floodplain site (Figure 3) common herbaceous plant taxa include *Ampelopsis arborea* (pepper-vine), *Croton glandulosis* (croton), *Digitaria sanguinalis* (crab grass), and *Dioda teres* (dioda). The riparian site (Figure 3) commonly included the herbaceous species *Equisetum hyemale* (horsetail), *Juncus diffusissimus* (soft rush), *Parthenocissus quinquefolia* (Virginia creeper), *Verbena brasiliensis* (verebena), and *Ampelopsis arborea* (pepper-vine), and the woody species *Salix nigra* (black willow), *Lonicera japonica* (Japanese honeysuckle), and *Populus deltoids* (poplar). In the new floodplain site (Figure 3) common herbaceous plant taxa include: *Leersia oryzoides* (cut grass), *Solidago nemoralis* (goldenrod), *Panicum anceps* (panicum), and *Xanthium strumarium* (cocklebur). Newly planted *Quercus* (oak) seedlings were observed in the new floodplain, but did not occur along established transects. Comparisons have been completed for a number of native versus introduced species, woody versus herbaceous species, and annuals versus biennial versus perennial species for the entire study collection. One hundred twenty-one native species and two introduced species were collected along established transects. In the woody versus herbaceous comparison, 102 herbaceous species and 21 woody species were collected. For the perennial versus biennial versus annual species comparison, 112 perennial, one biennial species, and 10 annual species were collected. These data revealed most species sampled were native herbaceous perennials which originated from a combination of wind and water seed dispersal. Species richness (number of species sampled within each site) and total percent cover within the ridge, old floodplain, riparian zone and new floodplain were calculated (Figure 4). The similarity index comparisons of the four habitat areas revealed the greatest similarity occurred between the new floodplain and the riparian areas (Table 1).

DISCUSSION

Based on floristic data collected in this study, a diverse community of early to late successional species were present within the Abiaca Creek watershed. The majority of the sampled species were native herbaceous perennials. Cover data are particularly useful because they allow comparisons of the amount of surface occupied by different life forms (Daubenmire 1968). The relative importance of cover in assessing changes in vegetation depends, to a large extent, on the life forms of the plants involved. For example, *Ampelopsis cordata* (pepper-vine) may occur with high cover but low frequency in the riparian zone; in contrast *Equisetum hyemale* (horsetail) exhibited low cover with high frequency. Thus, species cover and frequency were combined, and used to calculate importance values (Figure 3). For this study the highest species richness occurred on the ridge and in the old floodplain with 64 and 44 different encountered species, respectfully, (Figure 4). These results were consistent with the expected outcomes, since the ridge and old floodplain have received the least disturbance. The highest percent cover was observed on the ridge where the herbaceous stratum has not been disturbed for several decades (Figure 4). According to importance values calculated for each habitat, the new floodplain exhibits early successional species, as expected (Figure 3). The similarity index calculations revealed that currently, the new floodplain versus the riparian habitat areas were the most similar and the ridge versus the new floodplain were the least similar (Table 1). Initially explained by recent disturbance in construction of new floodplains, these similarity data could be explained by the hydrology of the habitat areas: the new floodplain and riparian habitats are regularly flooded, with standing water present for several weeks not uncommon. Analysis of rainfall data (NOAA 2000) for the 1998 through present time (May 2000) period revealed this to be an unusually dry period. The USGS stage data between October 1998 and April 2000 were analyzed and are displayed in Figure 5, revealing the stream has overtopped its banks at the Cruger gage (near Highway 49) only three days in early April 2000. The Seven-Pines gage (near the ridge sampling site) has not been out of the banks during the fore-mentioned period. Hence, the recent frequency and duration of flooding in the new floodplain and riparian habitats is best explained by the topography of the habitats, rather than the hydrology of Abiaca Creek. The flooding regime of the newly formed floodplain reveals the potential for successful successional development of a bottomland habitat, if average rainfall is experienced.

An understanding of the relationship between plants and characteristics of their immediate hydrogeomorphological environment is a recent and interdisciplinary development (Malanson 1993). The distribution of plant species and communities within the riparian and floodplain zones reflects the sensitivity of vegetation to a variety of characteristics of the physical environment including: 1) the degree and duration of waterlogging, 2) the frequency of flooding, 3) soil and water quality, and 4) the rate of sedimentation (Gurnell 1997). Plant species distribution in response to the physical environment is evident in such characteristics as 1) ability to survive transfer for site of erosion to site of deposition, 2) ability to compete for vegetational succession, and 3) ability to survive abrasive effects of flow velocity and sediment transport regimes (Gurnell 1997). The dependent relationship between floodplain vegetation and hydrological and fluvial processes is well documented (Marston et al. 1995). By reducing floodplain disturbance and lowering the waterlogging, an expected result might be that pioneer and disturbance dependent landscapes would reduce in area and be replaced by a more homogeneous alluvial forest. Data from this study suggest interaction between the riparian zone and the new floodplain has been increased since the similarity index calculations revealed that currently, the new floodplain versus the riparian habitat areas are the most similar. Landscape diversity could possibly be reduced in the Abiaca Creek watershed unless connectiveness is insured between the riparian zone and the newly formed floodplain, rather than allowing these two habitat areas to homogenize. The borrow pits formed during the levee construction provide one example of a potential link between the newly established habitats. Borrow pits were observed adjacent to the new floodplain sampling site (Figure 6). These borrow pits have the potential to benefit the site by acting as an essential link between the newly formed possibly fragmented habitats. The borrow pits could additionally respond as constructed wetlands providing water quality benefits to the runoff of the adjacent agricultural fields. Further, these pits could act as a transition zone between the riparian habitat and the new floodplain habitat providing the opportunity for the new floodplain to develop following the successional patterns of the old floodplain rather than the adjacent riparian zone.

CONCLUSIONS

Throughout Abiaca Creek, the majority of species sampled were native herbaceous perennials. The highest species richness occurred on the ridge with the next highest in the old floodplain. The highest total percent cover was observed on the ridge. Importance values exhibited early successional species, as expected, while similarity index calculations revealed the new floodplain and the riparian habitat areas were the most similar, and the ridge and the new floodplain were the least similar.

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REFERENCES

Barbour M.G., J.H. Burk, and W.D. Pitts. 1987. Terrestrial plant ecology. 2nd ed. The Benjamin/Cummings Publishing Company, Inc. Menlo Park, California.

Daubenmire, R. 1968. Plant Communities. Harper& Row Publishers, New York, New York.

Department of Army. 1992. Yazoo Basin, Mississippi: Demonstration Erosion Control (DEC) Project Supplement G to General Design Memorandum No. 54-Abiaca Creek Watershed. U.S. Army Corps of Engineers Vicksburg District. Vicksburg, Mississippi, USA.

Gurnell, A.M. 1997. The hydrological and geomorphological significance of forested floodplains. Global Ecology and Biogeography Letters 6: 219-229.

Lowe, E.N. 1910. Our waste lands: A preliminary study of erosion in Mississippi. Mississippi Geological Survey, Jackson, Mississippi.

Malanson, G.P. 1993. Riparian Landscapes. Cambridge University Press, Cambridge.

Marston, R.A., J. Girel, G. Pautou, H. Piegay, J.P. Bravard, and C. Arneson. 1995. Channel metamorphosis, floodplain disturbance, and vegetation development: Ain River, France. Geomorphology 13: 121-131.

National Oceanic and Atmospheric Administration (NOAA). Department of Commerce. 2000. National climatic data center. http://www.ncdc.noaa.gov/pub/data/coop-precip/mississippi.txt

Odum, E.P. 1971. Fundamentals of Ecology. 3rd ed. W.B. Saunders Company Philadelphia, Pennsylvania.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press. Chapel Hill, NC.

Watson, C.C., N. K. Raphelt, and D.S. Piedenharm. 1997. Historical background of erosion problems in the Yazoo Basin. In Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incesion. Ed. by Wang, S.S.Y., E.J. Langendoen, and F. D. Shields Jr. pp.115-119.

Table 1. Similarities between the understory plants in four habitats of Abiaca Creek.

Location	Similarity Index
Ridge vs Old Floodplain	0.20
Ridge vs Riparian	0.18
Ridge vs New Floodplain	0.15
Old Floodplain vs Riparian	0.22
Old Floodplain vs New Floodplain	0.19
Riparian vs New Floodplain	0.34

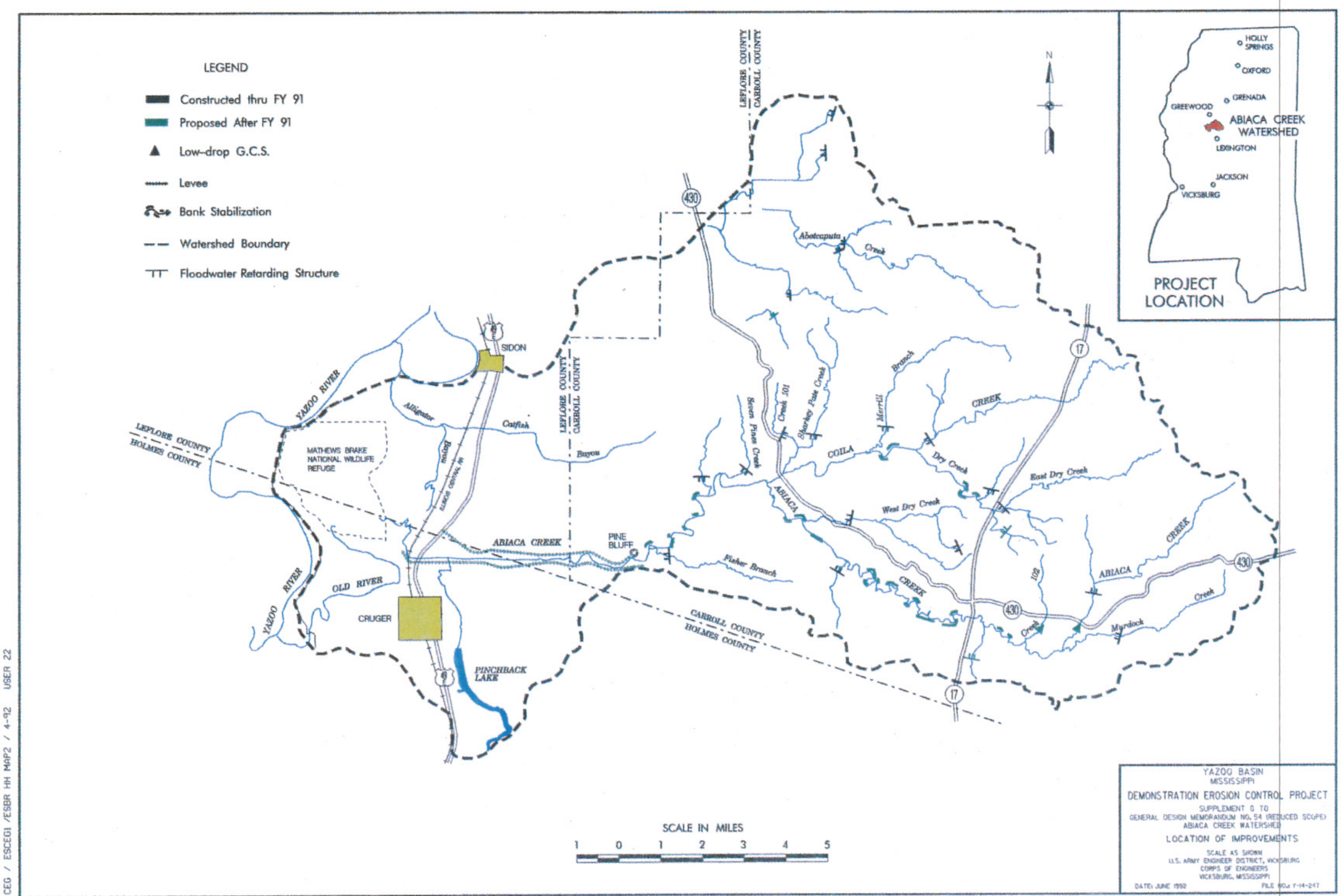


Figure 1. Abiaca Creek watershed diagram indicating location within Mississippi.

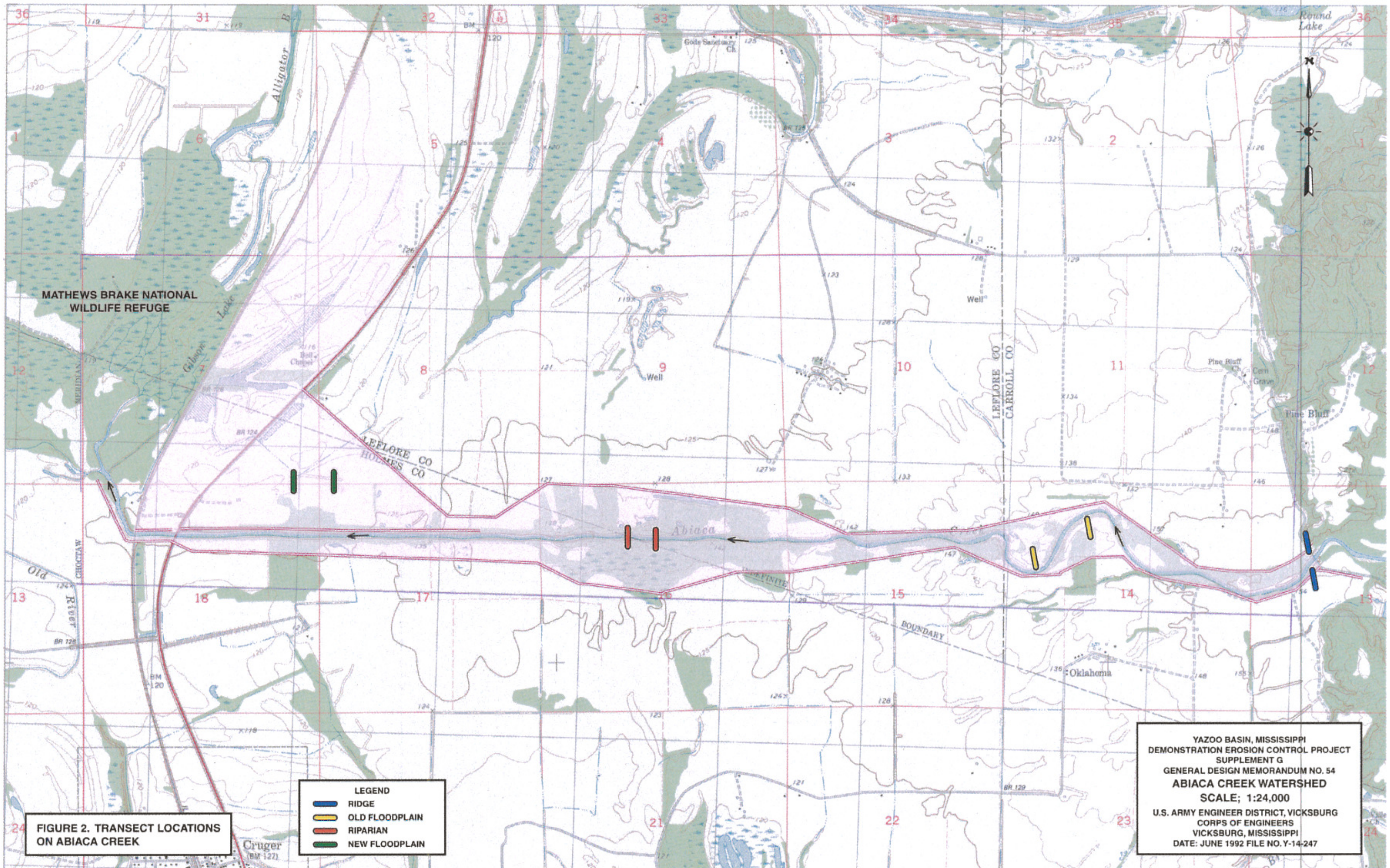


Figure 2. Locations of plant transects within Abiaca Creek watershed and site location relative to Matthew's Brake National Wildlife Refuge.

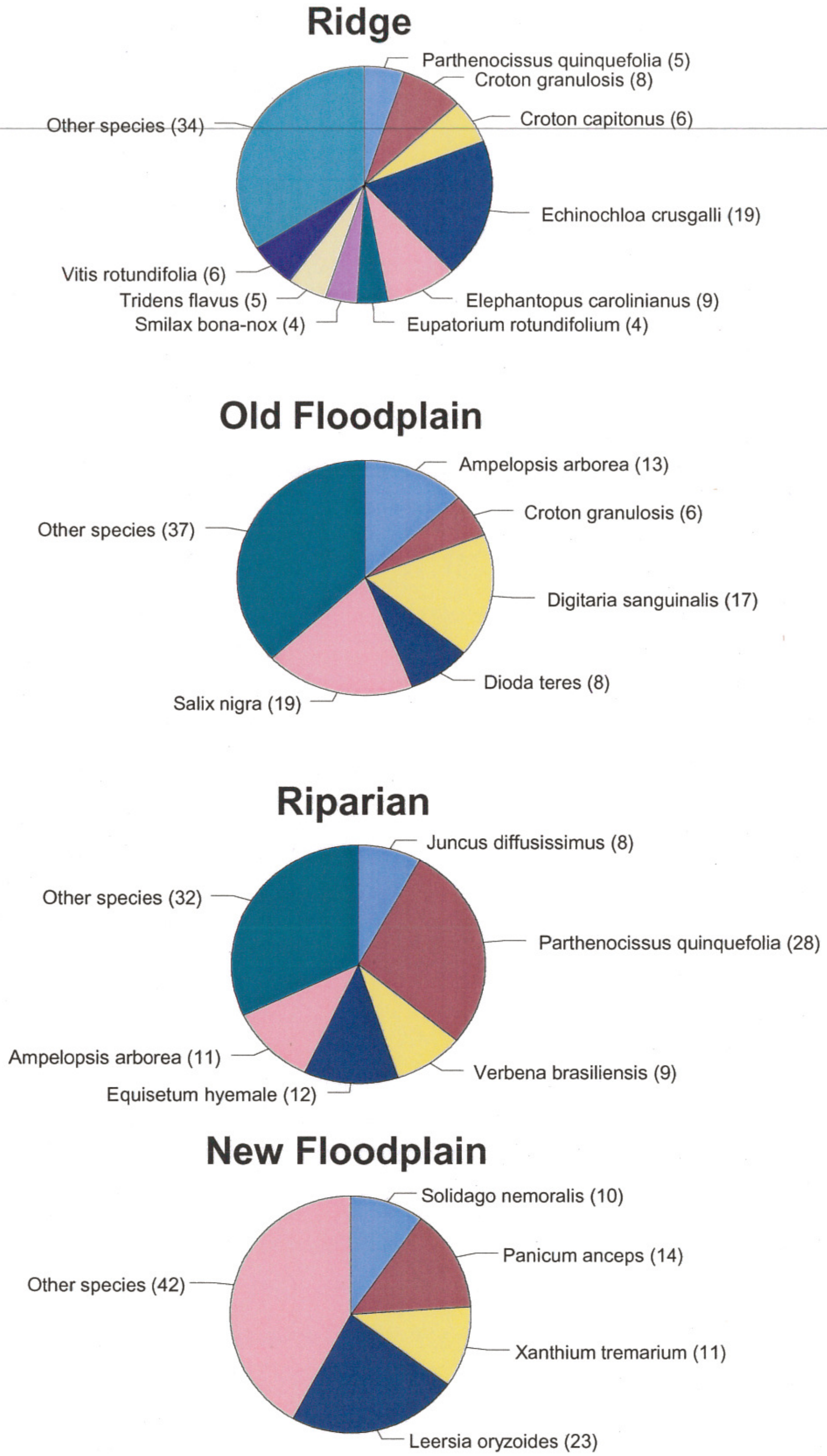


Figure 3. Graphs of importance values for Abiaca Creek plant collections.

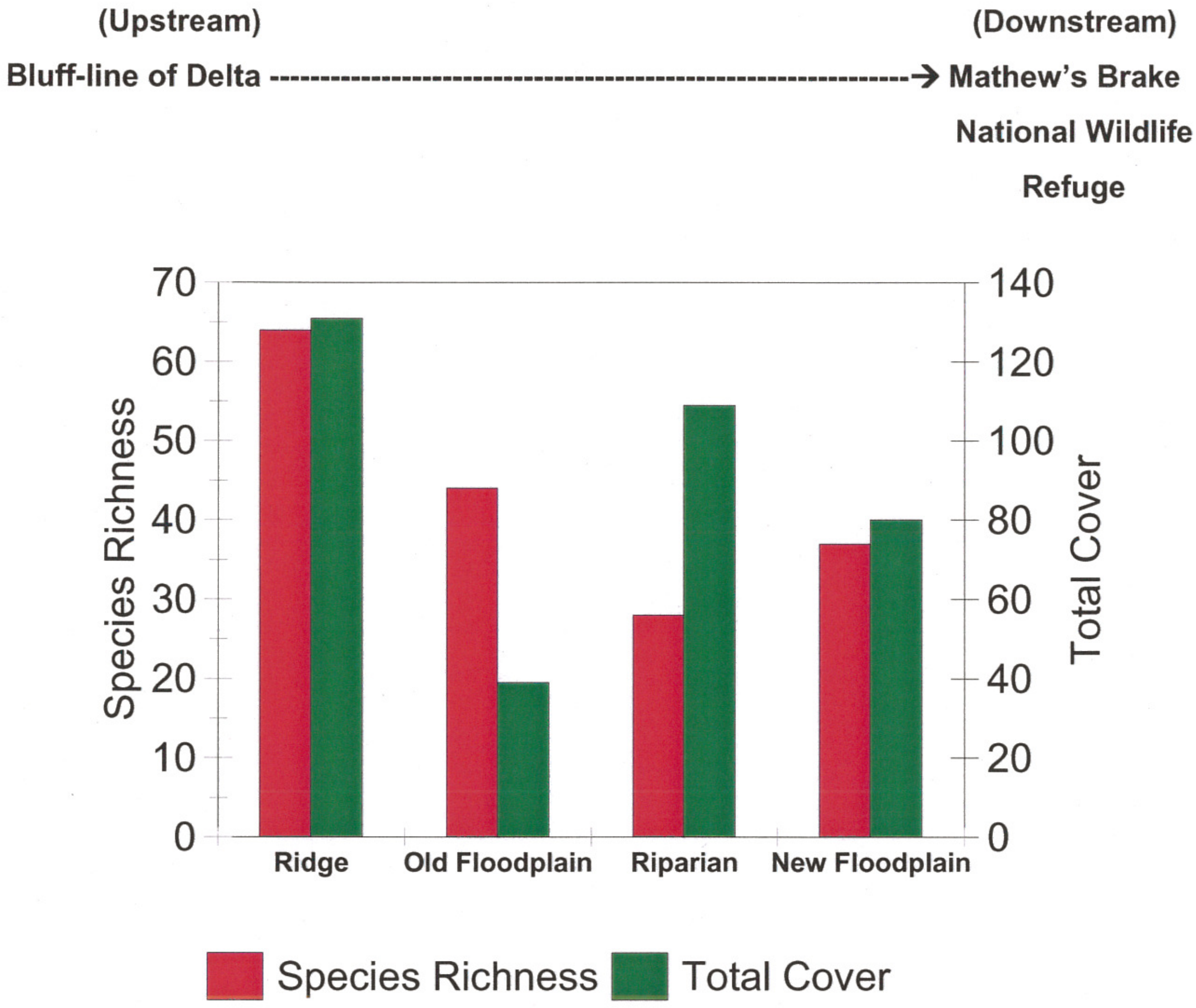
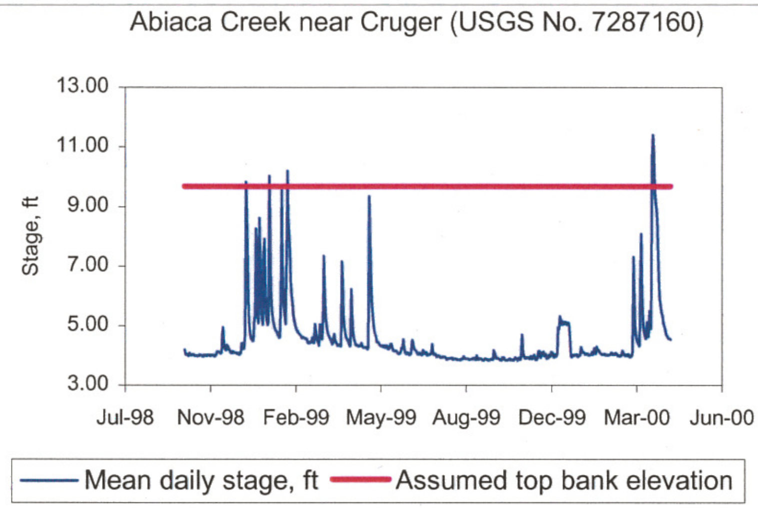


Figure 4. Species richness and total cover of understory vascular plants at Abiaca Creek.



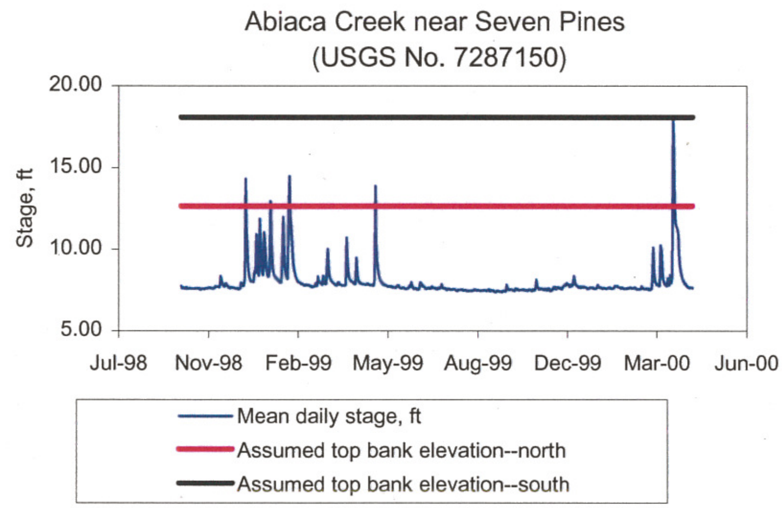


Figure 5. Overbank flooding during the study period inferred from USGS Cruger and Seven Pines mean daily stage records. Assumed top bank elevation from 1996 survey records provided by Colorado State University. Top bank elevation for Abiaca Creek near Cruger is the north top bank elevation at a survey cross section 150 m upstream from the gage. Top bank elevations for Abiaca Creek near Seven Pines correspond to those shown on a survey cross section immediately downstream from the gage.

Figure 6. Borrow pits within Abiaca Creek Watershed

Appendix A. Abiaca Plant Family Names

Family
Aceraceae
Amaranthaceae
Anacardiaceae
Apiaceae
Aspidiaceae
Asteraceae
Balsaminaceae
Betulaceae
Bignoniaceae
Brassicaceae
Caprifoliaceae
Chenopodiaceae
Commelinaceae
Convolvulaceae
Cucurbitaceae
Cupressaceae
Cyperaceae
Equisetaceae
Euphorbiaceae
Fabaceae
Fagaceae
Geraniaceae
Hypericaceae

Family
Juncaeae
Liliaceae
Loganiaceae
Lythraceae
Magnoliaceae
Oleaceae
Onagraceae
Oxalidaceae
Passifloraceae
Platamaceae
Poaceae
Poygonaceae
Ranunculaceae
Rosaceae
Rubiaceae
Salicacea
Saxifragaceae
Scrophulariaceae
Ulmaceae
Varbenaceae
Vitaceae
Zygophyllaceae

Appendix B. Abiaca Plant Species List by Location

Location Key:

1=Ridge 2=Old Floodplain 3=New Floodplain 4=Riparian

Genus Species	Common Name	Location
Acalypha rhomboidea	three-seeded mercury	1
Acer negundo	box elder	1, 2
Agrostis sp.	bent grass	2
Amaranthus palmeri	pigweed	1, 3
Ambrosia artemisiifolia	ragweed	2
Amelanchier sp.	serviceberry	3
Ammannia coccinea	ammannia	1, 3
Ampelopsis arborea	pepper-vine	1, 2, 4
Ampelopsis cordata	pepper-vine	2
Andropogon sp.	broom straw	1, 2, 3, 4
Arundinaria gigantea	cane	2
Aster dumosus	aster	1
Aster loriformis	aster	2
Aster sp.	aster	1
Aster vimineus	aster	1
Athyrium aspleniodes	roth	1
Betula nigra	river birch	3
Boehmeria cylindrica	false nettle	2
Brunnichia cirrhosa	ladies'-eardrops	3, 4
Callicarpa americana	beauty-berry	1
Campsis radicans	trumpet vine	2
Cassia fasciculata	partridge pea	2
Catalpa bignonioides	catalpa	1
Chenopodium ambrosiodes	goosefoot	1
Cinna arundinacea	wood reed	1, 2
Commelina virginica	dayflower	1
Coreopsis tinctoria	tickseed	3, 4
Croton capitatus	croton	1,2

Appendix B. (continued)

1=Ridge 2=Old Floodplain 3=New Floodplain 4=Riparian

Genus Species	Common Name	Location
Croton glandulosus	croton	1,2
Cyperus aristatus	sedge	2
Cyperus erythrorhizos	sedge	1
Cyperus flavascens	sedge	2
Cyperus iria	sedge	2
Desmodium rigidum	beggar's ticks	4
Digitaria sanguinalis	crab grass	2
Digitaria sp.	crab grass	1, 3, 4
Dioda teres	dioda	2
Echinochloa crusgalli	barnyard grass	1
Echinocystis lobata	wild cucumber	1
Elephantopus carolinianus	elephants foot	1
Elephantopus tomentosus	elephants foot	1, 4
Eleusine indica	goose grass	2
Equisetum hyemale	horsetail	2, 4
Eryngium prostratum	eryngo	4
Eupatorium bonariensis	thoroughwort	3
Eupatorium capillifolium	dog-fennel	1, 2, 3
Eupatorium incarnatum	thoroughwort	1
Eupatorium rotundifolium	thoroughwort	1
Euphorbia ammannioides	euphorbia	1
Fagus grandifolia	beech	1
Fimbristylis autumnalis	fimbristylis	1
Fraxinus americana	white ash	1
Geranium carolinianum	wild geranium	3
Helenium tenuifolium	sneeze weed	4
Helianthus giganteus	sunflower	1
Heterotheca subaxillaris	heterotheca	2
Hydrangea arborescens	hydrangea	1
Hypericum mutulum	St. John's-wort	2

Appendix B. (continued)

1=Ridge 2=Old Floodplain 3=New Floodplain 4=Riparian

Genus Species	Common Name	Location
Hypericum perfiriadum	St. John's-wort	3
Impatiens pallida	jewel weed	4
Ipomoea coccinea	morning glory	2, 3
Juncus acuminatus	soft rush	4
Juncus diffusissimus	soft rush	3, 4
Juncus effusus	soft rush	3
Juncus tenuis	soft rush	3, 4
Juncus validus	soft rush	2
Juniperus virginiana	red cedar	1
Leersia oryzoides	cut grass	2, 3, 4
Lepidium perfoliatum	peppergrass	3, 4
Ligustrum japonicum	privet	1
Lindernia sp.	lindernia	1
Liriodendron tulipifera	tulip tree	1, 3
Lonicera japonica	Japanese honeysuckle	1, 2, 4
Ludwigia alternifolia	ludwigia	1, 2, 3
Ludwigia pilosa	ludwigia	2
Microstegium virmineum	microstegium	1, 4
Oenothera biennis	evening primrose	1
Oxalis stricta	wood sorrel	1
Panicum anceps	panicum	3, 4
Panicum coparium	panicum	3
Panicum hemitomon	panicum	1
Panicum linearifolium	panicum	1
Panicum sp.	panicum	1
Panicum sp.	panicum	1
Parthenocissus quinquefolia	Virginia creeper	1, 2, 4
Passiflora lutea	passion flower	1
Phleum agrostoides	Timothy grass	1
Phleum pratense	Timothy grass	3

Appendix B. (continued)

1=Ridge 2=Old Floodplain 3=New Floodplain 4=Riparian

Genus Species	Common Name	Location
Platanus occidentalis	sycamore	2, 3
Poaceae sp.	poaceae	2, 3
Polygonum acandeus	knotweed	1
Polygonum aviculare	knotweed	1
Polygonum glaucum	knotweed	3
Polygonum sagittatum	arrow leaf tear thumb	3
Polypremum procumbens	polypremum	1, 4
Populus deltoides	poplar	2
Prunus serotina	plum	2
Ptelea trifoliata	hop-tree	1
Ptilimnium capillaceum	ptilimnium	3
Quercus nigra	water oak	2
Ranunculus sardous	buttercup	3
Rhus radicans	poison ivy	1
Robinia pseudo-acacia	black locust	1, 2
Rubus sp.	dewberry	1
Rubus trivialis	dewberry	2
Rumex pulcher	rumex	4
Salix nigra	black willow	2, 4
Smilax bona-nox	greenbrier	1
Smilax sp.	greenbrier	1
Solidago altissima	goldenrod	3, 4
Solidago canadensis	goldenrod	2
Solidago nemoralis	goldenrod	3
Sorbus americana	sorbus	2
Tovara virginiana	jumpseed	1
Tridens flavus	purple top	1, 3
Ulmus alata	winged elm	1
Ulmus americana	american elm	1, 2
Uniola sessiliflora	uniola	3

Appendix B. (continued)

1=Ridge 2=Old Floodplain 3=New Floodplain 4=Riparian

Genus Species	Common Name	Location
Verbascum virgatum	mullein	1
Verbena brasiliensis	verbena	2, 3, 4
Vitis rotundifolia	muscadine	1
Xanthium strumarium	cocklebur	1, 4
Zizaniopsis miliacea	wild rice	3