CHANGES IN BAYGALL VEGETATION FROM 1986 TO 2001 AT FORT POLK IN WEST CENTRAL LOUISIANA

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ABSTRACT

Baygalls are a plant community associated with small streams in west central Louisiana. Plots from a 1986 study on the effects of sedimentation on baygall vegetation were resampled in 2001. Nested subsamples were used and the same areas were sampled during each time period. Importance values were calculated using frequency, individual density, stem density, and dbh. In 1986, the sedimented and control baygalls were significantly different in all variables except for woody individual density and woody stem density. In 2001, dbh was the only variable not significantly different between the control and sedimented baygalls. In the sedimented area between 1986 and 2001, the woody plant variables increased while herbaceous plant variables decreased. Woody species, *Liquidambar styraciflua* and *Alnus serrulata* showed a large decrease, however, *Toxicodendron radicans*, *Smilax rotundifolia*, and *Ligustrum sinense* increased. In the control baygalls, four fern species increased in importance value.

RESUMEN

Los "Baygalls" son una comunidad vegetal asociada a pequeños torrentes en el centro-oeste de Luisiana. Las parcelas de un estudio en 1986 sobre los efectos de la sedimentación en la vegetación baygall se volvieron a muestrear en 2001. Se usaron submuestras anidadas y se muestrearon en cada periodo las mismas áreas. Los valores de importancia se calcularon usando frecuencia, densidad individual, densidad de tallos, y diámetro a la altura del pecho. En 1986, los baygalls sedimentados y de control fueron significativamente diferentes en todas las variables excepto para la densidad individual de leñosas y densidad de tallos leñosos. En 2001, el diámetro a la altura del pecho fue la única variable no significativamente diferente entre el control y los baygalls sedimentados. En el área sedimentada entre 1986 y 2001, las variables de plantas leñosas aumentaron mientras que las variables de plantas herbáceas disminuyeron. Las especies leñosas *Liquidambar styraciflua* y *Alnus serrulata* mostraron una gran disminución, sin embargo, *Toxicodendron radicans*, *Smilax rotundifolia*, y *Ligustrum sinense* aumentaron. En los baygalls de control, cuatro especies de helechos incrementaron su valor de importancia.

INTRODUCTION

Baygall is a colloquial term that refers to the small drainage systems and to the vegetation developed along the streams (Allen et al. 1990). In the center of most baygalls is a small sandy or gravelly-bottomed stream that is intermittent in the upper drainage and usually continuous in the lower portions of the drainage. The smaller streams drain into slightly larger streams and ultimately into a larger watercourse. Baygalls are surrounded by pine forests and are narrow in the upper portion gradually widening downstream to a maximum width of 20–50 meters. Drainage from the surrounding upland pine forest percolates downward until it reaches an impervious layer of clay or rock typically forming seepage areas throughout the baygall. Pitcher plant bogs are found in open areas in and along the edge of many baygalls (Allen et al. 1987). The woody vegetation in the baygalls is predominately broad-leaved (dicotyledonous) deciduous or evergreen trees or shrubs contrasting with the very common evergreen (gymnospermous) needle-leaved trees of the upland pine forests. The vegetation developed along the floor of the baygall is sparse and contains a number of ferns, bryophytes, especially peat moss (*Sphagnum* spp.), and a few shade-tolerant flowering plants.

METHODS

In the summer of 2001, six baygalls used in a 1986 study (Allen et al. 1990) were examined for resampling. The study area in one of the sedimented baygalls was completely destroyed and thus was excluded from resampling. One of the two transects in two different control baygalls could not be relocated. Two transects were resampled in the one sedimented baygall with a total of 37 subsamples. Four transects in four different control baygalls were resampled with 94 subsamples. The 1986 data from these 37 and 94 relocated samples only were used for comparisons with the 2001 data.

In 1986, the starting point for each transect was randomly located in the center of a baygall using random numbers and pacing. The transect extended perpendicular from the baygall stream upslope to the end of the baygall vegetation or sedimented area. Subsamples were established using metal poles at one meter intervals along the transect. Most of the original metal poles were still in place along the transects. In both sampling periods, nested subsamples were taken along the transects at each of the one meter markers. A 0.09 meter (0.3 meter × 0.3 meter) quadrat was used to sample the herbaceous plants. The sample was taken on the upstream side of each point. The shrubs (woody plants with a dbh (diameter at breast high at approximately 4.5 feet) of less than 4 inches and/or shorter than 25 feet) were sampled using a 1 meter square quadrat with 1/2 meter on each side of the transect center line. The trees (woody plants 4 inches dbh or larger and/or 25 feet or taller) were sampled using 10 meter × 1 meter quadrat with 5 meters on each side of the transect center line. All species and total number of stems were recorded in each quadrat at each subsample. The dbh was recorded to the nearest 0.1 cm for woody taxa of sufficient height

Some of the herbaceous taxa could only be identified to genus, family

(Poaceae or Cyperaceae), or class. Data were entered and analyzed using Microsoft Excel software. The community physiognomy variables were calculated by summing the value for each subsample and dividing by the number of subsamples, 37 for sedimented baygalls and 94 for control baygalls. Species richness was calculated using all plant taxa. Individual density (number of individuals per subsample) and stem density (number of stems per subsample) were calculated for herbaceous taxa and also for woody taxa. The dbh was also calculated for woody taxa.

The population variables were calculated for all taxa by summing the value for each subsample and dividing by the number of subsamples, 37 for sedimented baygalls and 94 for control baygalls. The frequency (percentage of subsamples of occurrence) and mean value for individual density and stem density was calculated for all taxa. The mean value for dbh was calculated for the woody taxa of sufficient size. Relative frequency, relative individual density, and relative stem density were calculated for all herbaceous taxa from the sedimented baygalls by summing the values for all herbaceous taxa in the sedimented area and dividing the value for each taxon by the total. The relative values for frequency, individual density, and stem density were calculated identically for the herbaceous taxa from the control baygalls and for woody taxa from both control baygalls and sedimented baygalls. All relative values were then converted to a percentage. The importance value for each herbaceous taxon was calculated by summing the values for relative frequency, relative individual density, and relative stem density. The importance value for each woody taxon was calculated by summing the values for relative frequency, relative dbh, relative individual density, and relative stem density. The total importance value for all herbaceous taxa is 300 and for the woody taxa is 400.

Most plants were identified in the field by the senior author, and voucher herbarium specimens for most taxa were collected, mounted, and filed at Ft. Polk. Duplicates of many of the taxa were deposited in the Herbarium of the University of Louisiana at Monroe (NLU). Some taxa were identified in the laboratory using Allen, (1980 or 1992); Correll and Correll (1972); Correll and Johnston (1970); Diggs et al. (1999); Godfrey and Wooten (1979, 1981); or Radford et al. (1968). The scientific names are from USDA, NRCS (2002).

RESULTS

The mean physiognomy community variables (species richness, dbh, woody individuals, woody stems, herbaceous individuals, and herbaceous stems) per subsample for the sedimented and control baygalls for 1986 plus 2001 are presented in Table 1. The standard deviation is also given. The student's t-test was used to compare variables between control 1986 and control 2001, sedimented 1986 and sedimented 2001, control 1986 and sedimented 1986, and control 2001 and sedimented 2001. Allen et al. (1990) reported that t-test comparisons showed

TABLE 1. Community Physiognomy data (Species Richness, DBH, and Density) in control (94 subsamples) and sedimented baygalls (37 subsamples) for 1986 and 2001 at Fort Polk, La. All variables are significantly different at the 0.05 level between: control 1986 and control 2001; sedimented 1986 and sedimented 2001; control 1986 and sedimented 1986; and control 2001 and sedimented 2001, except where noted. Standard deviation is included in parentheses.

	Control Baygalls		Sedimented Baygalls	
	1986	2001	1986	2001
Species Richness	4.79 (2.36)	6.28(2.41)	7.32(2.67)	5.00(2.12)
No. Woody species	34	42	25	27
No. Herbaceous Species	24	23	34	3
DBH (cm)	17.16[a] (23.54)	17.71[a,b] (21.94)	6.19(21.64)	14.19[b] (15.30)
Woody Individual Density	7.13[c](4.40)	12.80(5.94)	6.73[c] (4.34)	10.41(5.59)
Woody Stem Density	8.10[c](5.05)	15.87(7.42)	7.35[c](5.22)	11.32(6.14)
Herbaceous Individual Density	1.94[a](3.05)	1.38[a](1.64)	15.05(8.35)	0.16(0.55)
Herbaceous Stem Density	4.21[a] (7.82)	4.24[a] (6.10)	22.30(19.41)	0.19(0.62)

[a] Not significantly different between 1986 and 2001 control baygalls
[b] Not significantly different between 2001 control and 2001 sedimented baygalls
[c] Not significantly different between 1986 and 2001 sedimented baygalls

all variables between the control 1986 and sedimented 1986 data to be significantly different. However, when the data for the relocated samples only are used, the woody individual density and woody stem density were not significantly different between the control and sedimented baygalls in 1986. When the control 1986 data are compared to the control 2001 data, the species richness, woody individual density, and woody stem density were the variables that were significantly different. A comparison of the 1986 sedimented data to the 2001 sedimented data reveals that all six variables are significantly different. In the 2001 control and sedimented data, dbh was not significantly different while the other five variables were all significantly different. In Table 1, the variables that are not significantly different are indicated by: [a] if between 1986 and 2001 control baygalls; [b] if between 2001 control baygalls and 2001 sedimented baygalls; and [c] if between 1986 control baygalls and 1986 sedimented baygalls. The most dramatic changes from 1986 to 2001 occurred in the sedimented baygalls with great increases in dbh (6.19 cm to 14.19 cm), woody plant individuals (6.73 to 10.41), and woody plant stems (7.35 to 11.32). Large decreases occurred in herbaceous individuals (15.05 to 0.16) and herbaceous stems (22.30 to 0.19).

The importance values for each woody taxon in the control and sedimented baygalls for 1986 and 2001 are in Table 2. In 1986, the woody taxa with the highest

TABLE 2. List of woody taxa and importance value from control baygalls and sedimented baygalls for 1986 and 2001.

Taxon	1986 control	1986 sedimented	2001 control	2001 sedimented
Acer rubrum	17.87	22.27	17.06	7.54
Alnus serrulata	0.00	18.32	4.27	0.00
Aronia arbutifolia	5.59	1.74	8.52	0.00
Berchemia scandens	7.13	7.74	6.10	5.51
Bignonia capreolata	1.12	0.00	8.22	15.03
Callicarpa americana	2.50	1.74	4.83	2.11
Cephalanthus occidentalis	0.00	26.42	0.00	0.00
Chionanthus virginicus	0.56	0.00	1.19	0.00
Cornus florida	0.56	0.00	0.35	0.00
Cyrilla racemiflora	0.00	0.00	0.70	0.00
Gelsemium sempervirens	7.57	4.26	5.88	3.90
Hamamelis virginiana	0.00	0.00	0.70	0.00
Hypericum spp.	0.56	1.74	0.35	0.00
Ilex coriacea	22.45	0.00	35.00	3.08
Ilex opaca	7.91	1.74	5.62	0.00
Itea virginica	1.68	26.94	4.94	0.00
Ligustrum sinense	0.00	7.74	0.00	47.47
Liquidambar styraciflua	5.95	35.10	1.69	7.58
Lonicera japonica	0.00	0.00	0.00	6.51
Lyonia lucida	23.00	0.00	33.72	0.00
Magnolia virginiana	52.14	6.78	37.04	20.79
Morella caroliniensis	19.61	1.74	13.62	1.05
Morella cerifera	4.76	16.27	0.65	22.91
Nyssa sylvatica	78.30	148.97	51.69	69.28
Parthenocissus quinquefolia	0.00	0.00	0.35	0.00
Persea palustris	23.37	1.74	24.50	3.16
Pinus palustris	0.00	0.00	2.76	0.00
Pinus taeda	22.15	2.52	22.64	49.00
Quercus alba	0.00	0.00	1.34	0.00
Quercus falcata	0.56	0.00	0.00	0.00
Quercus nigra/laurifolia	4.73	22.51	6.95	9.32
Quercus seedling	0.00	0.00	0.35	0.00
Rhododendron spp.	7.12	0.00	4.85	0.00
Rhus copallina	0.00	1.74	0.35	0.00
Rubus spp.	8.13	6.96	18.60	2.11
Salix nigra	0.00	9.85	0.00	0.00
Sassafras albidum	1.12	0.00	0.00	0.00
Smilax glauca	5.88	0.00	8.92	1.05
Smilax laurifolia	9.46	0.00	8.32	6.27
Smilax rotundifolia	28.43	4.26	5.52	23.70
Smilax smallii	0.00	0.00	1.46	0.00
Smilax tamnoides	0.00	0.00	0.00	1.05
Toxicodendron radicans	9.24	16.64	21.31	60.40
Toxicodendron vernix	1.68	0.00	0.85	1.05

TABLE 2. continued

Taxon	1986 control	1986 sedimented	2001 control	2001 sedimented
Vaccinium arboreum	0.00	0.00	0.00	1.55
Vaccinium arkansanum	1.12	0.00	0.91	0.00
Vaccinium elliottii	1.96	0.00	2.30	2.11
Viburnum dentatum	4.33	4.26	4.23	18.32
Viburnum nudum	11.45	0.00	20.69	8.17
Vitis rotundifolia	0.00	0.00	0.70	0.00

importance value (>20.00%) in the control baygalls were *Nyssa sylvatica, Magnolia virginiana, Smilax rotundifolia, Persea palustris, Lyonia lucida, Ilex coriacea,* and *Pinus taeda* and in 2001, the top taxa were *Nyssa sylvatica, Magnolia virginiana, Ilex coriacea, Lyonia lucida, Persea palustris, Pinus taeda, Toxicodendron radicans,* and *Viburnum nudum.* In the sedimented baygalls in 1986, the most important taxon was *Nyssa sylvatica* with an importance value of 148.97%, which was almost five times as much as the second most important taxon. In 2001, *Nyssa sylvatica* was still the most important taxon, but its importance value was only 69.28%. In the sedimented baygalls in 1986, other taxa with importance value greater than 20.00% were *Liquidambar styraciflua, Itea virginica, Cephalanthus occidentalis, Quercus nigra/laurifolia,* and *Acer rubrum.* In the same sedimented baygalls in 2001, the taxa with more than 20.00% importance value were *Toxicodendron radicans, Pinus taeda, Ligustrum sinense, Smilax rotundifolia, Morella cerifera,* and *Magnolia virginiana.*

The importance value for each herbaceous taxon in the control baygalls for 1986 and 2001 are in Table 3. In 1986, the taxon with the highest importance value was Poaceae followed by *Rudbeckia scabrifolia, Dichanthelium tenue, Viola primulifolia,* and herbaceous dicotyledons. In 2001, the five taxa with the highest importance value (in decreasing order) were *Dichanthelium tenue, Woodwardia aerolata, Rudbeckia scabrifolia, Carex leptalea,* and *Chasmanthium laxum.* In 2001, there were only three herbaceous taxa observed in the sedimented baygalls (Poaceae 137.91%, *Chasmanthium laxum* 108.06%, and *Mitchella repens* 54.03%); this contrasted tremendously with the 43 taxa recorded in 1986 in all subsamples (Allen et al. 1990) and the 34 taxa in the relocated subsamples. The taxa with the highest importance value in 1986 were Poaceae, *Lycopus* spp., Herbaceous dicotyledons, *Juncus diffusissimus,* and *Juncus coriaceus.*

CONCLUSIONS

In 1986, the data indicated that sedimentation had a significant effect on the baygall vegetation community. The student's t test showed four variables to be

Table 3. List of herbaceous taxa and importance value from control baygalls for 1986 and 2001.

Taxon	1986	2001
Apteria aphylla	1.89	0.00
Arisaema triphyllum	3.78	8.46
Arnoglossum ovata	0.00	3.47
Athyrium felix-femina	4.01	9.62
Carex folliculata	0.00	15.72
Carex leptalea	0.00	24.50
Chasmanthium laxum	4.97	17.74
Coreopsis gladiata	10.19	0.00
Cyperaceae	2.70	6.42
Dichanthelium acuminatum	0.00	2.95
Dichanthelium commutatum	1.89	0.00
Dichanthelium dichotomum	0.00	4.22
Dichanthelium tenue	43.36	61.67
Erechtites hieracifolia	1.89	0.00
Eupatorium leucolepis	0.00	2.20
Eupatorium rotundifolium	1.89	0.00
Herbaceous dicot	27.29	0.00
Lachnocaulon anceps	3.50	0.00
Lobelia reverchonii	1.89	2.20
Lycopus spp.	0.00	2.20
Melanthium virginicum	2.65	0.00
Mitchella repens	14.29	16.32
Osmunda cinnamomea	5.80	10.32
Poaceae	47.72	2.20
Rhynchospora rariflora	4.72	0.00
Rudbeckia scabrifolia	43.98	29.89
Scleria oligantha	0.00	2.70
Solidago patula	1.89	9.39
Symphyotrichum spp.	0.00	4.23
Viola primulifolia	42.30	9.07
Woodwardia areolata	16.42	52.29
Woodwardia virginica	1.89	2.20
Xyris spp.	9.08	0.00

highly significantly different between the sedimented and control or non-sedimented baygalls. Species richness and herbaceous individuals and stems had increased in the sedimented baygalls while the dbh had decreased. Sedimentation had killed many of the larger woody plants which explained the decrease in the dbh. The increase in species richness and herbaceous individuals and stems probably occurred because the addition of sedimentation created a more mesic habitat.

When the two areas (control and sedimented) were compared again in 2001, the dbh had increased in the sedimented baygalls and was no longer different

(Table 1). A comparison of the sedimented area 1986 data to the 2001 data revealed that the species richness had decreased from 7.32 to 5.00 species per sample. The number of woody individuals and stems had almost doubled and the dbh had more than doubled in the sedimented baygalls. The biggest changes in the sedimented baygalls occurred with the herbaceous plants where the mean number of individuals decreased from 15.05 to 0.16 and the mean number of stems decreased from 22.30 to 0.19 stems. These changes in the sedimented baygall indicate that this area is changing from an open area to a forested area. The increase in trees and shrubs has created more shade and caused a large decrease in the number of herbaceous plants. The number of herbaceous species decreased from 34 to 3.

In the control baygalls between 1986 and 2001, species richness, woody individuals, and woody stems had all increased significantly and the dbh, herbaceous individuals, and herbaceous stems had remained fairly constant. These changes and lack of change could be attributed to normal succession in the baygalls.

Nyssa sylvatica is a tree that seems to be little affected by sedimentation, as its importance value is very high in the sedimented baygalls in 1986 (Table 2). The tree (*Liquidambar styraciflua*), shrubs (*Alnus serrulata* and *Cephalanthus occidentalis*), and vine (*Toxicodendron radicans*) seem to grow better in the sedimented areas as indicated by the increase in their values. Tree species (*Magnolia virginiana* and *Pinus taeda*), shrub species (*Persea palustris* and *Ilex coriacea*), and the vine (*Smilax rotundifolia*) seem to have been affected by sedimentation as their values decreased in the sedimented baygall. In 2001 in the control baygalls, the shrubs (*Ilex coriacea* and *Lyonia lucida*) had increased in importance value and is probably linked to natural succession in the baygalls. The sedimented baygalls had undergone more dramatic changes between 1986 and 2001 where early successional species (*Liquidambar styraciflua* and *Alnus serrulata*) showed a tremendous decrease in importance value; *Alnus serrulata* was completely absent in 2001 and *Liquidambar styraciflua* decreased from an importance value of 35.10% to 7.58%. The shade tolerant vines (*Toxicodendron radicans* and *Smilax rotundifolia*) increased greatly in importance values. The introduced species (*Ligustrum sinense*) had a large increase in importance value from 7.74% in 1986 to 47.47% in 2001. Most of these changes seemed to be linked to succession in a sedimented area except for the introduced species filling in the niches normally occupied by native shrubs.

The notable change in the herbaceous taxa in 1986 was the increase in the number of weedy taxa in the sedimented baygalls that were not present in the control areas or were present in small numbers (Allen et al. 1990). Some of the weedy taxa include several species of *Juncus* and *Solidago*, *Diodia teres*, *Ambrosia artemisiifolia*, and *Bidens aristosa*. The creation of a new habitat in the sedimented baygalls is the reason for the invasion by the weedy taxa. All of the ferns (*Athyrium felix-femina, Osmunda cinnamomea, Woodwardia aerolata*, and *Woodwardia virginica*) were not found in any of the sedimented samples but were present in the control samples. All four showed an increase in importance value between 1986 and 2001 in the control baygalls. The fern taxa in the sedimented baygalls in 1986 apparently decreased because of increased sun exposure caused by the death of trees in the baygall. These fern species probably increased in value in the control baygalls in between 1986 and 2001 as a result of increased shade. In 2001, the sedimented baygalls changed dramatically with virtually no herbaceous plants persisting. The dense shade produced by the trees and shrubs greatly decreased the number of herbaceous plants, especially weedy species.

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