July 25, 1996

Mr. Bob Lindsay
Natural History Biologist
Illinois Department of Natural Resources
P.O. Box 67
Goreville, IL 62939

Dear Bob:

This is a final report for IDNR project, SIU# 6-23755, "Ecosystem function and restoration in the Cache River Bioreserve, Illinois". The grant has been very helpful in the support of my undergraduate student workers, and I am grateful.

I am enclosing the final report for my WRC/USGS project on the role of flooding in seed dispersal. This serves as a complete report for the scientific aspect of the research. I thought that here I would summarize the details of this report and then comment on the benefit of the project to the undergraduates involved in my research. Let me know if you require any additional information.

The research explores the role of flood pulsing in the dynamics of cypress swamp species regeneration. High water is important in dispersing seeds to the periphery of the swamp to target restoration sites. Because the seeds of many cypress swamp species are extremely short-lived, seed dispersal is important in resupplying live seeds to the seed bank. In the case of cypress, approximately 5% of the seeds survive on the surface of the soil for one year. Farmed sites are nearly devoid of cypress swamp species. Seeds of more than 40 species disperse in the water including cypress, tupelo, buttonbush, and water locust.

At the same time that high water is important in resupplying swamp species to seed banks, summer drawdown is important for seed germination. Seedlings do not survive long periods of inundation. In field situations, seedlings flooded with more than 50 cm of water for one month during the summer season did not survive. However, dormant seedlings flooded in the winter time, do survive for up to 3 months in low amounts of

sedimentation under greenhouse conditions. High water, especially if combined with sedimentation, almost completely inhibits seed germination.

Because both high water and drawdown are important in the regeneration of cypress, in impounded sites such as Buttonland Swamp, regeneration is limited to a narrow ring at the periphery of the swamp. In 1993, regeneration occurred just above 330 feet. This elevation is typical of sites which are underwater in the winter but that drawdown in the summer.

The undergraduate students have been involved in all aspects of this research, seed sorting of seed dispersal traps, plant census in the greenhouse seed bank studies, maintenance of sedimentation studies in the greenhouse and data entry. Some of the undergraduate students have decided to chose careers involving wetland ecology because of their job experiences in the lab. The undergraduates become full members of the lab and gain from their close interactions with faculty and graduate students. I worked as a field assistant as an undergraduate and appreciate the importance of the experience in my development as a scientist.

Thanks for your support of this project. If you have any questions, please do not hesitate to contact me.

Sincerely,

Dr. Beth Middleton, Associate Professor

The Role of Flooding in Seed Dispersal: Restoration of Cypress Swamps along the Cache River, IL

Beth Middleton
Department of Plant Biology
Southern IL University, Carbondale, IL 62901
618-453-3216 FAX: 618-453-3441
E-Mail: GA4003@SIUCVMB.SIU.EDU

Project Number: IL-WRC-95-220

Water Resources Center
University of Illinois at Urbana-Champaign
1101 West Peabody Drive
Urbana, IL 61801

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FOREWARD

The ecoclinal populations of the Cache River watershed lie at the northern edge of the cypress swamp region in the Mississippi Embayment. Because of their extreme northern location, they are likely to be more fragile and susceptible to damage than other cypress swamps to the south. Ecoclinal population are more difficult to restore (Holland and Risser 1991). With this idea in mind, I set out to study the potential of hydrologic restoration in the reestablishment of the plant species in formerly farmed fields. The study was conducted during relatively wet years (1993 through 1995), so that the timing of the study provided ideal conditions to study the effects of flooding on seed dispersal.

I am convinced by my studies, that hydrologic restoration, that is the restoration of flowing riverine channels with high water during winter flooding followed by low water conditions in dry seasons or years is essential in both the regeneration and maintenance of healthy plant populations in these swamps (Middleton 1994, Middleton 1995, Middleton in press). The Lemna-laden water in a cypress swamp contains disseminules for the natural restoration of a cypress swamp including seeds, vegetative plant fragments, insects and larvae, i.e., a miniature swamp.

Through the restoration of the hydrologic pulsing characteristic of riverine wetlands of the southeastern United States, this disseminule-rich water can be encouraged to deposit its valuable contents on the surface of targetted restoration areas. This study demonstrates the potential of cypress swamps regenerating naturally on sites where the hydrologic regime characteristic of cypress swamps is restored. The lack of plant regeneration in cypress swamps with altered hydrology is a problem that can be solved by engineers intent on recreating the conditions under which swamp species evolved.

ACKNOWLEDGMENTS

The author wishes to extend her thanks to Mr. Rich Allgire and Dr. M. Demissie of the Illinois State Water Survey for the water gage information critical to setting elevation levels in this study. The Illinois Water Resources Center deserves special thanks for inviting me to present this study to their annual board meeting. Mr. Jim Waycuilis of the Illinois Department of Natural Resources was invaluable to this project in his help in finding the Owl Pond study location. Mr. Max Hutchison of the Nature Conservancy provided information regarding the location of study sites for the regional seed bank study and Mr. Al Novara of the U.S. Fish and Wildlife Service regarding sapling survivorship. At least 30 private farmers allowed me access to their farmed fields and provided information regarding the history of these sites. The Illinois Department of Conservation, U.S. Fish and Wildlife Service, Ducks Unlimited and the Citizens to Save the Cache allowed access to many study sites in the region under their ownership.

Thanks to the many people who assisted in field and laboratory work for this study including Charlie Giedeman, Mark Basinger, John Wilker, Bob Weichman, Mary Kandl, Keith Fessell, Janet Taylor, Shaun Conrad, Nukhet Akanil, Jonathan Taylor, Eduardo Sanchez, Erin Conley, Holly Harris, Dorothy Simmons, Edmond Schott, Scott Kuykendall, Allison Strauss, Rob Rubinas, Mike Pennington, Scott Hertel, Angie Hampton, Donna Brown, Chris McKinley, Mike Mittage, John Rivera, Beth Suedmayer, Kate Peterson, Steve Christianson, Mike Betka, Ted Kalkreuth, Christa Chausse, Chris McKinley, Ken Werner, Jason Nagle, Brandi Sanguinett, Ken Thompson, Yuzo Toya, Jason Schellenberg, Brad King, Kirk Dowdy, Ajax Solis, Kriste Ericcson, Jeff Swayne, Eileen Jiskra, Laura Traiforos, Sharon Kline, Amy Horstman, Fabienne Latorture, Cristobel Bolanos, Diane Sakonyi, Tim Loftus, Todd Bittner, Heather Williams, Jason Utley, Jose Orriola, James Baker, Tomomi Nakashima, Anna Lundstein, and Justine Kelley.

ABSTRACT

The potential for natural regeneration of cypress swamps is highest on the periphery of permanently impounded cypress swamps where flooding reestablishes the seed bank and where summer drawdown allows the germination of the seeds of aquatic species. That the seed bank of cypress swamps is short-lived is demonstrated by the small number of aquatic species in seed banks farmed for as little as 1-5 years. Based on principal components analysis, the four factors which explained 90% of the variability of the regional seedbanks were area collected, water regime (flooding/drawdown), seed species and seed totals. Cypress and tupelo were found in the seed banks of areas farmed for only 1 year, but these were not viable. The seed bank of cypress swamps was found in abandoned farm fields up to the edge of the flood sheet, but did not move beyond it for the most part. Water dispersed species such as cypress and beggar's-ticks were found at elevations that flooded, but not above. Based on principal components analysis, the five factors that explained 85% of the variability in the seedbank at elevations were elevation, water regime (flooding/drawdown), site, seed total and species. At least 40 cypress swamp species dispersed in the water, and species such as cypress and tupelo dispersed solely in the water. Seed dispersal varied seasonally, with most species such as cypress and buttonbush having the highest numbers of seeds dispersed during winter months (November through February and November through May, respectively). Annual variability in the dispersal of live seeds for 1993 versus 1994 was dramatic for cypress and buttonbush (98 versus 1 and 4693 versus 1912 seeds m^{-2}, respectively). Wind dispersed species such as silver maple, American elm and buttonbush also dispersed in the water, and buttonbush, across the snow in January and February 1993, to several meters above the flood line. At Crawford Tract, the site of the seed dispersal study, the highest water levels recorded at the time of seed trap collection during this two year study were recorded at 101.4069 m (332.70 ft) on December 7, 1993. Natural regeneration of the abandoned farm fields adjacent to Buttonland Swamp can be anticipated along the periphery of the impounded swamp from the edge of the highest flooding (101.4069 m) at the upper edge of the zone of summer seasonal drawdown.

INTRODUCTION

Objectives and Justification

The objective of this study was to test the potential of flooding as an agent in the restoration of cypress swamps. The project determined the quantity of stream overflow necessary to resupply the short-lived seeds to seed banks of cypress swamps in abandoned farmland earmarked for restoration and the ability of seeds to disperse, germinate and regenerate in these conditions. For swamps and adjacent farm fields, this study suggests that natural hydrologic restoration, that is flood pulsing, can provide a less expensive and more effective method of restoration than handplanting a limited number of species. This study suggests that hydrologic restoration can result in the regeneration of cypress swamps.

The understanding of the relationship of hydrology and seed dispersal will help in the effort to restore huge tracts of cypress swamps in the Cache River region and has undoubtedly been the route to the reestablishment of naturally disturbed areas through the millennia. It is a timely study in that, as part of the North American Waterfowl Management Plan, portions of the Cache River watershed will be restored to bottomland hardwood forest and have been purchased by the U.S. Fish and Wildlife Service, the Nature Conservancy and the Illinois Department of Natural Resources (formerly the Illinois Department of Conservation).

Seed Bank Dynamics, Seedling Establishment and Adult Requirements

For the restoration of cypress swamp vegetation to be successful, the specific hydrologic requirements of the species must be met for all stages of their life histories. For successful seed germination, the absence of flooding is required for all but submersed species (Baskin *et al.* 1993, Galinato and van der Valk 1986, Schneider and Sharitz 1986, Baskin and Baskin 1988). In unaltered swamps in southern Illinois, seasonal wet/dry swamps are dry only in the summer (June through September, personal observation) and flooded during the winter (Basinger 1994). Deep swamps may be a meter or more in depth in the winter and flooded to less than an inch in a typical summer (Voigt and Mohlenbrock 1964).

Permanently flooded swamps have little regeneration (Klimas 1987). In unmodified rivers of the Southeast, opportunities for reestablishment of dominant species occur on point bars or in river meanders (Shankman 1991, Shankman 1993). Seedlings of cypress require a drawdown of two years (Shelford 1954). Once established, saplings tolerate flooding better than seedlings but less than adult trees. In Louisiana, the above-ground portion of cypress grows taller and survivorship is higher when flooded for 7-10 months per year (Conner and Flynn 1989). At the Bellrose Tract owned by the U.S. Fish and Wildlife Service, saplings survived flooding for 5 weeks during the growing season (April/May), and some of these were overtopped by 30 cm of water. The site had been drained two years previously, so it is likely that these saplings were two or less years old. Also, rabbits sometimes ate saplings to the soil surface, but the saplings grew back (Al Novara, personal communication).

Adult plants of dominant emergent and tree species can tolerate periods of inundation. However, flowering and seed production are lower in permanently flooded swamps (Klimas 1987, Waters and Shay 1991). In cypress swamps, production levels are higher with summer drawdown and lower with permanently impoundment (Conner and Day 1992, Middleton 1995). Flooding often results in the accelerated growth in the above-ground portions of the

plant and the erroneous conclusion that the trees are producing more biomass when flooded. However, flooding results in the reapportioning of below-ground biomass of storage material to above-ground portions of the plant, at least temporarily (Day and Megonigal 1993). Mortality of flood tolerant species, such as cypress and tupelo can result from prolonged flooding during the growing season and usually occurs in wet years following the alteration of hydrology through dams and levees (Eggler and Moore 1961, Whitlow and Harris 1979, Harms *et al.* 1980, Klimas 1982, Hook 1984, Loftus 1994).

METHODS

Study Area

The Cache River area in southern Illinois (Figure 1) was once an extensive region of cypress and mixed hardwood swamp of approximately 250,000 hectares in the northernmost region of the Gulf Coastal Plain (Ugent *et al.* 1981) before its extensive alteration for agriculture. Agricultural development by clearing and drainage began in the Cache River area in the late 1800's though most of the area was drained in the 1930's. The Post Creek Cutoff, built in about 1916, was only partially successful in draining the area, but it did alter the flow pattern of the Lower Cache River (Demissie *et al.* 1990). Altogether, 50% of the area has been farmed in the past, but even before the governmental land acquisition began, 15% of the farmland had been abandoned (U.S. Fish and Wildlife Service 1990).

The study site for the seed dispersal to farm fields study and water quantity study was at the interface of the Crawford Tract and Owl Pond, a bald cypress swamp near the town of Perks (37°17'50"N; 89°03'10"E). The seed viability study was placed on an point bar directly north of Owl Pond. The seedling survivorship study was done here and at the Crawford Tract/Owl Pond interface, while the seed germination and soil moisture study was done at these sites, in addition to a trail owned by the Illinois Department of Natural Resources near the canoe landing to the north.

The seedbank study at various elevations took place at the interface of the Crawford Tract and Owl Pond, and at two farm/swamp interface sites owned by the Nature Conservancy near the former town of Rago, now nearest Whitehall, Illinois.

The regional seedbank study spanned the entire Cache River region. In the Lower Cache, in Buttonland Swamp, soil from four unfarmed areas was collected, in addition to seven other areas which were farmed from 1 to 30 years. Near Karnak, one unfarmed site was collected, as well as three other sites farmed from 10 to 25 years. Near Tamms, one unfarmed site was collected, along with eighteen sites farmed from 3 to 50 years. Near Horseshoe Lake, one unfarmed site was collected, along with three sites farmed for 25 years. Near Mounds, one unfarmed site was collected (this area consisted of a few cypress trees in the river channel) along with three sites farmed for 13 years. In the Upper Cache, near Goose Pond, one unfarmed site was collected, along with five sites farmed from 5 to 25 years. Near Cypress Pond, one unfarmed site was collected, along with one additional site farmed for 10 years. Near Section 8 Woods, one unfarmed site was collected, along with one site farmed for 15 years. Near Heron Pond, two unfarmed sites were collected along with three sites farmed for 15 years. Near Deer Pond, one unfarmed site was collected along with five sites farmed for 1 through 15 years.

The Crawford Tract was last farmed before 1990. In 1995, the vegetation was comprised of saplings of *Fraxinus americana*, *Cephalanthus occidentalis*, and near the swamp, *Taxodium distichum*. Owl Pond, a part of Buttonland Swamp and an old channel of the Cache River, is comprised of stands of old growth *Taxodium distichum*, *Nyssa aquatica* and thick stands of *Cephalanthus occidentalis*. Subsurface flow in the area is nearly undetectable (Marsh McBirney Model 201 portable flow meter); however, surface flow due to wind is common. The Diel Dam constructed in 1982, is a low-head channel dam downstream from Buttonland

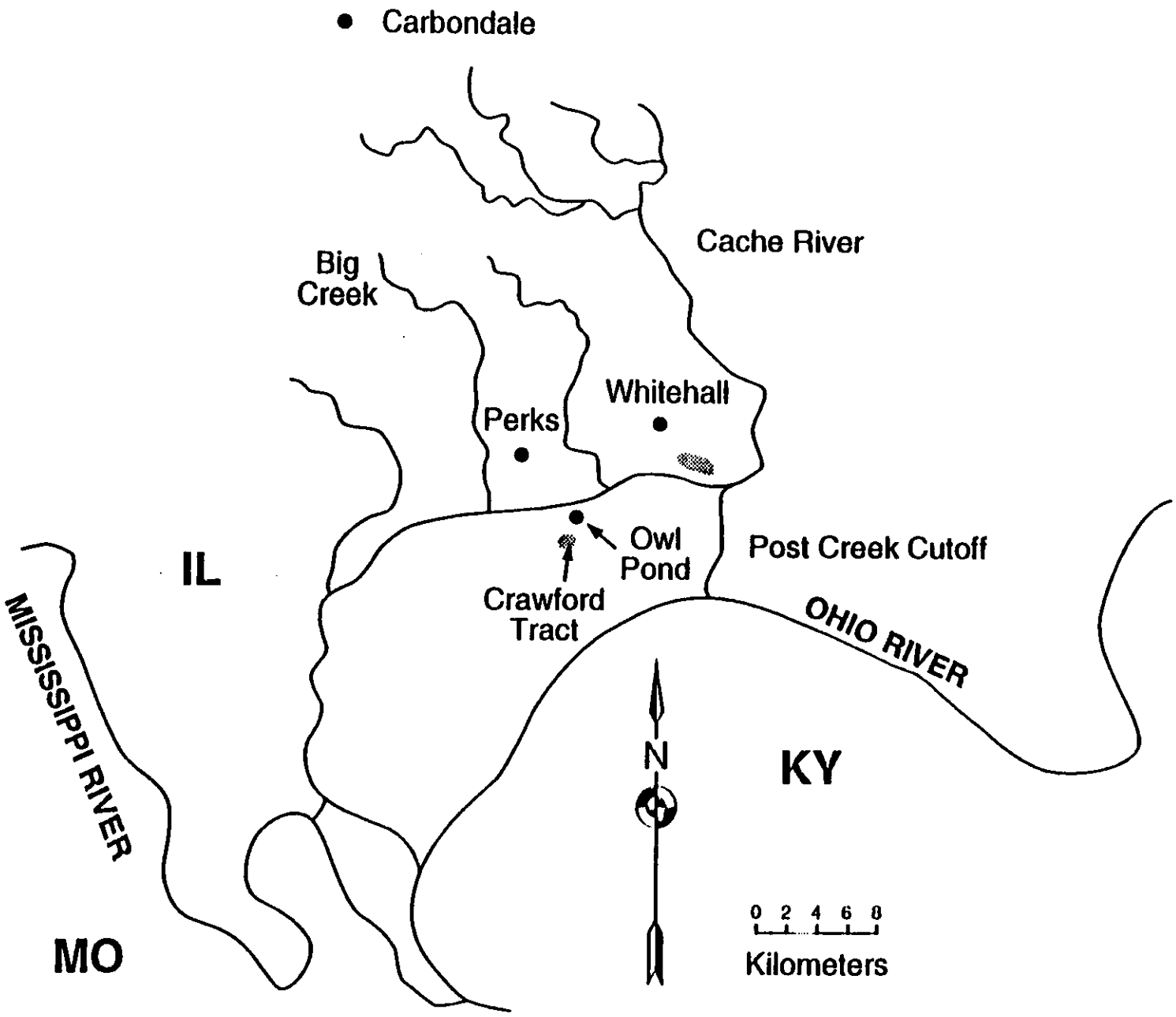

Figure 1. Location of the Cache River cypress swamps, including Crawford Tract and Owl Pond, part of Buttonland Swamp near Perks, southern Illinois. The former town of Rago (not pictured) was south of Whitehall, Illinois just north of the Cache River.

Swamp (Muir *et al.* 1995). During this study, Buttonland Swamp was permanently flooded with water depths in Owl Pond, ranging from approximately 2 m during winter floods to 0.5 m in summer drought (personal observation).

Seed Dispersal to Abandoned Fields

Hypothesis 1. Stream overflow has a decreasing ability to disperse seeds at increasing distances from the river channel and into farmed fields.

In May 1993, 30 aquatic seed traps (Middleton 1995) were placed in a formerly farmed area, Crawford Tract adjacent to the Cache River near Owl Pond, Perks, Illinois (Figure 1) owned by The Citizens to Save the Cache. To accommodate high water, ten additional traps were added at two higher elevations (103.7655 and 104.4507 m msl) in February 1994 (Figure 2). Sites were chosen near a water gage near Perks, IL. Each month the level of the water was measured at a permanent baseline set to a water gage (via Rich Allgire, Illinois Water Survey). The seed traps were placed along transects traversing the stream channel perpendicular to and continuing into the adjacent farmed field. The transects were arranged randomly within 20 m intervals. A set of five traps were placed at 10 m intervals along the transects starting in the center of the Cache River at 8 elevations. Positions and elevations of the seed traps were surveyed with a theodolite (Topcon Model GTS 201D with data logger) and preliminary maps drawn with TDS Easy (1994)

Seeds in the traps were collected each month until June 1995. The aquatic seed traps were designed in my lab (Middleton 1995). This study determined if seeds were able to be carried from a cypress swamp into an adjacent farm field via the water, and the nature of the dispersion of these seeds.

To convert the data to a m^{-2} basis, the total number of seeds captured in the aquatic traps (horizontal trapping surface of 27 cm^2) was multiplied by 13.7 and in the aerial traps (27-cm diameter) by 17.5 (Middleton 1995).

Seed Bank Study of Field/Swamp Interface

Hypothesis 3. Seeds of cypress swamps are less numerous in the seed banks of farmed cypress swamps at increasing distances from the river channel.

In March 1993, seed bank samples were collected at 6 elevations at 3 sites (approximately 98.2885, 100.0932, 100.2436, 101.1279, 192.0175 and 102.4534; Figure 2). One of these sites was the Crawford Tract, site of the seed trap study. At this site, the samples were collected next to the seed traps. At the two Rago sites, the soil was collected starting at the edge of the river, and then at 6 elevations approximating the Owl Pond collection elevations. The collection from the 5 points equidistant from the river were combined to create one sample and composited into 6 samples from each site. In June 1993, the soil trays were set-up in the greenhouse of the SIUC Plant Biology Department. After sieving the soil to remove plant fragments, each composite soil sample was subdivided into 10 subsamples and placed in 30 x 30 cm plastic soil trays. The 10 soil trays from each wetland were placed into one of 10 large

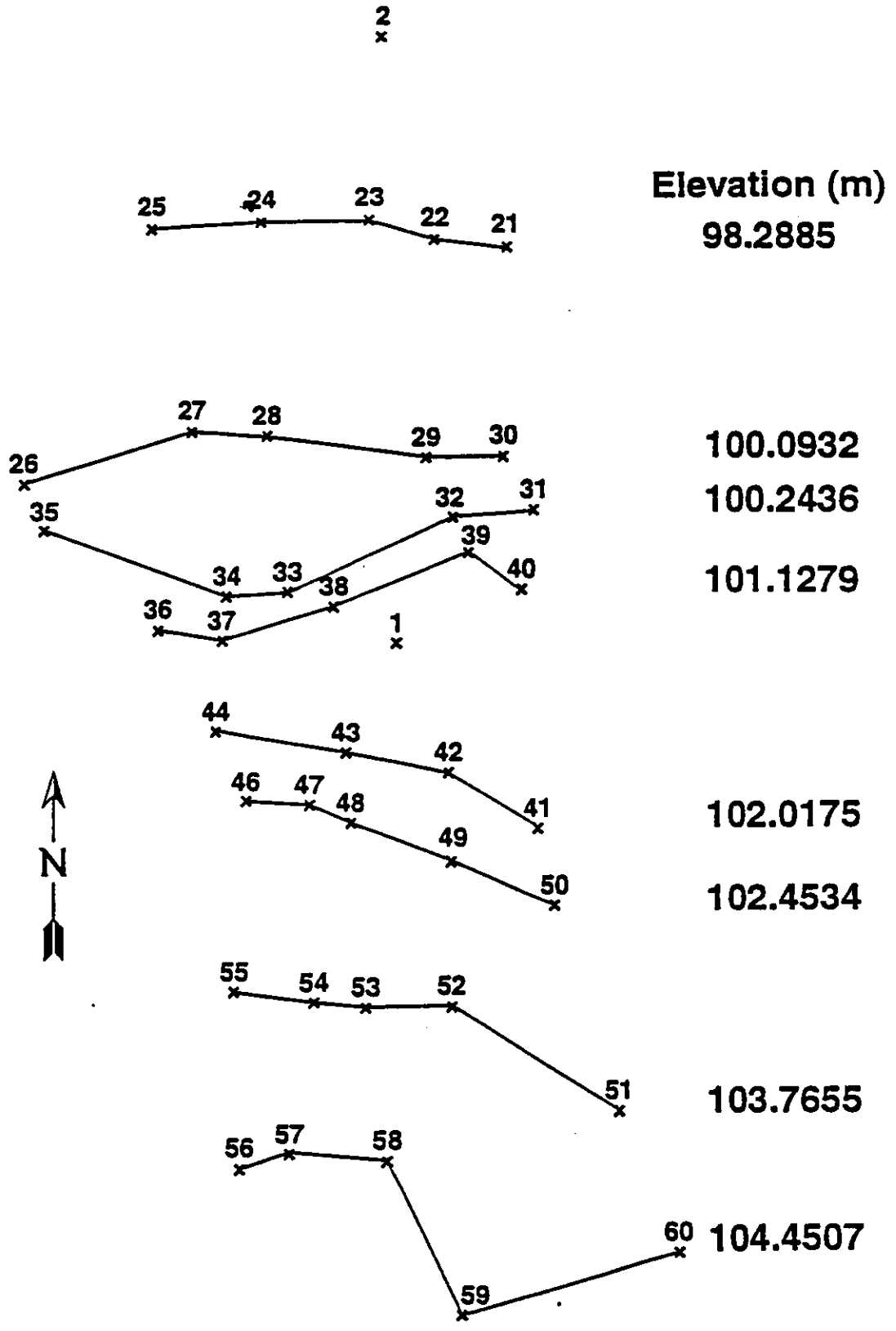

Figure 2. Locations and elevations of seed traps (aquatic and aerial) from June 1993 through May 1995 in Crawford Tract, southern Illinois. Elevations were determined using a baseline set to a water gage of the Illinois State Water Survey (Rich Allgire, personal communication). Numbers 21 through 60 correspond to seed trap numbers; number 1 is the position of the theodolite and number 2 is the position of the metal post with set point of the baseline.

metal tanks as follows: 5 soil trays were kept moist with tap water, 5 soil trays were submersed in tap water. All trays were completely randomized within the tanks. Plants which emerged from the soil in the trays were identified, tallied, and then pulled to prevent seed contamination until July 1994. After the experiment was finished, the soil was sieved through a 2 mm screen to retrieve ungerminated seeds. These seeds were tested for viability using a tetrazolium staining method (Shuel 1948). To convert to a m-2 basis, the total number of seedlings germinating was multiplied by 16.

To test the ability of seeds to move across the surface of the snow, during the frozen period of January through February 1994, at 3 sites within 3 elevations, 1 cm of surface snow was collected in 0.25 m^2 quadrats with a trowel adjacent to seed traps above the ice sheet in Crawford Tract (seed traps #32, 33, 34, 47, 48, 49, 52, 53, 54). Seeds collected were identified to species, tallied and tested with tetrazolium for viability. To convert to a m-2 basis, the total number of seeds captured were multiplied by 4.

Regional Seed Banks

Hypothesis 3. Seeds of cypress swamps in farmed areas decrease in richness and density over time.

Seventy wetlands were selected in the region that had either never been farmed, or farmed for longer periods of time (1 to >50 years). Soil was collected in the spring before May in 1992 and 1993. With a shovel, twenty soil samples were collected at stratified random points in each wetland along two transects. The soil from each wetland was composited separately, and then placed into 10 soil trays over a piece of fiberglass screen to prevent the soil from escaping the bottom of the tray. The 10 soil trays were completely randomized within blocks of tanks within the greenhouse of the Plant Biology Department of Southern Illinois University. Plants which emerged from the soil were identified, tallied and then pulled from the trays to prevent seed contamination. No seeds were observed emerging from trays of sterilized soil.

To convert to a m-2 basis, the total number of seedlings germinating was multiplied by 16. The data were subjected to principal components analysis using SAS (1988). Five factors were considered (not weighted according to covariance), including area, species, flooding/drawdown treatment, total of seeds, and intact/farmed history (Kachigan 1982).

Seed Longevity

Hypothesis 5. Seeds of cypress (*Taxodium distichum*) live for the same length of time whether placed above- or below-ground.

At four replicate sites, 12 fiberglass bags filled with 25 cypress seeds were placed either above- or below-ground in November 1993. At intervals of 1-6 months, a bag of seeds was collected from each of the four replicate sites, above- and below-ground. Water depth was recorded at each replicate site at each collection time. The viability of seeds was tested using tetrazolium.

Seedling Survivorship

Hypothesis 6. Seedlings of cypress will die if flooded but not if unflooded.

In May 1993, August 1993 and May 1994, 100 seedlings (naturally emerged) were marked with aluminum tags a point bar near Owl Pond. Their survivorship and water depths were recorded monthly.

Water Quantity

Hypothesis 7. Quantity of stream overflow during flooding in the Cache River is not great enough to carry seeds to substantial parts of the river floodplain.

Model of seed dispersal for each species overlain against various flood events were created using geostatistics in GS$^+$ (Gamma Design Software, 1991). The extent of the flood sheet was estimated by relating gage height to topographic relief plotted on a scanned USGS map. An attempt was made to model the spread of the historical flood sheet by using maximum gage heights in the Cache River near Forman, Illinois (Maurer *et al.* 1991, Stahl *et al.* 1989). However, this gage lies at a higher level than Buttonland Swamp, and so it was not possible to use this gage for historical information at Buttonland Swamp. The monthly water elevation maxima from Highway 37 (placed in 1986 or 1987; Allgire personal communication) which is comparable, is not published. Because the cypress swamp species in the seed bank are very short-lived, flooding over the past two years is important to the model but not flooding over the past decade. For a complete justification of the omission of this portion of the study, see "Findings".

FINDINGS

Regional Seed Banks

The ability of the seed bank to regenerate vegetation is dependent on the longevity of the seeds, the frequency of dispersal (Fenner 1985, Schneider and Sharitz 1988) and the timing of germination opportunities (Schneider and Sharitz 1986, Sharitz *et al.* 1990). The seed banks of farmed fields are nearly completely devoid of cypress swamp species (Appendices 1-10) such as cypress, tupelo (*Nyssa aquatica* L.), and buttonbush (*Cephalanthus occidentalis* L.) because seeds are not maintained for very long without seed input through dispersal. While short seed longevity is undoubtedly important (Figure 3), preemergent herbicide usage in farmed areas may also act to reduce cypress swamp species. A study preliminary to the one described here, showed that most of the dominant species of cypress swamps were not present in farm fields farmed for less than one year. This study was based on soil collections from sets of cypress swamps matched with former swamps farmed for various lengths of time (1-50 years).

Four factors explained 90% of the variation of the regional seed banks including area collected, seed species, flooded/drawdown treatment and the seed totals (Table 1). Because area collected was important (factor loading = 0.64 on first principal component), regional landscape heterogeneity of the seed banks is suggested in the Cache River region. The vegetation of the swamps in the region are distinctly different in the Upper versus the Lower Cache due to their position at the northern extreme of the cypress swamp region (Basinger 1994). Length of time the site was farmed had very low weighting on either of the first two principal components.

That the seed banks of cypress swamps are short-lived stands in sharp contrast to those of wetlands just to the north of southern Illinois (Leck and Graveline 1979). In the prairie pothole region, 60% of the aquatic species survive for 20 years of farming and certain species much longer (Wienhold and van der Valk 1989). In this study, seeds of the dominant tree species, cypress and tupelo did not germinate from the soil of intact cypress swamps, but were present as dead seeds. These species were not present in the soil of fields which had been farmed for more than 1 year.

A study of the viability of cypress seeds over time in Buttonland Swamp showed that seeds live for shorter periods on the surface of the swamp than below-ground (Figure 3). The tree component of bottomland forests is short-lived and drops in density from spring to fall because of the germination and decay of seeds (Titus 1991). Seeds germinated in the bags placed on the surface of the soil immediately after drawdown, thereby removing them from the seed bank. Because the seeds lose their viability over time, seed dispersal becomes an important factor in replenishing the seed bank of cypress swamps.

Seed Dispersal into Abandoned Fields

Both the studies of the seed banks of farmed areas and seed viability indicate that seeds do not live for long periods of time in the seed banks of cypress swamps. Because of the results of the preliminary seed bank study and seed viability study, I hypothesized that seeds

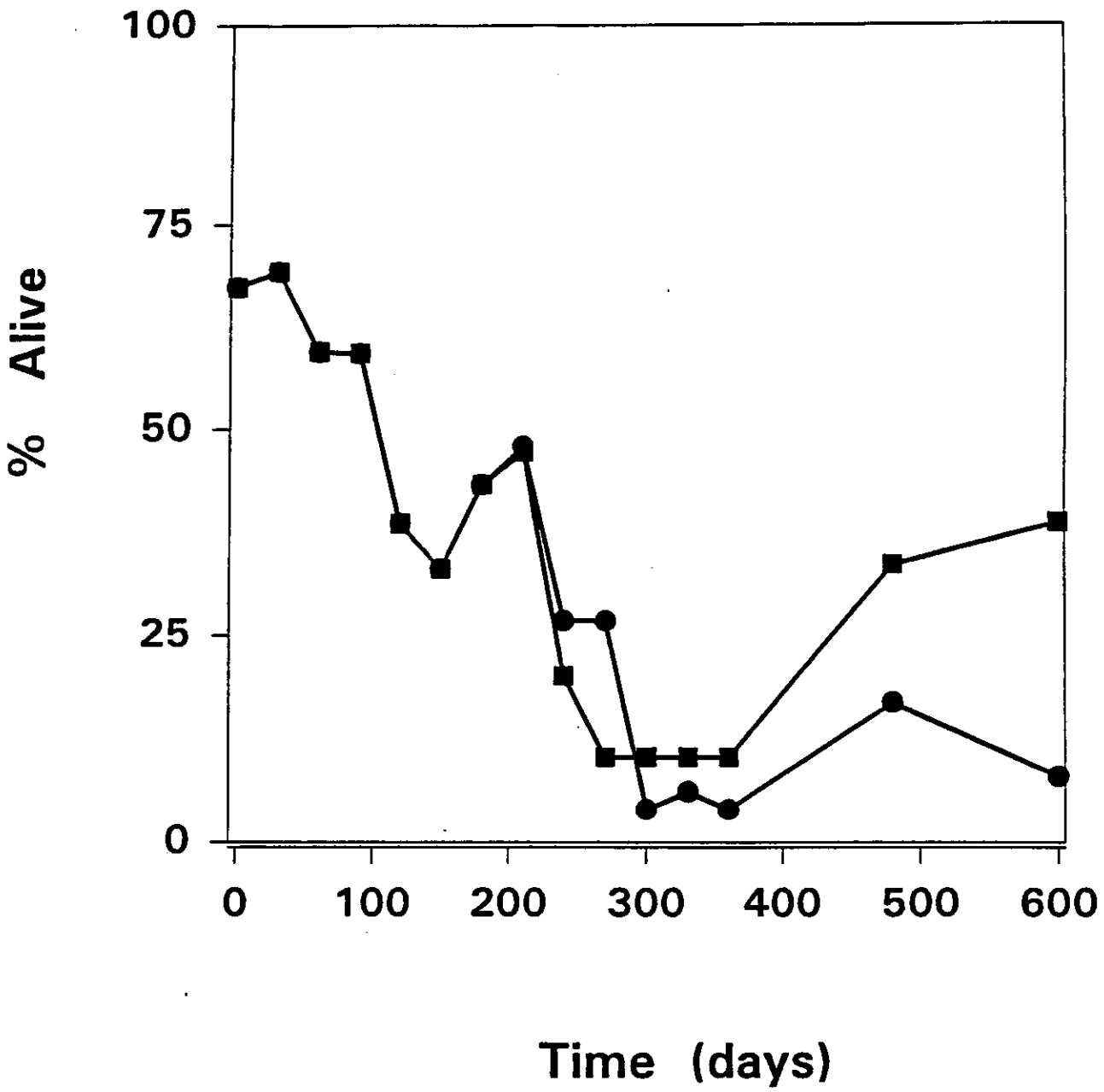

Figure 3. Seed viability of cypress seeds placed in the field in November 1993 until August 1995. Squares represent sets of seeds placed above- and circles, below-ground.

Table 1. Summary of factor analysis for the regional seed bank study, Cache River, southern Illinois, 1992-1993.

Factor names and the high loading variables	Factor loadings
Factor I:	
Area	0.64
Species of Seed	0.63
Factor II:	
Flooded/Drawdown	0.71
Seed Totals	-0.69

could be dispersed via flood water to replenish the seed banks of farmed fields with cypress swamp species. Just as in most tropical forests (Garwood 1989), regeneration from seed banks in cypress swamps is dependent on the constant input of seeds via seed dispersal.

Seeds of more than 40 species were dispersed in the water (Tables 2, 3a-b) within cypress swamps including cypress and buttonbush. In both years of the study (1993-95), buttonbush had the highest number of live seeds dispersed in the water (4693.4 and 1912.9; Table 3b). The seed rain (Table 3c-d) was estimated using aerial traps. The elevations and locations of the seed traps (Figure 2) were related to water gage measurements from the Illinois Water Survey (Table 4). My observations of water levels during field collection sessions, fit expectations of water spread based on Illinois Water Survey information. For example, on March 9, 1994 the river stage level was 101.24 m above sea level (Table 4). On that day, I observed that the water sheet in Crawford Tract extended just beyond seed traps #36-40 which we estimated at 101.12 m above sea level (Figure 2).

Aquatic seed dispersal into farmed fields from cypress swamps extends across the water sheet. The water sheet corresponded closely with the dispersion of seeds in the Crawford Tract. A high number of aquatic seeds are deposited on the drift line, or edge of the water sheet. On March 9, 1994, aquatic seeds were collected in seed traps #36 through 40, but not in those beyond the water sheet. Figure 4 gives a map showing the dispersion of cypress seeds over the Crawford Tract on March 9, 1994. These maps are drawn using geostatistics and therefore reflect statistically based estimates of seed dispersion around seed traps and not actual means (Figures 5 and 6).

Cypress seeds, which are large, move into the farm field only via flooding but not during the summer (Figure 7a). Cypress are dispersed in a nonrandom fashion in the swamp dependent on wind and water speed and direction, and presence of vegetation (Figure 8). Buttonbush seeds are smaller and have some capability of moving beyond the edge of the flood sheet (Figure 7b) by wind and ice rafting (Figure 9). Buttonbush was the only species of seed observed on the surface of the snow, indicating that all of the other species are limited by aquatic dispersal.

The highest water level during the two year study recorded for the water gage at the monthly sample times was on December 7, 1993 (101.4069 meters msl) above seed traps 36 - 40. (We actually observed that the water had been as higher than 102.0175 meters msl by the presence of drift near traps 46 through 50 during one month, but it was not at the time of the survey so we could not verify this with the Illinois Water Survey). The U.S.G.S. map for the Crawford Tract (Figure 10), would indicate then that the water levels reached just beyond 330 (100.58 m) but under the 340 (103.63 m) foot contour. This indicates that the high water mark and the potential for aquatic seed dispersal lies between the 330 and 340 foot contour given the current hydrologic scenario dictated by the Post Creek Cutoff and the Diel Dam.

I had hoped to relate gage heights to historical records via the Forman gage (Stahl *et al.* 1982-1988; Maurer *et al.* 1989-91) but this gage is at a higher elevation (Allgire, personal communication; Tables 4 and 5) and can not be related to the Crawford Tract using the baseline with the Highway 37 gage used in this study. Unfortunately, the Highway 37 gage was not placed until 1985 or 1986 and the information for this gage is not published (Allgire, personal communication). However, in hindsight, it is clear that because seeds in seed banks

are short-lived, that the seed dispersal must be on a yearly basis to replenish the seed bank with swamp species. Because of this, historical records of the flood sheet are not as important as thought at the beginning of the study.

Seed Bank at Elevations

The studies discussed previously indicate that seeds of cypress swamps are short-lived in farm fields but can be delivered to sites via the flood sheet. To observe if seeds are actually delivered to the seed bank in the flooded portions of farmed fields, the seed bank was observed at 6 elevations in the Crawford Tract and also at two sites near the former town of Rago (Rago East and Rago West; Appendix 11). All but the sites at the highest elevation (102.4534 m) flooded at times during the two year study. These sites all had a seed bank of cypress swamp species, except for the highest elevation. Water dispersed species such as buttonbush, beggar's-ticks and rice cut grass (Table 3) were not found in the seedbanks at the highest elevation (Appendix 11). Short-lived cypress seeds were found as dead seeds in the seed banks of sites that flooded (below elevation 102.4534 m). This study indicates that flooding is an effective dispersal agent for seeds of cypress swamps. In addition, many species of aquatic insects (adults and larvae), liverworts and aquatic plant fragments disperse in the water (personal observation). This study suggests that flooding in of itself can be an effective agent in the restoration of cypress swamps when the flood water is laden with seeds and other disseminules.

Five factors explained 85% of the variation of the seed distribution in the seed banks including elevation, flooding/drawdown treatment, site, seed total, and species. Elevation was important with a high factor loading on the second principal component (0.63; Table 6).

Seeds of cypress swamp species for the most part only germinate during drawdown (Appendices 1-11). In addition, seedlings die when flooded for only short periods of time (Figure 11). This also indicates that water fluctuation is important in the both the use of natural dispersal in restoration, but also in the maintenance of regeneration in intact cypress swamps. Hydrological alteration through dams, levees because they increase water levels and channelization because it decreases water levels damp water fluctuation (Bayley 1995; Junk *et al.* 1989; Ligon 1995; Spark 1992) and damage the ability of the swamp to regenerate. In plant communities, it is necessary for vegetation to regenerate periodically over decades in response to natural disturbance (Harper 1977, Simpson *et al.* 1989).

Flood Pulse and Regeneration

The ideal water regime for the regeneration of cypress swamps is one where water flowing through cypress swamps delivers seeds to abandoned fields, and then recedes during summer drought to allow germination and establishment. This water regime is described in the growing literature associated with the advantages of pulsing river discharge for the floodplain ecosystem. Flood pulsing is associated with decreased sedimentation, toxic metal removal, high primary and secondary production, higher root oxygenation, and increased habitat diversity (Bayley 1995, Junk et al. 1989, Ligon 1995, Sparks 1992). While this

concept was developed in the tropics for fisheries ecology, it is now being applied to the engineered riverine systems of temperate regions.

In Buttonland Swamp at the present time, regeneration is limited to a narrow ring at the edge of the swamp which is flooded in the winter but dries in the summer (Figure 10). Flood pulsing would allow the maximum potential regeneration to occur in the swamp and in the abandoned fields.

CONCLUSIONS

The seed banks of cypress swamps are short-lived and dependent on frequent aquatic dispersal. Seeds of most species are most viable in the winter time immediately following their production. While seed dispersal of cypress swamp species is almost solely limited to times of flooding, the germination and establishment of species is dependent on drawdown.

Because the presence of a viable seed bank is dependent on flooding, only those areas which frequently flood can be expected to revegetate naturally. The best hydrologic situation for the natural regeneration of cypress swamp species is the one described by the flood pulse concept with naturally fluctuating water levels.

RECOMMENDATIONS FOR FUTURE RESEARCH

The idea that reestablishment of cypress swamp communities can be accomplished through the restoration of hydrologic fluctuation should be tested in a restoration program. If targeted abandoned fields could be flooded with water flowing through cypress swamps laden with seeds to reestablish the seed bank, the regrowth of the vegetation in these areas could be monitored and compared to areas which are either not reflooded or reflooded without hydrologic fluctuation. Replicates could be established throughout the region to thoroughly test the natural restoration of cypress swamps through hydrologic fluctuation.

While my studies have focussed on cypress, the life history strategies of other dominant species as well as rare species needs to be worked out. Cypress is a good model species for this system, but other species are likely to show variations in their requirements throughout their life histories.

The behavior of the populations here should be compared to ecoclinal (sensu van der Maarel 1990) populations in other northern portions of the cypress swamp region, as well as comparisons made to those to the south of southern Illinois. In general, very little is known about species in communities at the edges of their ranges and restoration of these areas has been identified as a key area of future research (Holland and Risser 1991). This is a critical issue in restoration ecology, because it is likely that species may be much more difficult to reestablish at the edge of their range.

Table 2. Aquatic seeds which disperse in cypress swamps (Middleton submitted).

Acer negundo (box elder)
Bidens discoidea (beggar's ticks)
Bidens frondosa (beggar's ticks)
Brunnichia ovata (ladies' ear drops)
Carex normalis (sedge)
Carex sp.
Carya laciniosa (shellbark hickory)
Carya sp. (hickory)
Cephalanthus occidentalis (buttonbush)
Cyperus erythrorhyzos
Echinochloa crusgalli (barnyard grass)
Eleocharis sp.
Elymus canadensis
Fraxinus pennsylvanica (green ash)
Fraxinus profunda (pumpkin ash)
Gleditsia aquatica (water locust)
Juglans cinerea (butternut)
Jussisaea sp.
Leersia oryzoides (rice cut grass)
Nyssa aquatica (tupelo)
Panicum sp.
Planera aquatica (planer-tree)
Platanus occidentalis (sycamore)
Quercus bicolor (swamp white oak)
Quercus lyrata (overcup oak)
Quercus palustris (pin oak)
Rhynchospora corniculata
Rosa palustris (swamp rose)
Rumex orbiculatus
Salix sp.
Scutellaria lateriflora (scullcap)
Taxodium distichum (cypress)
Ulmus alata (elm)

Table 3. Mean seeds (x ± SE) of water-dispersed seeds m-2 yr-1 including seeds collected in aquatic traps, a. total live and dead, b. live only and in aerial traps, c. total live and dead, and d. live only from June 1, 1993 through May 30, 1995 at all elevations in Buttonland Swamp, southern Illinois.

Table 3a.

	Year 1 x ±SE	Year 2 x ±SE	Total/2 x ±SE
Acer saccharinum L.	2.1±7.3	2.1±13.8	2.1±10.5
Agrostis sp.	0.0±0.0	1.4±6.8	0.7±3.4
Andropogon virginicus L.	0.3±2.2	0.0±0.0	0.2±1.1
Bidens discoidea (T. & G.) Britt	5.7±24.5	18.8±75.2	12.3±49.9
Bidens frondosa L.	2.8±12.2	4.1±19.7	3.5±16.0
Brunnichia cirrhosa Banks	324.5±1979.0	13.4±55.6	169.0±1017.3
Campsis radicans (L.) Seem.	0.3±2.2	1.0±5.2	0.7±3.7
Carex sp.	10.3±26.0	56.9±354.6	33.6±190.3
Cephalanthus occidentalis L.	8356.1±13741.6	5207.0±10362.4	6781.6±12052.0
Crataegus sp.	0.0±0.0	33.9±228.7	17.0±114.4
Elymus sp.	0.4±2.3	0.0±0.0	0.2±1.2
Fraxinus americana L.	3.1±11.0	1.4±8.7	2.3±9.9
Gleditsia aquatica March.	2.6±13.2	5.5±37.6	4.1±25.4
Hordeum sp.	*1.0±3.7*	*0.0±0.0*	*0.5±1.9*
Nyssa aquatica L.	15.0±33.1	1.4±7.4	8.2±20.3
Planera aquatica Gmel.	7.1±17.1	0.3±2.5	3.7±9.8
Quercus lyrata Walt.	2.5±10.0	3.8±15.5	3.2±12.8
Rosa palustris Marsh.	40.0±169.8	0.3±2.2	20.2±86.0
Rumex crispus L.	4.2±22.2	1.4±7.3	2.8±41.8
Taxodium distichum (L.) Rich.	98.0±153.1	46.0±149.1	72.0±151.1
Ulmus americana L.	2.4±9.9	64.7±176.6	33.6±93.3
Other	0.6±3.2	24.0±130.4	12.3±66.8
Total	8879.0±16243.6	5487.4±11659.3	7183.2±13951.5

Table 3b.

Acer saccharinum L.	0.3±2.2	0.0±0.0	0.2±1.1
Agrostis sp.	0.0±0.0	1.4±6.8	0.7±3.4
Andropogon virginicus L.	0.0±0.0	0.0±0.0	0.0±0.0
Bidens discoidea (T. & G.) Britt	8.2±40.8	2.7±13.9	5.5±27.4
Bidens frondosa L.	0.8±3.2	2.4±13.5	1.6±8.4
Brunnichia cirrhosa Banks	260.4±1638.2	7.9±32.2	134.2±835.2
Campsis radicans (L.) Seem.	0.0±0.0	0.0±0.0	0.0±0.0
Carex sp.	6.9±21.3	55.8±352.1	31.4±186.7
Cephalanthus occidentalis L.	4693.4±8646.8	1912.9±4468.7	3303.2±6557.8
Crataegus sp.	0.0±0.0	26.4±177.5	13.2±88.8
Elymus sp.	0.0±0.0	0.0±0.0	0.0±0.0

Table 3b. (cont.)

	Year 1 x ±SE	Year 2 x ±SE	Total/2 x ±SE
Fraxinus americana L.	1.8±6.0	0.0±0.0	0.9±3.0
Gleditsia aquatica March.	0.5±2.5	1.0±7.2	0.8±4.9
Hordeum sp.	0.0±0.0	0.0±0.0	0.0±0.0
Nyssa aquatica L.	4.2±13.5	0.7±3.0	2.5±8.3
Planera aquatica Gmel.	4.7±12.0	0.3±2.5	2.5±7.3
Quercus lyrata Walt.	0.9±5.0	0.0±0.1	0.5±2.5
Rosa palustris Marsh.	32.8±153.4	0.3±2.2	16.6±77.8
Rumex crispus L.	0.3±2.2	0.7±4.3	0.5±3.3
Taxodium distichum (L.) Rich.	98.0±153.1	0.7±4.3	49.4±78.8
Ulmus americana L.	0.0±0.0	1.0±7.2	0.5±3.6
Other	0.6±3.2	15.4±76.8	8.0±40.0
Total	51138.0±10703.4	2029.6±5172.3	26583.8±7937.9

Table 3c.

Acer saccharinum L.	1.4±6.9	0.4±2.8	0.9±4.9
Agrostis sp.	6.4±32.0	4.4±27.6	5.4±29.8
Andropogon virginicus L.	0.0±0.0	0.0±0.0	0.0±0.0
Bidens discoidea (T. & G.) Britt	0.5±3.0	3.0±16.6	1.8±9.8
Bidens frondosa L.	2.0±7.1	0.0±0.1	1.0±3.6
Brunnichia cirrhosa Banks	1.3±6.6	2.2±13.2	1.8±9.9
Campsis radicans (L.) Seem.	0.9±3.9	0.0±0.0	0.5±2.0
Carex sp.	1.0±5.6	20.5±128.3	10.8±67.0
Cephalanthus occidentalis L.	1211.5±3519.7	69.0±205.2	640.3±1862.5
Crataegus sp.	0.6±3.2	4.4±26.2	2.5±14.7
Elymus sp.	0.7±4.3	0.4±2.6	0.6±3.5
Fraxinus americana L.	8.7±28.9	4.4±27.6	6.6±28.3
Gleditsia aquatica March.	5.8±28.8	0.0±0.0	2.9±14.4
Hordeum sp.	1.3±8.3	3.5±22.1	2.4±15.2
Nyssa aquatica L.	0.0±0.0	0.9±5.5	0.5±2.8
Planera aquatica Gmel.	0.0±0.0	0.0±0.0	0.0±0.0
Quercus lyrata Walt.	11.1±38.6	3.1±14.3	7.1±26.5
Rosa palustris Marsh.	215.3±641.8	3.5±22.1	109.4±332.0
Rumex crispus L.	0.0±0.0	1.3±8.3	0.7±4.2
Taxodium distichum (L.) Rich.	110.0±338.2	3.4±25.9	56.7±182.1
Ulmus americana L.	212.2±187.2	97.8±107.5	155.0±147.4
Other	43.5±213.4	15.9±92.7	29.7±153.1
Total	1833.9±5077.5	238.1±748.6	1036.0±2913.1

Table 3d.

Table 3d. (cont.)

	Year 1 x ±SE	Year 2 x ±SE	Total/2 x ±SE
Acer saccharinum L.	0.0±0.0	0.4±2.8	0.2±1.4
Agrostis sp.	0.6±3.2	4.4±27.6	2.5±15.4
Andropogon virginicus L.	0.0±0.0	0.0±0.0	0.0±0.0
Bidens discoidea (T. & G.) Britt	0.5±3.0	0.0±0.0	0.3±1.5
Bidens frondosa L.	0.0±0.0	0.0±0.0	0.0±0.0
Brunnichia cirrhosa Banks	0.0±0.0	1.8±10.6	0.9±5.3
Campsis radicans (L.) Seem.	0.0±0.0	0.0±0.0	0.0±0.0
Carex sp.	0.4±2.8	20.1±125.6	10.3±64.2
Cephalanthus occidentalis L.	821.9±2578.7	11.4±32.8	416.7±1305.8
Crataegus sp.	0.6±3.2	4.4±26.2	2.5±14.7
Elymus sp.	0.0±0.0	0.0±0.0	0.0±0.0
Fraxinus americana L.	5.8±20.2	0.0±0.0	2.9±10.1
Gleditsia aquatica March.	4.0±19.3	0.0±0.0	2.0±9.7
Hordeum sp.	0.0±0.0	3.5±22.1	1.8±11.1
Nyssa aquatica L.	0.0±0.0	0.0±0.0	0.0±0.0
Planera aquatica Gmel.	0.0±0.0	0.0±0.0	0.0±0.0
Quercus lyrata Walt.	0.6±3.2	1.3±8.3	1.0±5.8
Rosa palustris Marsh.	197.9±557.8	3.5±22.1	100.7±290.0
Rumex crispus L.	0.0±0.0	1.3±8.3	0.7±4.2
Taxodium distichum (L.) Rich.	68.9±260.3	0.0±0.0	34.5±130.2
Ulmus americana L.	177.7±176.6	57.6±87.5	117.7±132.1
Other	42.1±215.5	15.9±92.7	29.0±154.1
Total	1321.0±3843.8	125.6±466.6	723.3±2155.2

Table 4. Monthly river stage information for seed trap collection area. Data is a preliminary interpretation of the recorder information and subject to revision from the Illinois State Water Survey gaging station on the Cache River, Route 37 (Allgire, personal communication).

Date	Time	River Stage (in meters, msl)
June 3, 1993	12:51	99.9196
July 5, 1993	12:00	100.1054
July 31, 1993	12:00	99.6909
August 29, 1993	12:00	99.7793
September 3, 1993	12:00	99.7854
October 3, 1993	12:00	99.6817
November 7, 1993	13:00	100.0658
December 7, 1993	13:30	101.4069
December 21, 1993	10:30	100.7668
January 1994 {frozen}		
February 1994 {frozen}		
March 9, 1994	12:00	101.2362
April 3, 1994	12:00	100.8949
May 1, 1994	12:00	101.1204
June 7, 1994	12:00	99.9896
July 7, 1994	12:00	100.0536
July 31, 1994	13:30	99.8860
August 28, 1994	13:00	99.8921
October 2, 1994	13:00	99.8402
November 6, 1994	13:00	100.6876
December 4, 1994	13:00	100.3066
{frozen briefly}		
January 15, 1995	1:00	100.5840
{frozen briefly}		
February 19, 1995	14:20	100.8461
April 2, 1995	13:55	100.2883
April 30, 1995	13:00	100.7608
June 8, 1995	13:40	100.7425
July 2, 1995	14:03	101.1753
July 30, 1995	12:30	100.3127

Table 5. Maximum gage height and discharge rate for the Cache River near Forman, Illinois from 1982-1991. All data are from the U.S.G.S. Water Data Reports (Stahl *et al.* 1982-1988; Maurer *et al.* 1989-91). The datum of this gage is 318.47 feet.

Date	gage ht (ft)	gage ht (m)	discharge rate
February 2, 1982	344.77	105.09	7280 ft^3 sec^{-1}
December 27, 1983	344.27	104.93	7020 ft^3 sec^{-1}
November 28, 1984	333.17	101.55	2040 ft^3 sec^{-1}
April 2, 1985	341.77	104.17	5540 ft^3 sec^{-1}
May 18, 1986	340.17	103.68	4740 ft^3 sec^{-1}
February 28, 1987	331.47	101.03	1650 ft^3 sec^{-1}
December 26, 1988	333.37	101.61	2450 ft^3 sec^{-1}
February 16, 1989	340.67	103.84	5080 ft^3 sec^{-1}
May 19, 1990	334.87	102.07	2920 ft^3 sec^{-1}
December 31, 1991	335.87	102.37	3000 ft^3 sec^{-1}

Table 6. Summary of factor analysis for the seed bank at elevations study, Cache River, southern Illinois, 1992-1993.

Factor names and the high loading variables	Factor loadings
Factor I:	
Flooding/Drawdown Treatment	0.60
Seed Total	-0.58
Site	-0.44
Factor II:	
Elevation	0.63
Site	-0.51
Species	-0.42

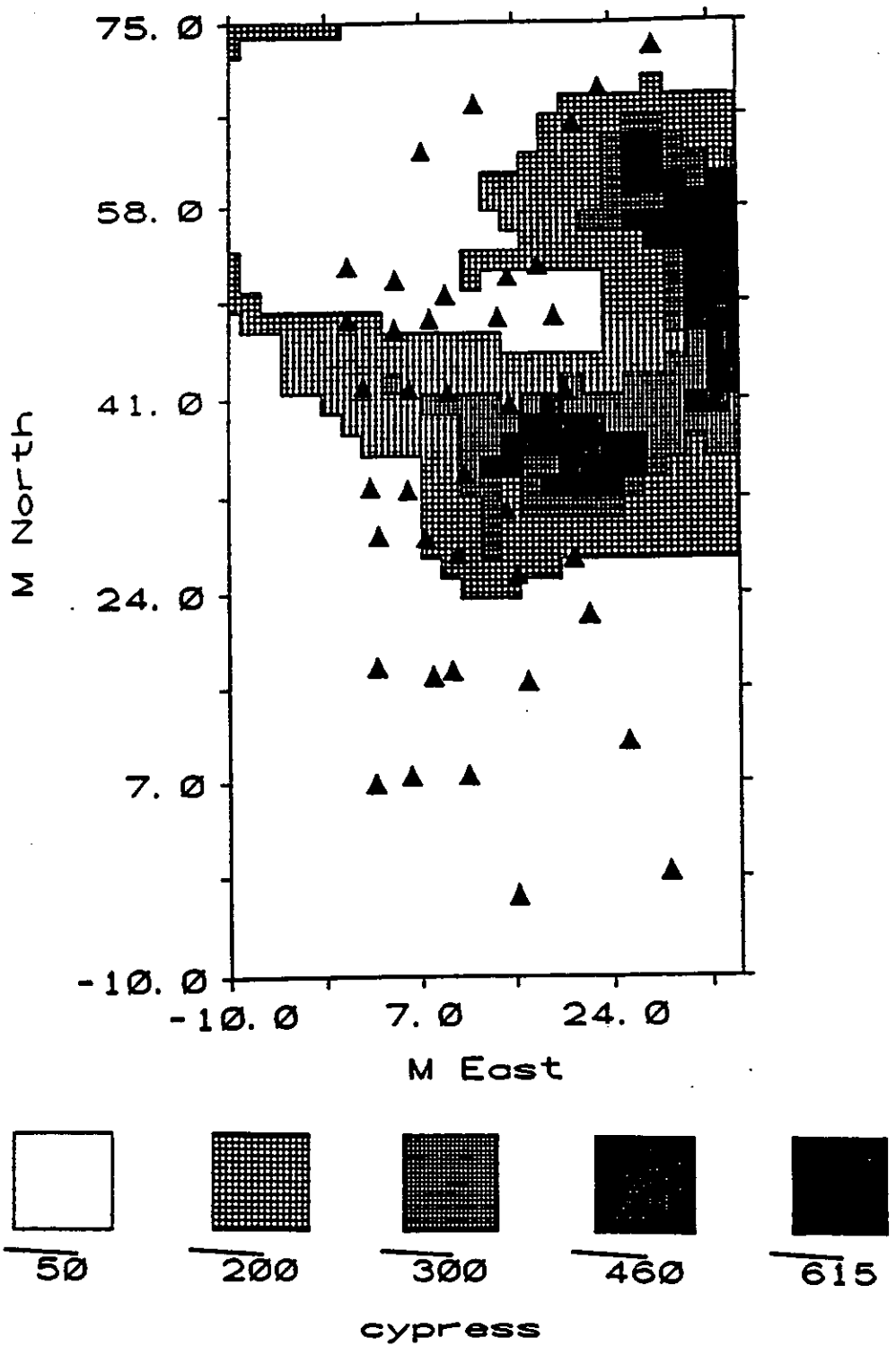

Figure 4. Dispersion of cypress seeds at elevations using geostatistical analysis at Crawford Tract, southern Illinois, March 9, 1994.

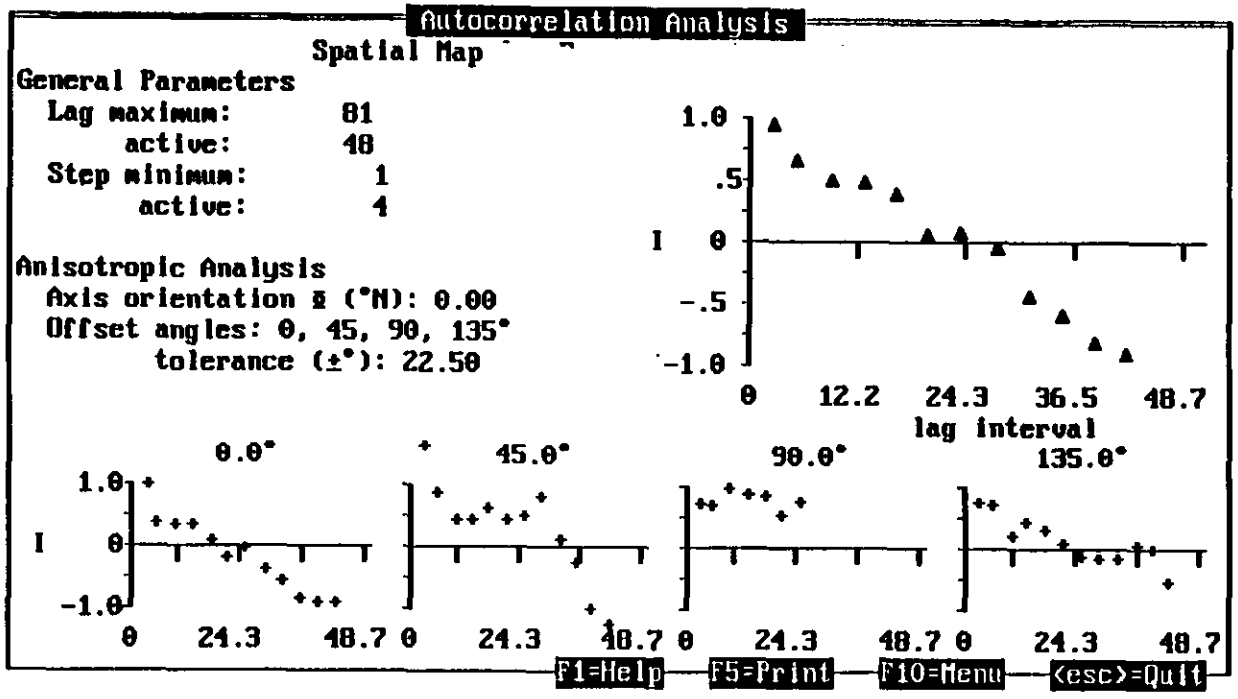

Figure 5. Autocorrelation analysis of cypress seed dispersion using geostatistical analysis at Crawford Tract, southern Illinois on March 9, 1995.

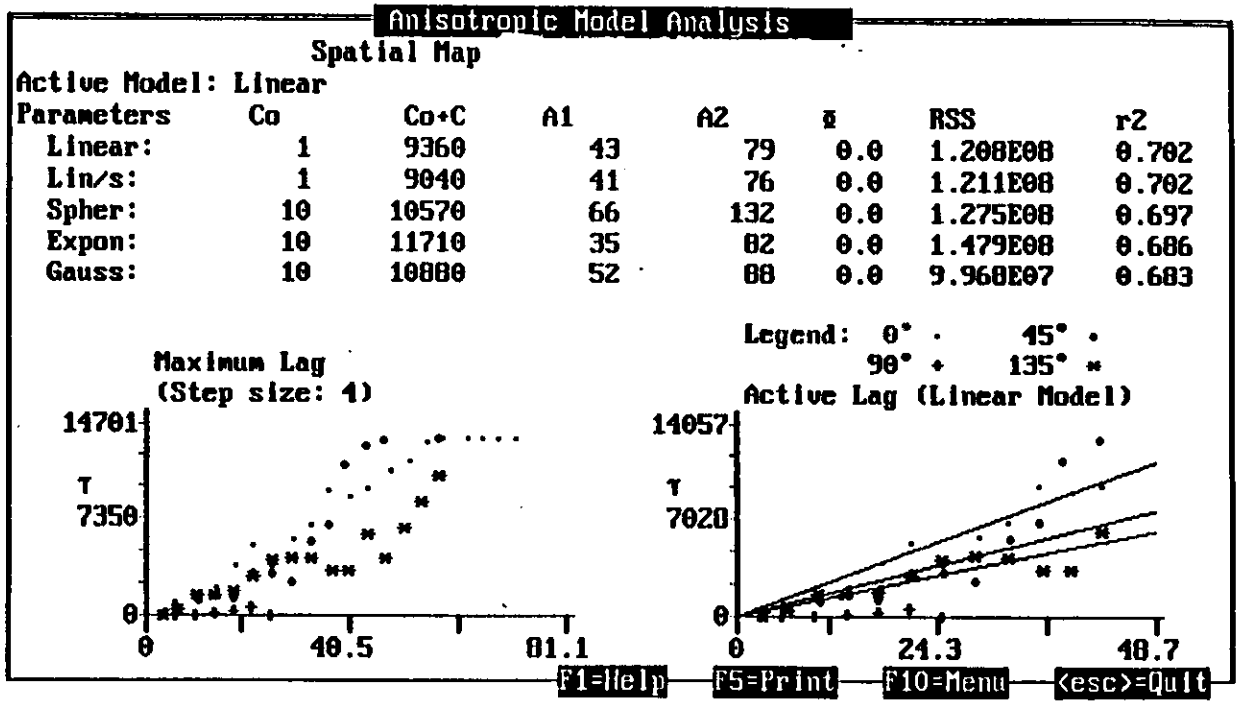

Figure 6. Anisotropic semivariogram to test level of spatial organization for aquatic cypress seeds dispersing on the surface of the Crawford Tract, southern Illinois on March 9, 1995.

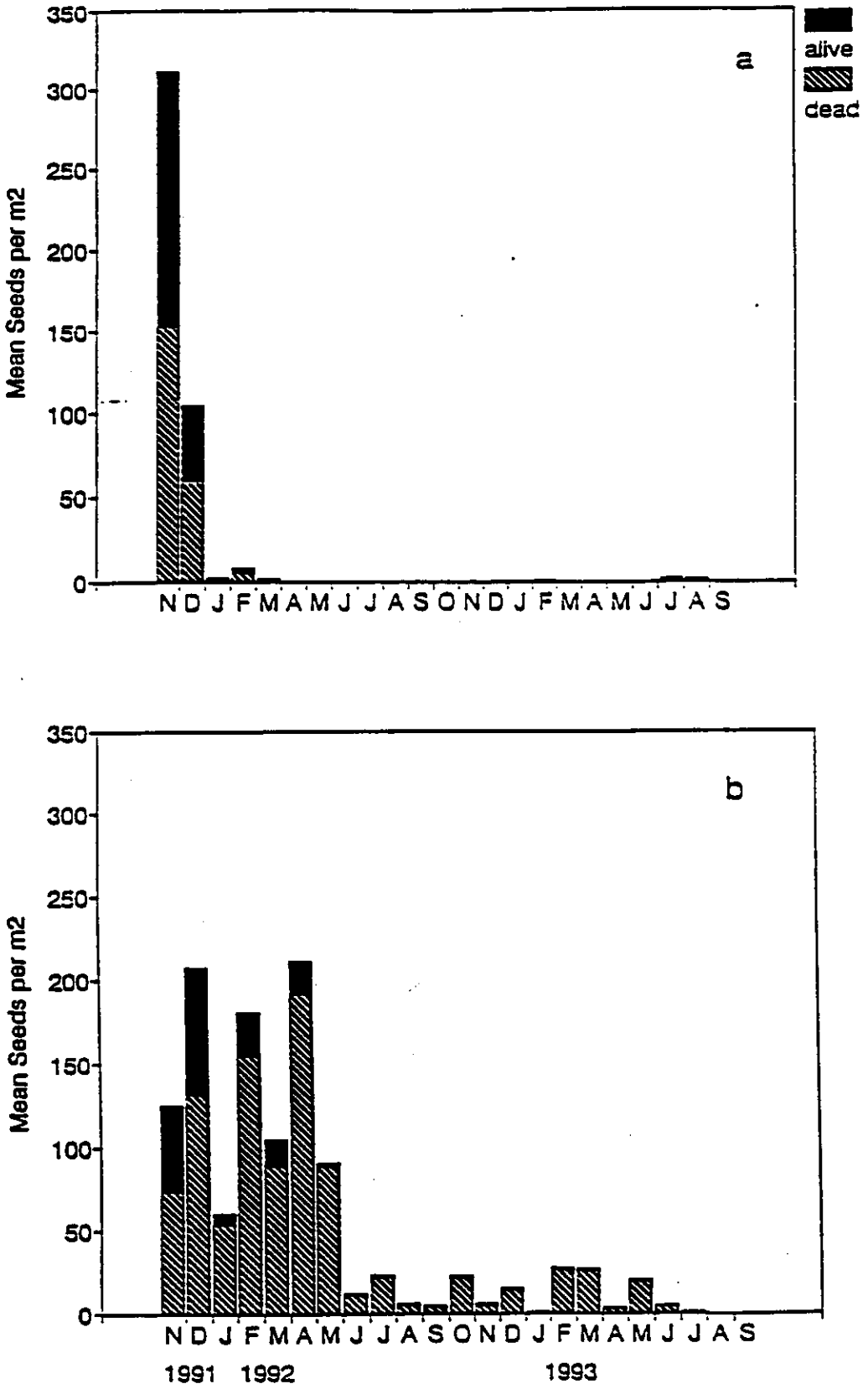

Figure 7a & b. Seasonal seed dispersal for cypress (a) and buttonbush (b) in aquatic traps placed in Owl Pond, southern Illinois from November 1991 through November 1993.

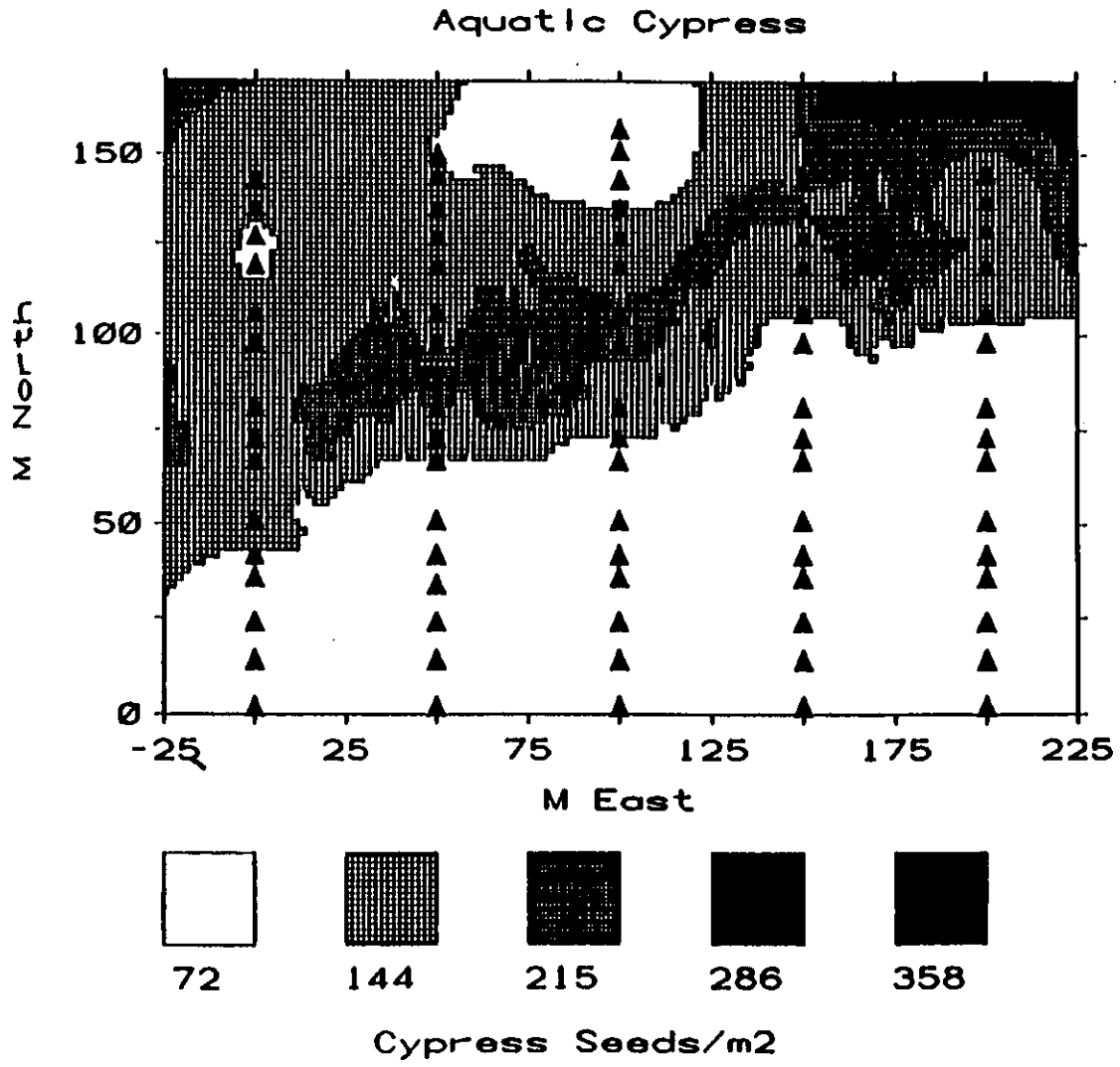

Figure 8. Dispersion of cypress seeds over the southern section of Buttonland Swamp on April 20, 1993 (Wilker and Middleton unpublished).

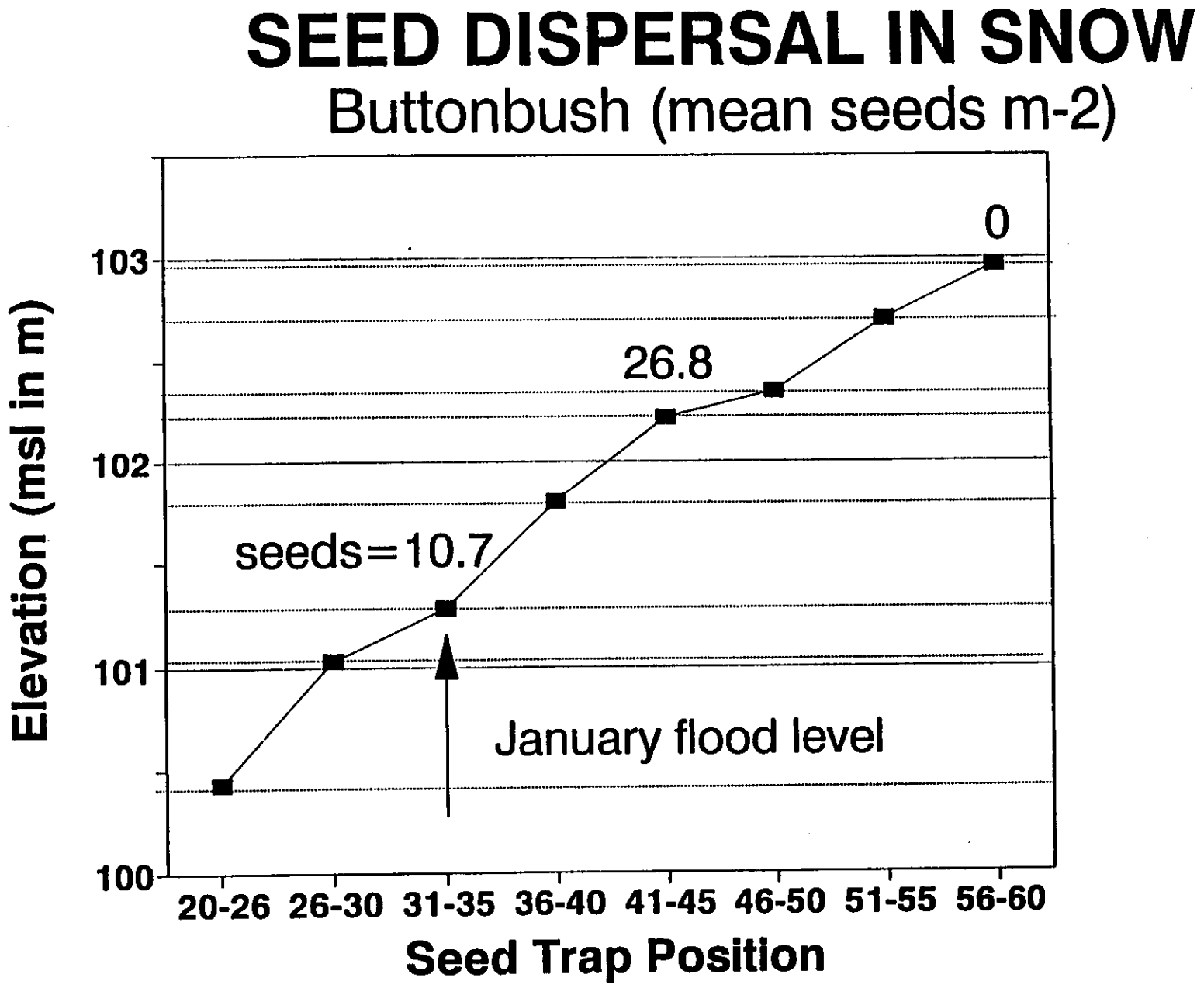

Figure 9. Buttonbush seed collected on the surface of snow in January 1993 at Crawford Tract. Buttonbush seeds were found above the level of the January flood level (via observation of seed trap and ice position) indicating that buttonbush seeds have a limited ability to move across snow.

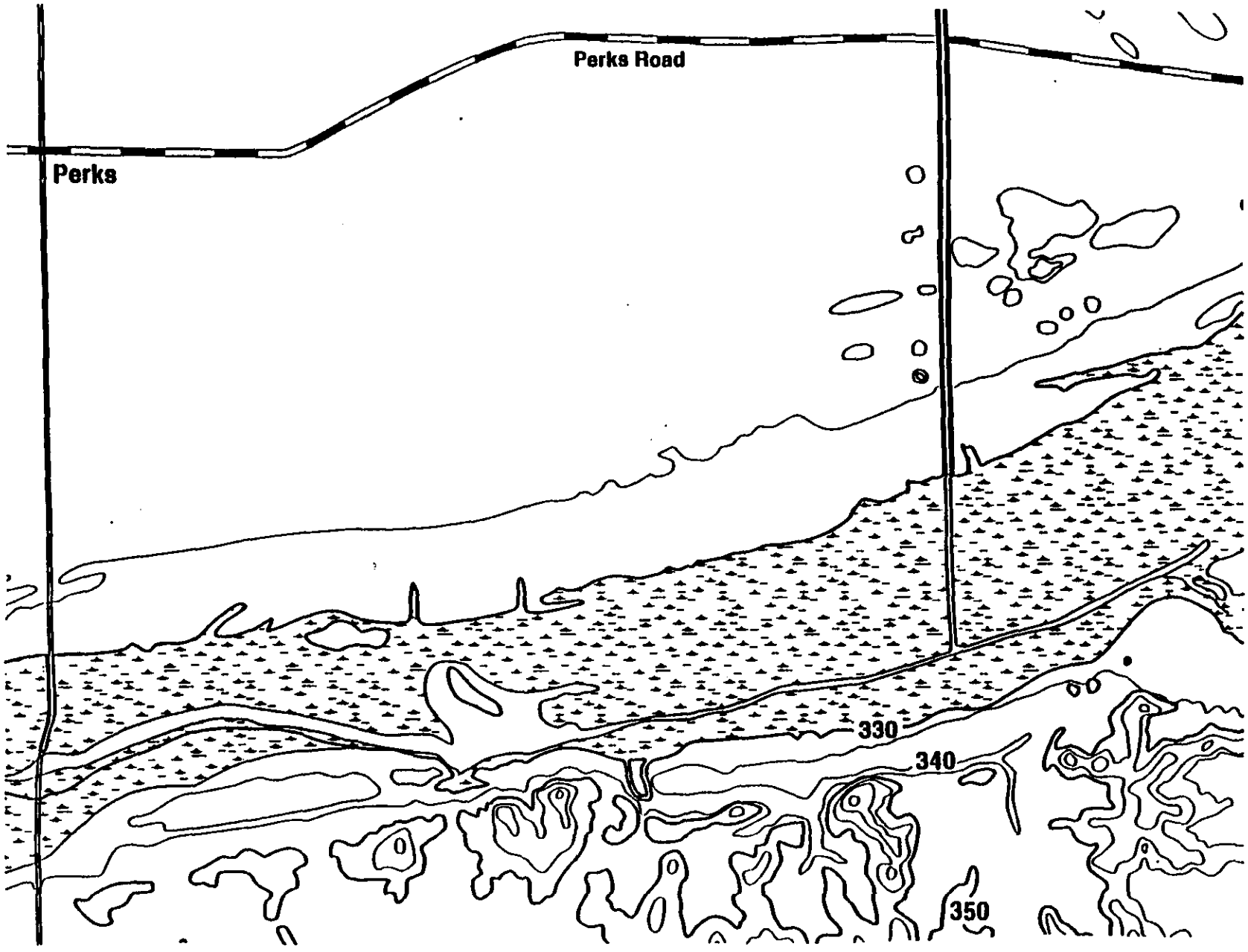

Figure 10. Zone of natural plant regeneration at the outer edge of Buttonland Swamp, southern Illinois for June 1993 through August 1995. The narrow band at Crawford Tract was just above 330 feet but below 340 feet (100.584 and 103.632 m, respectively). The highest water level recorded during the study was 101.407 m on December 7, 1993.

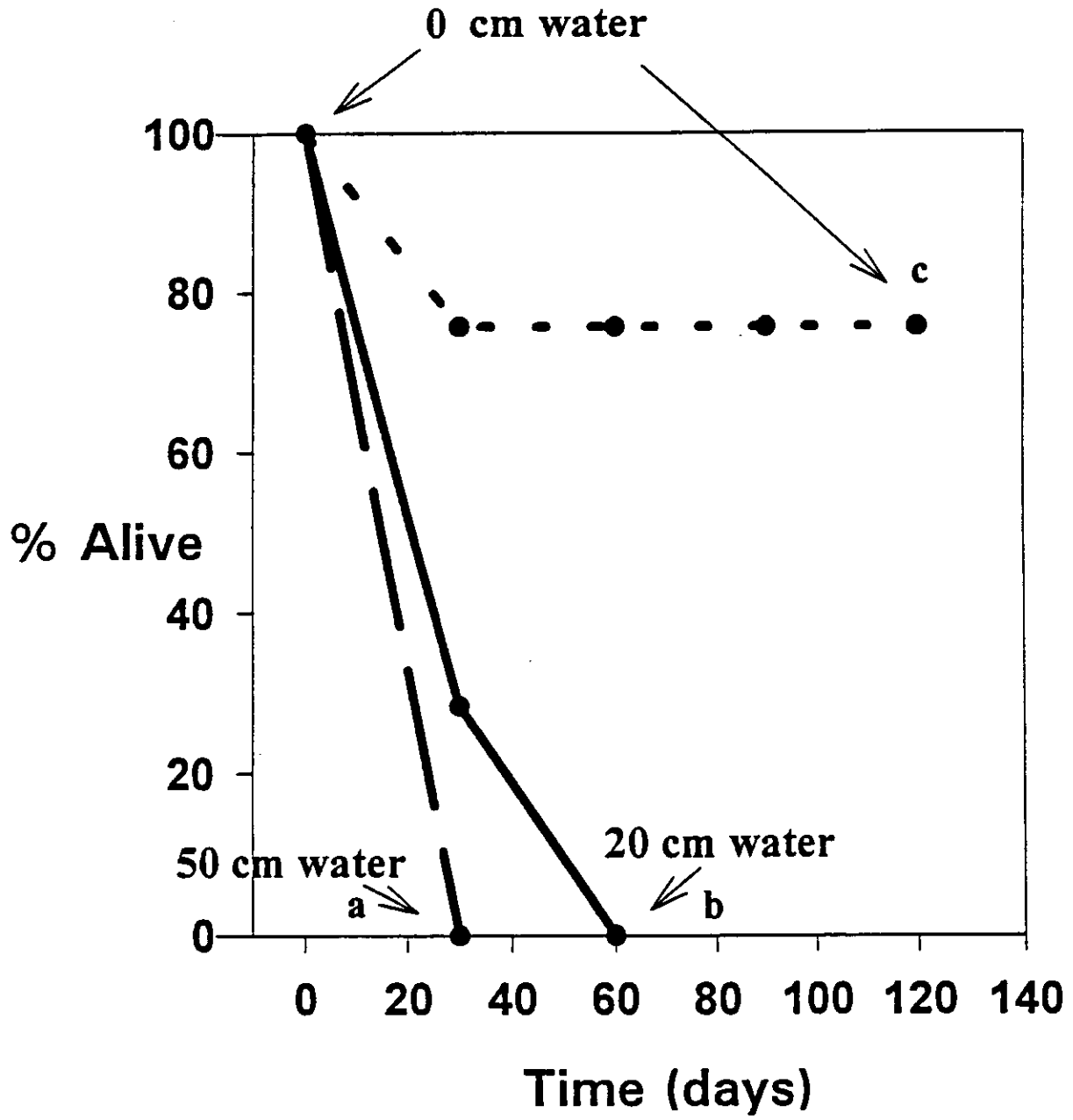

Figure 11. Seedling survivorship for 3 cohorts of cypress seedlings tagged in Buttonland Swamp, southern Illinois. "A" represents seedlings marked in August 1994, "b" in May 1994, and "c" in August 1993 (Middleton in press).

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Appendix 1. Seed banks (numbers of seeds m^{-2}) of sites unfarmed and farmed for various lengths of time near Karnak of the Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Karnak Site No. (time farmed)			
Species	Karnak 25 (0)	Karnak 27 (10)	Karnak 24 (25)	Karnak 26 (25)
Abutilon theophrasti Medikus	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Agrostis perennans (Walter) Tuckerman	0 ± 0	3.2 ± 7.2*	0 ± 0	3.2 ± 7.2*
Alopecurus carolinianus Walter	102.4 ± 229.0	0 ± 0	0 ± 0	0 ± 0
Amaranthus retroflexus L.	3.2 ± 7.2	748.8 ± 488.1	3.2 ± 7.2	9.6 ± 14.31
Ambrosia artemisiifolia L.	3.2 ± 7.2	0 ± 0	0 ± 0	0 ± 0
Ammannia auriculata Willd.	0 ± 0	6.4 ± 14.3*	0 ± 0	0 ± 0
Ammannia coccinea Rottb.	0 ± 0	400.0 ± 219.7	0 ± 0	6.4 ± 14.3*
Andropogon virginicus L.	*3.2 ± 7.2*	*6.4 ± 14.3*	*25.6 ± 40.2*	*0 ± 0*
Bidens frondosa L.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Bidens cernua L.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Boehmeria cylindrica (L.) Swartz.	*57.6 ± 24.3*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Brassica hirta	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Cephalanthus occidentalis L.	*6.4 ± 8.8*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Cyperus aristatus	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Cyperus erythrorhizos Muhl.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Cyperus ferruginescens	*19.2 ± 13.4*	*9.6 ± 14.3*	*0 ± 0*	*0 ± 0*
Cyperus iria L.	*3.2 ± 7.2*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Cyperus pseudovegetus Steudel	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Cyperus strigosus L.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Digitaria ischaemun (Schreber) Muhl	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Digitaria sanguinalis (L.) Scop.	*0 ± 0*	*0 ± 0*	*352.0 ± 787.1*	*0 ± 0*
Echinochloa crusgalli (L.) P. Beauv.	*0 ± 0*	*262.4 ± 586.7*	*278.4 ± 622.5*	*3.2 ± 7.2*
Echinochloa muricata (P. Beauv.) Fern.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Eclipta prostrata (L.) L.	*0 ± 0*	*9.6 ± 14.3**	*3.2 ± 7.2*	*0 ± 0*
Elatine minima	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
(Nutt.) Fischer & C. A. Meyer				
Elatine triandra Schkuhr.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Eleocharis acicularis	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
(L.) Roemer & Schultes				
Eleocharis obtusa	*0 ± 0*	*9.6 ± 21.5**	*108.8 ± 81.1*	*35.2 ± 7.2*
Eragrostis hypnoides (Lam.) BSP.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Eragrostis reptans (Michx.) Nees	*3.2 ± 7.2*	*185.6 ± 88.1*	*3.2 ± 7.2*	*3.2 ± 7.2*
Erigeron philadelphicus L.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Eupatorium fistulusum Barratt.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Euphorbia marginata Pursh.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Fimbristylis autumnalis (L.) Roemer & Schultes	*6.4 ± 8.8*	*0 ± 0*	*6.4 ± 14.3*	*0 ± 0*
Galium tinctorium L.	*12.8 ± 20.9*	*3.2 ± 7.2*	*0 ± 0*	*0 ± 0*
Gratiola neglecta Torr.	*0 ± 0*	*12.8 ± 28.6*	*0 ± 0*	*0 ± 0*
Gratiola virginiana L.	*9.6 ± 21.5*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Heteranthera limosa (Swartz) Willd.	*0 ± 0*	*0 ± 0*	*0 ± 0*	*0 ± 0*
Hypericum mutilum L.	*0 ± 0*	*0 ± 0*	*6.4 ± 8.8*	*25.6 ± 36.8*

Appendix 1. (cont.)

Species	Karnak 25 (0)	Karnak 27 (10)	Karnak 24 (25)	Karnak 26 (25)
Ipomoea lacunosa L.	0 ± 0	3.2 ± 7.2	6.4 ± 8.8	19.2 ± 17.53
Iva annua L.	3.2 ± 7.2*	16.0 ± 27.7*	32.0 ± 33.9	0 ± 0
Juncus bufonius L.	3.2 ± 7.2	115.2 ± 102.1*	3.2 ± 7.2	9.6 ± 14.3
Juncus marginatus Rostk.	16.0 ± 35.8	249.6 ± 174.8	38.4 ± 85.9*	19.2 ± 34.7
Juncus tenuis	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Krigia caespitosa	3.2 ± 7.2	3.2 ± 7.2	0 ± 0	0 ± 0
Leersia oryzoides (L.) Swartz	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Lindernia dubia (L.) Pennell.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Ludwigia decurrens (*Jussiaea*) Walter	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Ludwigia glandulosa Walter	3.2 ± 7.2	83.2 ± 114.5	0 ± 0	25.6 ± 36.8
Ludwigia palustris (L.) Elliott.	0 ± 0	3.2 ± 7.2	0 ± 0	3.2 ± 7.2
Ludwigia polycarpa Short & Peter	0 ± 0	48.0 ± 67.9	0 ± 0	44.8 ± 42.9
Mimulus alatus Aiton	0 ± 0	0 ± 0	0 ± 0	3.2 ± 7.2
Muhlenbergia frondosa (Poiret) Fern.	6.4 ±14.3*	0 ± 0	0 ± 0	0 ± 0
Muhlenbergia schreberi J. F. Gmelin	0 ± 0	0 ± 0	28.8 ± 64.4	25.6 ± 41.72
Oxalis stricta L.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Panicum dichotomiflorum Michx	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Paspalum fluitans (Elliott) Kunth.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Penthorum sedoides L.	12.8 ± 28.6	9.6 ± 14.3	0 ± 0	3.2 ± 7.2
Pilea pumila (L.) A. Gray	0 ± 0	0 ± 0	0 ± 0	6.4 ± 8.8
Plantago virginica L.	0 ± 0	3.2 ± 7.2	3.2 ± 7.2	0 ± 0
Poa compressa L.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Polygonum pensylvanicum L.	3.2 ± 7.2	0 ± 0	16.0 ± 19.6	16.0 ± 19.6
Polygonum punctatum Elliott.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Ranunculus abortivus L.	0 ± 0	9.6 ± 21.5	64.0 ± 143.1	6.4 ± 14.3
Ranunculus scleratus L.	16.0 ± 35.8	35.2 ± 70.1	0 ± 0	0 ± 0
Rorippa sessiflora	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Senecio glabellus Poir.	38.4 ± 85.9	0 ± 0	0 ± 0	0 ± 0
Setaria faberi R. Herrm.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Typha latifolia L.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Verbena sp. L.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Veronica peregrina L.	3.2 ± 7.2	0 ± 0	6.4 ± 8.8	0 ± 0
Xanthium strumarium L.	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown Cyperaceae	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown Juncaceae	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown dicot	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown monocot	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown Poaceae	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown woody	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown composite	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown fern	0 ± 0	0 ± 0	0 ± 0	0 ± 0
unknown	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Total Seeds	339.2 ± 606.3	2236.8 ± 2111.7	985.6 ± 1954.5	268.8 ± 352.8

Appendix 2. Seed banks (numbers of seeds m-2) of sites unfarmed and farmed for various lengths of time near Buttonland Swamp of the Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Buttonland Swamp Site No. (time farmed)						
Species	Owl 64 (0)	Owl 65 (0)	Owl 67 (0)	Owl 70 (0)	Owl 71 (0)	Owl 69 (1)	Button 1 (15)
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Alopecurus carolinianus Walter	0±0	0±0	0±0	0±0	0±0	22.4±26.8	102.4±36.8*
Amaranthus retroflexus L.	0±0	0±0	0±0	0±0	0±0	0±0	28.8±47.2
Ambrosia artemisiifolia L.	0±0	0±0	0±0	0±0	0±0	0±0	28.8±13.4
Ammannia auriculata Willd.	3.2±7.2	0±0	0±0	0±0	0±0	86.4±159.8*	6.4±8.8
Ammannia coccinea Rottb.	124.8±261.3*	22.4±50.1*	0±0	3.2±7.2*	518.4±748.6*	483.2±322.7*	3.2±7.2*
Andropogon virginicus L.	0±0	0±0	0±0	0±0	0±0	0±0	6.4±14.3
Bidens frondosa L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Bidens cernua L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Brassica hirta	0±0	3.2±7.2	0±0	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	6.4±8.8	32.0±19.6	0±0	3.2±7.2	3.2±7.2	0±0	25.6±26.8
Cyperus aristatus	0±0	0±0	0±0	0±0	0±0	0±0	35.2±13.4
Cyperus erythrorhizos Muhl.	403.2±408.8	537.6±82.1	57.6±48.7	128.0±74.2	179.2±63.4	19.2±42.9	3.2±7.2
Cyperus ferruginescens	515.2±570.0	6.4±8.8	25.6±48.8	6.4±8.8	0±0	3.2±7.2	0±0
Cyperus iria L.	0±0	0±0	0±0	0±0	0±0	0±0	32.0±45.3
Cyperus pseudovegetus Steudel	0±0	0±0	0±0	0±0	0±0	19.2±28.6	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Digitaria sanguinalis (L.) Scop.	0±0	0±0	0±0	3.2±7.2	3.2±7.2*	41.6±44.7	9.6±21.5
Echinochloa crusgalli (L.) P. Beauv.	16.0±27.7	60.8±118.9	0±0	28.8±55.9	22.4±26.8	35.2±17.5	3.2±7.2
Echinochloa muricata (P. Beauv.) Fern (P. Beauv) Fern.	0±0	0±0	0±0	0±0	0±0	0±0	0±0

Appendix 2. (cont.)

Species	Owl 64 (0)	Owl 65 (0)	Owl 67 (0)	Owl 70 (0)	Owl 71 (0)	Owl 69 (1)	Button 1 (15)
Eclipta prostrata (L.) L.	54.4±56.1	25.6±36.8	0±0	3.2±7.2*	6.4±14.3	44.8±34.7	3.2±7.2*
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Eleocharis obtusa	9.6±21.5*	6.4±14.3	16.0±35.8*	0±0	102.4±144.2*	406.4±200.7	0±0
Eragrotis obtusa	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	0±0	0±0	0±0	0±0	0±0	0±0	12.8±13.4*
Erigeron philadephicus L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0	57.6±33.2	0±0
Galium tinctorium L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Gratiola neglecta Torr.	12.8±28.6	134.4±300.5	176.0±291.5	3.2±7.2*	28.8±64.4*	9.6±14.3*	0±0
Gratiola virginiana L.	7177.6±3513.3	454.4±622.1	233.6±322.3	348.8±667.7*	713.6±576.3	80.0±81.6*	0±0
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L.	3.2±7.2	51.2±105.8	0±0	0±0	9.6±14.3	0±0	0±0
Ipomoea lacunosa L.	0±0	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Iva annua L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Juncus bufonius L.	0±0	0±0	0±0	0±0	9.6±21.5	0±0	243.2±235.8
Juncus marginatus Rotsk.	0±0	0±0	0±0	0±0	28.8±48.5	0±0	224.0±259.7
Juncus tenuis	*3.2±7.2**	*6.4±14.3**	*0±0*	*38.4±18.2*	*0±0*	*0±0*	*0±0*
Krigia caespitosa	*0±0*	*0±0*	*0±0*	*0±0*	*0±0*	*0±0*	*3.2±7.2*
Leersia oryzoides (L.) Swartz	208.0±82.4	12.8±28.6	192.0±176.0	25.6±36.8	35.2±32.8*	12.8±28.6	19.2±26.3
Lindernia dubia (L.) Pennel.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	16.0±35.8	0±0	6.4±8.8*	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short and Peter	16.0±22.6	22.4±50.1*	3.2±7.2	0±0		0±019.2±28.6	86.4±134.6
Mimulus alatus Aiton	0±0	0±0	0±0	0±0	0±0	0±0	9.6±21.5*

Appendix 2. (cont.)

Species	Owl 64 (0)	Owl 65 (0)	Owl 67 (0)	Owl 70 (0)	Owl 71 (0)	Owl 69 (1)	Button 1 (15)
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0	0±0	0±0	128.0±146.2*
Muhlenbergia schriberi J. F. Gmelin	0±0	0±0	0±0	0±0	0±0	0±0	28.8±64.4
Oxalis stricta L.	6.4±14.3	16.0±27.7	12.8±20.9	12.8±13.4	25.6±26.8	0±0	28.8±32.8
Panicum dichotomiflorum Michx.	0±0	0±0	0±0	0±0	6.4±14.3	0±0	19.2±43.0
Paspalum fluitans (Elliott) Kunth.	0±0	176.0±291.5	28.8±64.4	131.2±293.4*	134.4±184.4	32.0±71.6	9.6±14.3
Penthorum sedoides L.	25.6±18.2	3.2±7.2	6.4±8.8	3.2±7.2*	0±0	0±0	28.8±48.5
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Plantago virginica L.	0±0	0±0	0±0	0±0	0±0	0±0	57.6±128.8
Poa compressa L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Ranunculus abortivus L.	0±0	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Ranunculus scleratus L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Rorippa sessiflora	0±0	19.2±42.9	0±0	0±0	0±0	9.6±21.5	3.2±7.2
Senecio glabellus Poir.	0±0	0±0	0±0	0±0	0±0	0±0	9.6±14.3
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Verbena sp.	0±0	0±0	0±0	0±0	0±0	0±0	12.8±17.5
Veronica peregrina L.	83.2±177.2	3.2±7.2	0±0	0±0	0±0	51.2±45.8	137.6±307.7
Xanthium strumarium L.	0±0	0±0	0±0	0±0	0±0	0±0	0±0
unknown Cyperaceae	208.0 ±354.9	89.6±200.4	3.2±7.2	32.0±40.0	557.6±58.3	307.2±270.3	0±0
unknown Juncaceae	0±0	0±0	0±0	0±0	0±0	0±0	0±0
unknown dicot	9.6±21.5	0±0	0±0	0±0	0±0	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	70.4±148.8	265.6±593.9	182.4±332.2	272.0±580.6	156.8±149.4	3.2±7.2	0±0
unkown woody	0±0	0±0	0±0	0±0	0±0	0±0	0±0
unknown composite	0±0	3.2±7.2	0±0	0±0	0±0	0±0	
unknown fern	0±0	41.6±93.0	0±0	0±0	12.8±20.9	12.8±28.6	0±0
unknown	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Total Seeds	8972.3±5793.4	1993.6±2730.2	944.0±1428.4	1043.2±1832.2	2554.4±2223.6	1756.8±1758.1	1366.4±1815.5

Appendix 2 (cont.)

Buttonland Swamp Site No. (cont.)

Species	Button 3 (15)	Button 4 (15)	Owl 66 (30)	Owl 68 (30)	Owl 74 (30)
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	80.0±25.3	70.4±51.3	0±0	0±0	0±0
Alopecurus carolinianus Walter	0±0	0±0	0±0	0±0	6.4±14.3
Amaranthus retroflexus L.	16.0±19.6	25.6±18.2	0±0	0±0	0±0
Ambrosia artemisiifolia L.	3.2±7.2	0±0	0±0	0±0	0±0
Ammannia auriculata Willd.	22.4±35.1*	118.4±52.6*	3.2±7.2	6.4±8.8*	188.8±220.4*
Ammannia coccinea Rottb.	22.4±21.5*	92.8±138.3*	3.2±7.2	35.2±70.1*	246.4±245.2
Andropogon virginicus L.	48.0±98.3	41.6±93.0	0±0	0±0	0±0
Bidens frondosa L.	0±0	0±0	0±0	0±0	12.8±28.6
Bidens cernua L.	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	0±0	0±0
Brassica hirta	0±0	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	0±0	0±0	0±0	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0	0±0
Cyperus erythrorhizos Muhl.	28.8±17.5	0±0	0±0	0±0	6.4±14.3*
Cyperus ferruginescens	0±0	0±0	0±0	0±0	0±0
Cyperus iria L.	0±0	0±0	0±0	0±0	0±0
Cyperus pseudovegetus Steudel	12.8±28.6	0±0	0±0	0±0	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	3.2±7.2	32.0±71.6	0±0	0±0	0±0
Echinochloa crusgalli (L.) P. Beauv.	128.0±268.7	99.2±213.0	6.4±14.3	35.2±51.1	3.2±7.2
Echinochloa muricata (P. Beauv.) Fern	0±0	0±0	0±0	0±0	0±0
Eclipta prostrata (L.) Lam.	0±0	0±0	12.8±8.6	60.8±83.4	361.6±213.0

Appendix 2 (cont.)

Species	Button 3 (15)	Button 4 (15)	Owl 66 (30)	Owl 68 (30)	Owl 74 (30)
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	3.2±7.2	3.2±7.2	0±0	0±0	16.0±35.8
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0
Eleocharis obtusa	16.0±22.6	19.2±20.8	0±0	12.8±20.9	22.4±14.3
Eragrotis obtusa	0±0	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	25.6±24.3	252.8±68.3	0±0	0±0	0±0
(Michx.) Nees					
Erigeron philadephicus L.	0±0	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0
Galium tinctorium L.	0±0	0±0	0±0	3.2±7.2	0±0
Gratiola neglecta Torr.	0±0	0±0	38.4±33.2	6.4±8.8*	32.0±39.2
Gratiola virginiana L.	0±0	0±0	64.0±104.3	201.6±243.1	592.0±542.6
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L.	3.2±7.2	0±0	9.6±14.3	0±0	19.2±17.5
Ipomoea lacunosa L.	9.6±21.5	3.2±7.2	0±0	0±0	0±0
Iva annua L.	57.6±73.8	48.0±107.3*	0±0	0±0	0±0
Juncus bufonius L.	569.5±682.7	310.4±313.8	0±0	0±0	0±0
Juncus marginatus Rotsk.	800.0±832.4	124.8±130.2*	0±0	0±0	0±0
Juncus tenuis	0±0	0±0	0±0	3.2±7.2	0±0
Krigia caespitosa	3.2±7.2*	0±0	0±0	0±0	0±0
Leersia oryzoides (L.) Swartz	0±0	0±0	9.6±21.5	0±0	0±0
Lindernia dubia (L.) Pennel.	6.4±14.3	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short & Peter	0±0	0±0	0±0	0±0	3.2±7.2

Appendix 2 (cont.)

Species	Button 3 (15)	Button 4 (15)	Owl 66 (30)	Owl 68 (30)	Owl 74 (30)
Mimulus alatus Aiton	0±0	28.8±64.4	0±0	0±0	0±0
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0	0±0
Muhlenbergia schrberi J. F. Gmelin	9.6±21.5	28.8±64.4	0±0	0±0	0±0
Oxalis stricta L.	0±0	0±0	9.6±21.5	0±0	3.2±7.2
Panicum dichotomiflorum Michx.	9.6±21.5	0±0	6.4±8.8	0±0	6.4±8.8
Paspalum fluitans (Elliott) Kunth.	6.4±14.3	0±0	25.6±57.2	419.2±937.3	0±0
Penthorum sedoides L.	0±0	6.4±8.8*	3.2±7.2	3.2±7.2	0±0
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	0±0	0±0
Plantago virginica L.	3.2±7.2	3.2±7.2	0±0	0±0	0±0
Poa compressa L.	0±0	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	6.4±8.8	9.6±8.8	0±0	0±0	0±0
Polygonum punctatum Elliott.	3.2±7.2	3.2±7.2	0±0	0±0	0±0
Ranunculus abortivus L.	0±0	6.4±14.3	0±0	0±0	0±0
Ranunculus scleratus L.	64.0±117.0	3.2±7.2*	0±0	0±0	0±0
Rorippa sessiflora	0±0	0±0	0±0	0±0	0±0
Senecio glabellus Poir.	0±0	0±0	0±0	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	0±0	0±0	0±0	0±0	0±0
Verbena sp.	0±0	0±0	0±0	0±0	0±0
Veronica peregrina L.	9.6±14.3	0±0	364.8±323.1	172.8±216.9	160.0±125.5
Xanthium strumarium L.	0±0	0±0	0±0	0±0	0±0
unknown Cyperaceae	0±0	0±0	352.0±530.4	19.2±20.9	35.2±78.7
unknown Juncaceae	0±0	0±0	0±0	0±0	0±0
unknown dicot	0±0	0±0	0±0	0±0	19.2±430
unknown monocot	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	0±0	0±0	268.8±283.7	166.4±152.9	505.6±930.9
unkown woody	0±0	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0	6.4±14.4
uunknown fern	0±0	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0	0±0
Total Seeds	1967.9±2426.8	1328.0±1467.9	1161.6±1412.2	1145.6±1836.1	2220.8±2943.3

Appendix 3. Seed banks (number of seeds m^2) of sites unfarmed and farmed for various lengths of time near Tamms of the Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

Species	Tamms Site No. (time farmed) Mounds77 (0)	Tamms23 (3)	Tamms18 (5)	Tamms22 (10)	Tamms2 (15)	Tamms10 (15)
Abutilon theophrasti Medikus	0±0	3.2±7.2	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0	25.6±18.2	25.6±21.4	64.0±51.8	22.4±50.1*
Alopecurus carolinianus Walter	0±0	0±0	0±0	6.4±14.3	0±0	0±0
Amaranthus retroflexus L.	3.2±7.2	67.2±53.5	102.4±117.9	112.0±89.1	150.4±52.6	6.4±8.8
Ambrosia artemisiifolia L.	0±0	41.6±14.3	0±0	0±0	3.2±7.2	144.0±77.6
Ammannia auriculata Willd.	0±0	0±0	0±0	35.2±78.7*	0±0	3.2±7.2
Ammannia coccinea Rottb.	166.4±372.1*	19.2±26.3	16.0±16.0	3.2±7.2	25.6±35.1	515.2±495.1
Andropogon virginicus L.	0±0	0±0	6.4±8.8	0±0	0±0	28.8±47.1
Bidens frondosa L.	0±0	0±0	0±0	0±0	0±0	3.2±7.2*
Bidens discoidea	0±0	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	6.4±14.3	0±0	0±0	0±0	0±0	0±0
Brassica hirta	0±0	0±0	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	0±0	0±0	0±0	3.2±7.2	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0	0±0	0±0
Cyperus erythrorhizos Muhl.	70.4±35.1	0±0	0±0	3.2±7.2	22.4±26.8	0±0
Cyperus ferruginescens	0±0	3.2±7.2	6.4±14.3	9.6±14.3	6.4±14.3	83.2±34.7
Cyperus iria L.	0±0	0±0	0±0	0±0	0±0	6.4±14.
Cyperus pseudovegetus Steudel	0±0	6.4±14.3*	6.4±14.3	0±0	3.2±7.2	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	6.4±14.3	0±0	192.0±339.6	0±0	0±0
Echinochloa crusgalli (L.) P. Beauv	60.8±109.9	0±0	6.4±14.3	0±0	76.8±91.5	169.6±81.3
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0	3.2±7.2	0±0	3.2±7.2	16.0±35.8
Eclipta prostrata (L.) L.	131.2±99.5	3.2±7.2	0±0	3.2±7.2	3.2±7.2	22.4±33.2

Appendix 3 (cont.)

Species	Mounds77 (0)	Tamms23 (3)	Tamms18 (5)	Tamms22 (10)	Tamms2 (15)	Tamms10 (15)
Elatine minima 0±0 (Nutt.) Fischer & C. A. Meyer	0±0	0±0	22.4±50.1	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0	12.8±28.6	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0	0±0
Eleocharis obtusa	9.6±14.3	99.2±13.4	201.3±97.1	118.4±103.4	35.2±17.5	16.0±27.7
Eragrotis obtusa						
Eragrotis reptans (Michx.) Nees	0±0	140.8±179.3*	12.8±13.4*	777.6±255.4*	6.4±8.8	342.4±64.6*
Erigeron philadephicus L.	0±0	0±0	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0	0±0
Galium tinctorium L.	0±0	0±0	0±0	0±0	6.4±8.8	3.2±7.2
Gratiola neglecta Torr.	3.2±7.2	0±0	0±0	0±0	0±0	0±0
Gratiola virginiana L.	2384±3246.6	0±0	0±0	713.6±1595.7	0±0	0±0
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L.	0±0	38.4±77.2	0±0	3.2±7.2	6.4±8.8	0±0
Ipomoea lacunosa L.	6.4±8.8	9.6±8.8	0±0	3.2±7.2	9.6±14.3	38.4±85.9*
Iva annua L.	0±0	0±0	35.2±78.7*	25.6±29.1	19.2±42.9*	22.4±41.7*
Juncus bufonius L.	0±0	464±513.8	710.4±936.6	1622.4±2117.3	166.4±254.4	521.6±808.6
Juncus marginatus Rotsk.	0±0	352.0±325.8*	11.6±928.9	1635±1693.5	307±285.1	534.4±489.5
Juncus tenuis	0±0	0±0	0±0	0±0	0±0	0±0
Krigia caespitosa	0±0	6.4±8.8	0±0	3.2±7.2	16.0±35.8	16.0±27.7
Leersia oryzoides (L.) Swartz	25.6±57.2*	0±0	0±0	0±0	0±0	0±0
Lindernia dubia (L.) Pennel.	0±0	0±0	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	0±0	22.4±50.1	0±0	0±0
Ludwigia polycarpa Short & Peter	3.2±7.2	96.0±131.9	3.2±7.2	153.6±199.1	99.2±178.3	134.4±291.7
Mimulus alatus Aiton	0±0	0±0	0±0	0±0	0±0	0±0

Appendix 3 (cont.)

Species	Mounds77 (0)	Tamms23 (3)	Tamms18 (5)	Tamms22 (10)	Tamms2 (15)	Tamms10 (15)
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Muhlenbergia schrberi J. F. Gmelin	0±0	153.6±226.4	9.6±14.3*	80.0±178.9	3.2±7.2	28.8±39.8
Oxalis stricta L.	9.6±21.5	28.8±64.4	0±0	12.8±13.4	0±0	169.6±260.9
Panicum dichotomiflorum Michx.	6.4±8.8	0±0	9.6±21.5	3.2±7.2*	3.2±7.2	0±0
Paspalum fluitans (Elliott) Kunth.	25.6±48.8	3.2±7.2	0±0	128.0±139.0	16.0±22.6	28.8±39.8
Penthorum sedoides L.	28.8±48.5	0±0	0±0	48.0±40.8	12.8±20.8	329.6±301.4
Pilea pumila (L.) A. Gray	0±0	6.4±8.8	0±0	0±0	0±0	0±0
Plantago virginica L.	0±0	0±0	3.2±7.2	35.2±78.7	0±0	128.0±286.2*
Poa compressa L.	0±0	3.2±7.2	0±0	0±0	9.6±21.5	0±0
Polygonum pensylvanicum L.	0±0	6.4±8.8	6.4±8.8	6.4±8.8	0±0	0±0
Polygonum punctatum Elliott.	0±0	12.8±28.6	9.6±21.5	32.0±71.6	12.8±28.6	0±0
Ranunculus abortivus L.	0±0	0±0	12.8±20.9	48.0±107.3	19.2±26.3	3.2±7.2*
Ranunculus scleratus L.	0±0	0±0	6.4±8.8	0±0	19.2±17.5	48.0±43.8
Rorippa sessiflora	6.4±8.8	0±0	0±0	0±0	0±0	0±0
Senecio glabellus Poir.	0±0	0±0	12.8±17.5	16.0±35.8	0±0	25.6±36.8
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	16.0±27.7	0±0	0±0	0±0	0±0	0±0
Verbena sp.	0±0	0±0	0±0	0±0	0±0	0±0
Veronica peregrina L.	1100.0±2416.9	0±0	0±0	38.4±85.8	0±0	96.0±133.4
Xanthium strumarium	0±0	0±0	0±0	0±0	0±0	0±0
unknown Cyperaceae	0±0	0±0	0±0	0±0	0±0	0±0
unknown Juncaceae	0±0	0±0	0±0	0±0	0±0	0±0
unknown dicot	0±0	0±0	0±0	0±0	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	0±0	0±0	0±0	0±0	0±0	0±0
unknown woody	0±0	0±0	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0	0±0	0±0
Total Seeds	4069.2±6560.4	1571.2±1754.7	1240.1±2436.3	5542.2±7411.5	1139.0±1335.9	3510.4±3893.2

Appendix 3 (cont.)

Tamms Site No. (cont.)

Species	Tamms11 (25)	Tamms12 (25)	Tamms13 (25)	Tamms14 (25)	Tamms15 (25)	Tamms16 (25)
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	131.2±120.5	28.8±23.7	60.8±118.3	67.2±107.0*	32.0±34.0	35.2±70.1*
Alopecurus carolinianus Walter	0±0	0±0	0±0	0±0	0±0	0±0
Amaranthus retroflexus L.	64.0±65.0	3.2±7.2	3.2±7.2	19.2±13.4	9.6±21.5	105.6±227.3
Ambrosia artemisiifolia L.	3.2±7.2	3.2±7.2	16.0±19.6	6.4±8.8	12.8±20.9	6.4±8.8
Ammannia auriculata Willd.	0±0	0±0	16.0±35.8	0±0	0±0	6.4±8.8*
Ammannia coccinea Rottb.	25.6±29.1	9.6±14.3	166.4±83.6*	22.4±50.1	6.4±14.3*	150.4±93.7*
Andropogon virginicus L.	0±0	0±0	0±0	12.8±28.6	3.2±7.2	112.0±170.1
Bidens frondosa L.	0±0	0±0	0±0	0±0	0±0	0±0
Bidens discoidea	0±0	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	0±0	0±0	0±0
Brassica hirta	0±0	0±0	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	0±0	0±0	0±0	0±0	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0	3.2±7.2	0±0
Cyperus erythrorhizos Muhl.	0±0	0±0	0±0	6.4±14.3	0±0	0±0
Cyperus ferruginescens	35.2±36.5	16.0±22.6	51.2±49.8	54.4±.36.8	60.8±26.3	6.4±14.3
Cyperus iria L.	6.4±14.3	0±0	54.4±70.3	6.4±8.8	3.2±7.2	9.6±8.8
Cyperus pseudovegetus Steudel	0±0	0±0	0±0	9.6±14.3	6.4±8.8	217.6±210.9
Cyperus strigosus L.	0±0	0±0	0±0	0±0	3.2±7.2*	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	3.2±7.2*	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	0±0	0±0	0±0	0±0	147.2±221.0
Echinochloa crusgalli (L.) P. Beauv	0±0	0±0	3.2±7.2*	380.8±539.6	198.4±443.6	0±0
Echinochloa muricata (P. Beauv.) Fern.	0±0	9.6±14.3	0±0	3.2±7.2*	0±0	3.2±7.2

Appendix 3 (cont.)

Species	Tamms11 (25)	Tamms12 (25)	Tamms13 (25)	Tamms14 (25)	Tamms15 (25)	Tamms16 (25)
Eclipta prostrata (L.) L.	28.8±39.8	9.6±21.5	144.0±133.9	0±0	25.6±24.3	38.4±48.8
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0	3.2±7.2	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0	0±0
Eleocharis obtusa	38.4±26.8	102.4±60.5	3.2±7.2	25.6±21.5	44.8±73.7	12.8±28.6
Eragrotis obtusa	0±0	0±0	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	25.6±57.2*	73.6±47.5*	9.6±14.3*	9.6±14.3	137.6±141.1	579.2±159.7
Erigeron philadephicus L.	0±0	0±0	9.6±14.3	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	48.0±59.9	3.2±7.2	0±0	35.2±20.9*
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	3.2±7.2	6.4±8.8	3.2±7.2	0±0	0±0	0±0
Galium tinctorium L.	9.6±14.3	3.2±7.2	0±0	9.6±14.3	0±0	0±0
Gratiola neglecta Torr.	0±0	0±0	0±0	3.2±7.2	0±0	0±0
Gratiola virginiana L.	0±0	0±0	0±0	6.4±8.8	0±0	0±0
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L.	0±0	35.2±78.7	9.6±8.8	25.6±29.1	60.8±36.5	0±0
Ipomoea lacunosa L.	3.2±7.2	19.2±26.3	35.2±78.7	32.0±46.6	25.6±48.8	3.2±7.2
Iva annua L.	6.4±14.3*	3.2±7.2	54.4±97.1*	0±0	16.0±22.6*	51.2±105.8
Juncus bufonius L.	883.2±1018.6	201.6±276.1	809.6±825.6	22.4±21.5*	569.6±759.4	748.8±680.1
Juncus marginatus Rotsk.	1580.8±572.4*	256.0±268.7	681.6±959.0*	12.8±28.62	115.2±125.2*	515.2±706.0
Juncus tenuis	0±0	0±0	0±0	0±0	0±0	0±0
Krigia caespitosa	0±0	0±0	12.8±13.4	19.2±28.6	0±0	3.2±7.2
Leersia oryzoides (L.) Swartz	3.2±7.2	0±0	3.2±7.2	0±0	3.2±7.2	0±0
Lindernia dubia (L.) Pennel.	6.4±14.3	0±0	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short & Peter	16.0±35.8	188.8±413.3	224.0±492.0	9.6±14.3	16.0±22.6	0±0
Mimulus alatus Aiton	0±0	0±0	0±0	0±0	0±0	0±0

Appendix 3 (cont.)

Species	Tamms11 (25)	Tamms12 (25)	Tamms13 (25)	Tamms14 (25)	Tamms15 (25)	Tamms16 (25)
Muhlenbergia frondosa (Poiret) Fern.	16.0±27.7*	0±0	0±0	0±0	0±0	0±0
Muhlenbergia schreri J. F. Gmelin	115.2±257.6	3.2±7.2*	131.2±226.7	0±0	41.6±93.0	217.6±365.6
Oxalis stricta L.	0±0	0±0	28.8±64.4	6.4±8.8	3.2±7.2	265.6±276.3
Panicum dichotomiflorum Michx.	0±0	0±0	44.8±91.5	16.0±35.8	16.0±16.0	6.4±8.8
Paspalum fluitans (Elliott) Kunth.	6.4±14.3	6.4±14.3	6.4±14.3*	0±0	0±0	76.8±105.2
Penthorum sedoides L.	3.2±7.2	6.4±14.3	0±0	38.4±36.8	6.4±14.3*	128.0±184.2
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	3.2±7.2	0±0	0±0
Plantago virginica L.	3.2±7.2*	0±0	51.2±114.5	3.2±7.2	3.2±7.2	19.2±28.2*
Poa compressa L.	0±0	0±0	67.2±150.3	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	6.4±8.8	0±0	6.4±8.8	0±0	0±0
Polygonum punctatum Elliott.	0±0	9.6±21.5	54.4±121.6	0±0	0±0	6.4±14.3
Ranunculus abortivus L.	44.8±49.2	3.2±7.2*	38.4±69.4	6.4±14.3	3.2±7.2	147.2±329.1
Ranunculus scleratus L.	86.4±145.6	12.8±13.4	3.2±7.2	32.0±29.9	0±0	176.0±393.5
Rorippa sessiflora	3.2±7.2	0±0	3.2±7.2	6.4±14.3	0±0	0±0
Senecio glabellus Poir.	0±0	0±0	0±0	0±0	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	0±0	0±0	0±0	0±0	0±0	0±0
Verbena sp.	3.2±7.2	0±0	0±0	0±0	0±0	0±0
Veronica peregrina L.	9.6±14.3	144.0±244.8	0±0	3.2±7.2*	0±0	0±0
Xanthium strumarium	0±0	3.2±7.2	0±0	0±0	0±0	3.2±7.2
unknown Cyperaceae	0±0	0±0	0±0	0±0	0±0	0±0
unknown Juncaceae	0±0	0±0	0±0	0±0	0±0	0±0
unknown dicot	0±0	0±0	0±0	0±0	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	0±0	0±0	0±0	0±0	0±0	0±0
unknown woody	0±0	0±0	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0	0±0	0±0
Total Seeds	3161.6±2625.2	1161.6±1643.8	2848.0±3977.5	886.4±1248.8	1430.4±2011.7	3738.6±4489.1

Appendix 3 (cont.)

Species	Tamms17 (50)	Tamms19 (50)	Tamms20 (50)	Tamms21 (50)
	Tamms Site No. (cont.)			
Abutilon theophrasti Medikus	0±0	0±0	3.2±7.2	0±0
Agrostis perennans (Walter) Tuckerman	214.4±66.5*	64.0±75.0*	28.8±20.9	3.2±7.2*
Alopecurus carolinianus Walter	0±0	0±0	0±0	0±0
Amaranthus retroflexus L.	176.0±135.8	9.6±14.3	0±0	51.2±39.8
Ambrosia artemisiifolia L.	0±0	41.6±51.3	0±0	0±0
Ammannia auriculata Willd.	3.2±7.2	16.0±22.6	0±0	3.2±7.2*
Ammannia coccinea Rottb.	12.8±13.3*	6.4±8.8	9.6±21.5*	163.2±113.9*
Andropogon virginicus L.	9.6±21.5	41.6±84.4	19.2±42.9	3.2±7.2
Bidens frondosa L.	0±0	0±0	6.4±14.3	0±0
Bidens discoidea	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	3.2±7.2	0±0	0±0	0±0
Brassica hirta	3.2±7.2	0±0	6.4±14.3	0±0
Cephalanthus occidentalis L.	0±0	0±0	19.2±42.9	0±0
Cyperus aristatus	0±0	0±0	3.2±7.2	0±0
Cyperus erythrorhizos Muhl.	6.4±14.3	19.2±13.4	0±0	0±0
Cyperus ferruginescens	3.2±7.2	51.2±47.2	16.0±11.3	3.2±7.2
Cyperus iria L.	0±0	0±0	0±0	0±0
Cyperus pseudovegetus Steudel	12.8±28.6*	9.6±21.5	0±0	28.8±17.5
Cyperus strigosus L.	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	92.8±207.5	118.4±264.8	0±0	0±0
Echinochloa crusgalli (L.) P. Beauv	3.2±7.2*	3.2±7.2	3.2±7.2	0±0

Appendix 3 (cont.)

Species	Tamms17 (50)	Tamms19 (50)	Tamms20 (50)	Tamms21 (50)
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0	0±0	0±0
Eclipta prostrata (L.) L.	0±0	112.0±131.0	0±0	3.2±7.2
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	3.2±7.2	0±0	0±0	3.2±7.2
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0
Eleocharis obtusa	57.6±62.6	38.4±33.2	0±0	172.8±146.4
Eragrotis hypoides	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	35.2±61.3	25.6±24.3*	9.6±21.5*	1132.8±436.9
Erigeron philadephicus L.	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	12.8±28.6
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0
Galium tinctorium L.	0±0	0±0	0±0	0±0
Gratiola neglecta Torr.	0±0	32.0±22.6	0±0	0±0
Gratiola virginiana L.	51.2±114.5*	3.2±7.2	0±0	0±0
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0
Hypericum mutilum L.	3.2±7.2	0±0	0±0	35.2±55.9
Ipomoea lacunosa L.	3.2±7.2	9.6±14.3	9.6±21.5*	3.2±7.2
Iva annua L.	3.2±7.2*	3.2±7.2	3.2±7.2*	22.4±41.7*
Juncus bufonius L.	598.4±387.4	83.2±118.3*	156.8±214.8	1305.6±1312.3*
Juncus marginatus Rotsk.	323.2±309.1*	131.2±126.2*	265.6±395.3	1187.2±1627.9
Juncus tenuis	0±0	0±0	0±0	0±0
Krigia caespitosa	3.2±7.2	0±0	3.2±7.2	0±0
Leersia oryzoides (L.) Swartz	0±0	0±0	0±0	0±0
Lindernia dubia (L.) Pennel.	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	3.2±7.2*	0±0	0±0	0±0

Appendix 3 (cont.)	*Tamms17*	*Tamms19*	*Tamms20*	*Tamms21*
Species	*(50)*	*(50)*	*(50)*	*(50)*
Ludwigia polycarpa Short & Peter	48.0±98.6	6.4±14.3	12.8±28.6	92.8±174.0
Minulus alatus Aiton	0±0	0±0	0±0	0±0
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0
Muhlenbergia schrberi J. F. Gmelin	243.2±329.7	0±0	137.6±307.7*	44.8±91.5*
Oxalis stricta L.	0±0	0±0	3.2±7.2	3.2±7.2
Panicum dichotomiflorum Michx.	6.4±8.8	0±0	0±0	0±0
Paspalum fluitans (Elliott) Kunth.	3.2±7.2*	6.4±14.3	0±0	22.4±50.1*
Penthorum sedoides L.	3.2±7.2*	3.2±7.2*	25.6±41.7	0±0
Pilea pumila (L.) A. Gray	3.2±7.2	0±0	0±0	0±0
Plantago virginica L.	0±0	0±0	0±0	3.2±7.2
Poa compressa L.	0±0	0±0	9.6±21.5	0±0
Polygonum pensylvanicum L.	16.0±16.0	3.2±7.2	3.2±7.2	0±0
Polygonum punctatum Elliott.	16.0±22.6	0±0	3.2±7.2	6.4±14.3
Ranunculus abortivus L.	99.2±93.6	9.6±21.5	0±0	0±0
Ranunculus scleratus L.	89.6±140.2	60.8±111.1	60.8±136.0	3.2±7.2*
Rorippa sessiflora	0±0	0±0	3.2±7.2	0±0
Senecio glabellus Poir.	0±0	0±0	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0
Typha latifolia L.	0±0	0±0	0±0	0±0
Verbena sp.	0±0	0±0	3.2±7.2	0±0
Veronica peregrina L.	0±0	0±0	0±0	3.2±7.2
Xanthium strumarium	3.2±7.2	0±0	0±0	0±0
unknown Cyperaceae	0±0	0±0	0±0	0±0
unknown Juncaceae	0±0	0±0	0±0	0±0
unknown dicot	0±0	0±0	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0
unknown Poaceae	0±0	0±0	0±0	0±0
unknown woody	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0
Total Seeds	2153.6±2247.1	940.8±1270.4	825.6±1239.0	4313.6±4230.0

Appendix 4. Seed banks (number of seeds m^2) of sites unfarmed and farmed for various lengths of time near Heron Pond of the Cache River region. An "*" indicates that the highest number of seed germinated in the flooded treatment.

	Heron Pond Site No. (time farmed)				
Species	Heron5 (0)	LBS6 (0)	DOC7 (15)	Schaeffer8 (15)	Schaeffer9 (15)
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	3.2±7.2	0±0	0±0	6.4±14.3
Alopecurus carolinianus Walter	0±0	0±0	0±0	3.2±7.2	0±0
Amaranthus retroflexus L.	22.4±50.1	19.2±34.7	12.8±20.9	3.2±7.2	9.6±8.8
Ambrosia artemisiifolia L.	0±0	0±0	0±0	0±0	6.4±14.3
Ammannia auriculata Willd.	99.2±221.8	6.4±14.3	236.8±362.8	51.2±90.1*	448.0±115.4
Ammannia coccinea Rottb.	44.8±100.2	0±0	176.0±140.9*	32.0±25.3	784.0±183.5
Andropogon virginicus L.	12.8±13.3	6.4±8.8	0±0	0±0	6.4±8.8
Bidens frondosa L.	0±0	0±0	0±0	0±0	3.2±7.2
Bidens cernua L.	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	16.0±27.7	0±0
Brassica hirta	0±0	0±0	0±0	3.2±7.2	0±0
Cephalanthus occidentalis L.	0±0	3.2±7.2	19.2±28.6	6.4±8.8	0±0
Cyperus aristatus	6.4±8.8	3.2±7.2	0±0	6.4±8.8	0±0
Cyperus erythrorhizos Muhl.	0±0	0±0	0±0	0±0	0±0
Cyperus ferruginescens	25.6±24.2	240.0±94.0	169.6±181.6	92.8±71.0	96.0±68.8
Cyperus iria L.	0±0	25.6±31.2	115.2±240.1	3.2±7.2	9.6±14.3
Cyperus pseudovegetus Steudel	0±0	0±0	0±0	0±0	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	9.6±14.3	0±0	9.6±14.3
Digitaria sanguinalis (L.) Scop.	54.4±121.6	0±0	0±0	0±0	0±0
Echinochloa crusgalli (L.) P. Beauv	0±0	35.2±78.7	0±0	0±0	44.8±52.3
Echinochloa muricata (P. Beauv.) Fern.	3.2±7.2*	0±0	0±0	0±0	0±0
Eclipta prostrata (L.) L.	0±0	0±0	54.4±51.4*	0±0	25.6±14.3*

Appendix 4 (cont.)

Species	Heron5 (0)	LBS6 (0)	DOC7 (15)	Schaeffer8 (15)	Schaeffer9 (15)
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	3.2±7.2*	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0
Eleocharis obtusa	12.8±28.6	3.2±7.2	57.6±128.8	0±0	25.6±31.2
Eragrotis hypnoides (Lam..) BSP.	0±0	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	3.2±7.2	41.6±84.4*	448.0±283.7*	3.2±7.2*	579.2±467.2
Erigeron philadephicus L.	0±0	9.6±14.3	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	12.8±28.6	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0
Galium tinctorium L.	0±0	0±0	0±0	0±0	0±0
Gratiola neglecta Torr.	0±0	0±0	0±0	0±0	3.2±7.2
Gratiola virginiana L.	0±0	0±0	121.6±271.9	0±0	3.2±7.2
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L.	0±0	3.2±7.2	339.2±758.5	0±0	6.4±8.8
Ipomoea lacunosa L.	6.4±14.3*	0±0	0±0	0±0	3.2±7.2
Iva annua L.	28.8±48.5*	25.6±41.7*	44.8±49.8*	19.2±42.9	28.8±64.4
Juncus bufonius L.	451.2±548.4	236.8±324.5	435.2±449.5	16.0±27.7	864.0±815.6
Juncus marginatus Rotsk.	185.6±258.1	240.0±229.6	214.4±300.1	57.6±128.8	550.4±831.3
Juncus tenuis	0±0	0±0	0±0	0±0	0±0
Krigia caespitosa	0±0	0±0	428.8±583.8	6.4±8.8	96.0±144.4
Leersia oryzoides (L.) Swartz	0±0	22.4±41.7	278.4±622.5	0±0	0±0
Lindernia dubia (L.) Pennel.	0±0	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	249.6±513.8	0±0	0±0
Ludwigia polycarpa Short & Peter	467.2±1044.7	42.7±60.4	511.2±802.0	6.4±14.3	0±0
Mimulus alatus Aiton	41.6±93.0±	25.6±57.2*	3.2±7.2	0±0	0±0

Appendix 4 (cont.)

Species	Heron5 (0)	LBS6 (0)	DOC7 (15)	Schaeffer8 (15)	Schaeffer9 (15)
Muhlenbergia frondosa (Poiret) Fern.	1171.2±767.5	262.4±151.2*	3.2±7.2*	3.2±7.2*	6.4±14.3*
Muhlenbergia schrberi J. F. Gmelin	448.0±890.1	28.8±39.8	70.4±157.4	188.8±404.5	12.8±28.6
Oxalis stricta L.	22.4±35.1	34.0±143.1	204.8±324.6	25.6±48.8	380.8±356.8
Panicum dichotomiflorum Michx.	0±0	70.4±157.4	0±0	16.0±19.6*	425.6±396.6
Paspalum fluitans (Elliott) Kunth.	0±0	9.6±21.5	0±0	16.0±16.0	131.2±235.8*
Penthorum sedoides L.	9.6±14.3	233.6±249.1	496.0±566.0	19.2±26.3	422.4±507.4
Pilea pumila (L.) A. Gray	3.2±7.2	0±0	0±0	3.2±7.2	0±0
Plantago virginica L.	0±0	6.4±14.3	176.0±375.9	0±0	0±0
Poa compressa L.	0±0	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0	0±0	0±0	0±0
Polygonum punctatum Elliott.	0±0	12.8±17.5	12.8±20.9	0±0	0±0
Ranunculus abortivus L.	25.6±57.2	0±0	0±0	6.4±14.3	9.6±14.3
Ranunculus scleratus L.	0±0	3.2±7.2	0±0	0±0	25.6±36.8
Rorippa sessiflora	0±0	0±0	0±0	86.4±139.3	121.6±112.3
Senecio glabellus Poir.	0±0	0±0	195.2±307.8	64.0±88.4	44.8±65.4
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	0±0	0±0	0±0	0±0	0±0
Verbena sp.	0±0	0±0	3.2±7.2	3.2±7.2*	0±0
Veronica peregrina L.	0±0	9.6±21.5	6.4±14.3	0±0	0±0
Xanthium strumarium	0±0	0±0	6.4±14.3	0±0	6.4±14.30
unknown Cyperaceae	0±0	0±0	0±0	0±0	0±0
unknown Juncaceae	0±0	0±0	0±0	0±0	0±0
unknown dicot	0±0	0±0	0±0	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	0±0	0±0	0±0	0±0	0±0
unknown woody	0±0	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0	0±0
Total Seeds	3144.8±3846.1	1676.7±2002.7	5103.2±7615.0	758.4±1269.0	5196.8±4683.4

Appendix 5. Seed banks (number of seeds m^{-2}) of sites unfarmed and farmed for various lengths of time near Goose Pond of the Upper Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Goose Pond Site No. (time farmed)				
Species	Goose56 (0)	Goose54 (5)	Goose55 (5)	Eddelman28 (5)	Eddelman30 (5)
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0	0±0	3.2±7.2	3.2±7.2*
Alopecurus carolinianus Walter	0±0	0±0	0±0	0±0	0±0
Amaranthus retroflexus L.	0±0	121.6±106.5	3.2±7.2	140.8±197.1	96.0±59.9
Ambrosia artemisiifolia L.	0±0	0±0	240.0±536.7	0±0	32.0±25.3
Ammannia auriculata Willd.	0±0	41.6±38.5	342.4±290.3	137.6±161.8	441.6±248.3
Ammannia coccinea Rottb.	96.0±40.8*	528.0±379.8	992.0±271.8	240.0±213.2	531.2±328.2
Andropogon virginicus L.	0±0	0±0	0±0	3.2±7.2	0±0
Bidens frondosa L.	3.2±7.2	0±0	0±0	0±0	0±0
Bidens vernua L.	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	0±0	0±0
Brassica hirta Moench.	0±0	0±0	0±0	6.4±8.8	0±0
Cephalanthus occidentalis L.	0±0	0±0	0±0	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0	0±0
Cyperus erythrorhizos Muhl.	547.2±175.4	86.4±65.6	115.2±34.7	0±0	9.6±14.3
Cyperus ferruginescens	115.2±172.8	12.8±13.4	9.6±14.3	0±0	0±0
Cyperus iria L.	0±0	0±0	0±0	0±0	0±0
Cyperus pseudovegetus Steudel	0±0	0±0	86.4±82.1	12.8±20.9	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	3.2±7.2	0±0	0±0	3.2±7.2
Echinochloa crusgalli (L.) P. Beauv	137.6±72.1*	134.4±61.5*	118.4±72.1*	6.4±8.8	25.6±57.2
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0	0±0	0±0	6.4±14.3
Eclipta prostrata (L.) L.	6.4±8.8	54.4±36.8	26.5±21.9	3.2±7.2*	12.8±28.6

Appendix 5. (cont.)

Species	Goose56 (0)	Goose54 (5)	Goose55 (5)	Eddelman28 (5)	Eddelman30 (5)
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	12.8±20.9	41.6±31.1
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	54.4±121.6*	0±0	0±0
Eleocharis obtusa	3.2±7.2	92.8±61.3*	428.8±118.3	9.6±14.3	92.8±63.4
Eragrotis hypnoides (Lam.) BSP.	0±0	0±0	0±0	6.4±8.8	3.2±7.2
Eragrotis reptans (Michx.) Nees	0±0	0±0	0±0	211.2±47.2*	51.2±23.7*
Erigeron philadephicus L.	0±0	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	6.4±14.3	6.4±14.3
Galium tinctorium L.	0±0	0±0	0±0	0±0	0±0
Gratiola neglecta Torr.	0±0	281.6±184.0	508.8±94.9	0±0	0±0
Gratiola virginiana L.	4038.4±5188.8	1926.4±2066.1	131.2±188.1	0±0	0±0
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L.	6.4±14.3	86.4±60.5	76.8±86.5	0±0	0±0
Ipomoea lacunosa L.	3.2±7.2	0±0	0±0	32.0±32.0	25.6±41.8
Iva annua L.	0±0	0±0	0±0	28.8±55.9	22.4±41.7*
Juncus bufonius L.	0±0	3.2±7.2	32.0±39.2	2739.2±3882.1	1654.4±973.0
Juncus marginatus Rotsk.	0±0	0±0	0±0	435.2±263.7*	483.2±512.7*
Juncus tenuis	0±0	0±0	224.0±54.3	0±0	0±0
Krigia caespitosa	0±0	0±0	0±0	0±0	3.2±7.2
Leersia oryzoides (L.) Swartz	22.4±50.1	51.2±53.5	38.4±36.8	0±0	0±0
Lindernia dubia (L.) Pennel.	3.2±7.2	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	3.2±7.2	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short & Peter	70.4±88.1*	51.2±49.8	0±0	3.2±7.2	28.8±64.4
Mimulus alatus Aiton	0±0	0±0	0±0	0±0	3.2±7.2

Appendix 5. (cont.)

Species	Goose56 (0)	Goose54 (5)	Goose55 (5)	Eddelman28 (5)	Eddelman30 (5)
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0	0±0
Muhlenbergia schreberi J. F. Gmelin	0±0	0±0	0±0	1398.4±2193.1	57.6±128.8
Oxalis stricta L.	3.2±7.2	0±0	0±0	6.4±14.3	48.0±83.1
Panicum dichotomiflorum Michx.	0±0	16.0±19.6	6.4±8.8	0±0	12.8±28.6
Paspalum fluitans (Elliott) Kunth.	198.4±443.6	0±0	44.8±100.2	0±0	0±0
Penthorum sedoides L.	28.8±34.7	188.8±118.3	12.8±20.9	0±0	12.8±28.6
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	3.2±7.2	0±0
Plantago virginica L.	38.4±85.9	0±0	0±0	0±0	6.4±14.3*
Poa compressa L.	0±0	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0	0±0	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0	0±0	0±0	3.2±7.2
Ranunculus abortivus L.	0±0	0±0	0±0	3.2±7.2	0±0
Ranunculus scleratus L.	0±0	0±0	0±0	44.8±83.4	3.2±7.2*
Rorippa sessiflora	0±0	12.8±28.6	0±0	0±0	0±0
Senecio glabellus Poir.	0±0	0±0	0±0	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	0±0	0±0	0±0	0±0	0±0
Verbena sp.	0±0	3.2±7.2	0±0	0±0	0±0
Veronica peregrina L.	0±0	44.8±26.3	3.2±7.2	0±0	0±0
Xanthium strumarium	0±0	0±0	3.2±7.2	6.4±14.3	0±0
unknown Cyperaceae	16.0±20.6	35.2±55.4	128.0±177.4	0±0	0±0
unknown Juncaceae	0±0	0±0	0±0	0±0	0±0
unknown dicot	80.0±179.0	16.0±35.8	3.2±7.2*	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	44.8±70.1	28.8±64.4	124.8±279.1	0±0	0±0
unknown woody	0±0	0±0	0±0	0±0	0±0
unknown composite	6.4±14.4	0±0	70.4±157.4	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0	0±0
Total Seeds	5472.0±6702.7	3820.8±3547.3	3824.9±2836.2	4640.0±7298.1	3721.6±2876.0

Appendix 5 (cont).

Goose Pond Site No. (cont.)

Species	*Eddelman29 (25)*
Abutilon theophrasti Medikus	*0±0*
Agrostis perennans (Walter) Tuckerman	*12.8±13.4*
Alopecurus carolinianus Walter	*0±0*
Amaranthus retroflexus L.	*272.0±192.7*
Ambrosia artemisiifolia L.	*0±0*
Ammannia auriculata Willd.	*3.2±7.2*
Ammannia coccinea Rottb.	*3.2±7.2*
Andropogon virginicus L.	*3.2±7.2*
Bidens frondosa L.	*0±0*
Bidens cernua L.	*0±0*
Boehmeria cylindrica (L.) Swartz	*0±0*
Brassica hirta Moench.	*0±0*
Cephalanthus occidentalis L.	*0±0*
Cyperus aristatus	*0±0*
Cyperus erythrorhizos Muhl.	*0±0*
Cyperus ferruginescens	*0±0*
Cyperus iria L.	*0±0*
Cyperus pseudovegetus Steudel	*0±0*
Cyperus strigosus L.	*0±0*
Digitaria ischaemun (Schreber) Muhl	*0±0*

Appendix 5 (cont).

Species	Eddelman29 (25)
Digitaria sanguinalis (L.) Scop.	0±0
Echinochloa crusgalli (L.) P. Beauv	0±0
Echinochloa muricata (P. Beauv.) Fern.	3.2±7.2
Eclipta prostrata (L.) L.	0±0
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0
Elatine triandra Schkuhr.	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0
Eleocharis obtusa	60.8±45.8
Eragrotis hypnoides (Lam.) BSP.	364.8±131.6
Eragrotis reptans (Michx.) Nees	60.8±109.9
Erigeron philadephicus L.	0±0
Eupatorium fistulusum Barratt.	0±0
Euphorbia marginata Pursh.	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	6.4±8.8
Galium tinctorium L.	0±0
Gratiola neglecta Torr.	0±0
Gratiola virginiana L.	0±0
Heteranthera limosa (Swartz) Willd.	0±0
Hypericum mutilum L.	0±0
Ipomoea lacunosa L.	6.4±8.8
Iva annua L.	6.4±14.3
Juncus bufonius L.	172.8±159.4
Juncus marginatus Rotsk.	67.2±92.2
Juncus tenuis	0±0
Krigia caespitosa	0±0
Leersia oryzoides (L.) Swartz	0±0
Lindernia dubia (L.) Pennel.	28.8±32.8

Appendix 5 (cont).

Species	Eddelman29 (25)
Ludwigia decurrens (Jussiaea) Walter	0±0
Ludwigia polycarpa Short & Peter	3.2±7.2
Mimulus alatus Aiton	0±0
Muhlenbergia frondosa (Poiret) Fern.	28.8±64.4
Muhlenbergia schrberi J. F. Gmelin	9.6±14.3
Oxalis stricta L.	0±0
Panicum dichotomiflorum Michx.	0±0
Paspalum fluitans (Elliott) Kunth.	0±0
Penthorum sedoides L.	0±0
Pilea pumila (L.) A. Gray	9.6±8.8
Plantago virginica L.	0±0
Poa compressa L.	0±0
Polygonum pensylvanicum L.	0±0
Polygonum punctatum Elliott.	0±0
Ranunculus abortivus L.	25.6±57.2
Ranunculus scleratus L.	105.6±227.3
Rorippa sessiflora	0±0
Senecio glabellus Poir.	0±0
Setaria faberi R. Herrm.	0±0
Typha latifolia L.	0±0
Verbena sp.	0±0
Veronica peregrina L.	0±0
Xanthium strumarium	0±0
unknown Cyperaceae	0±0
unknown Juncaceae	0±0
unknown dicot	0±0
unknown monocot	0±0
unknown Poaceae	0±0
unknown woody	0±0

Appendix 5 (cont).

Species	*Eddelman29 (25)*
unknown composite	*0±0*
unknown fern	*0±0*
unknown	*0±0*
Total Seeds	1244.4±1217.7

Appendix 6. Seed banks (number of seeds m-2) of sites unfarmed and farmed for various lengths of time near the town of Cypress of the Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Cypress Site No. (time farmed)	
Species	Cypress52 0	Cypress51 10
Abutilon theophrasti Medikus	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0
Alopecurus carolinianus Walter	3.2±7.2	0±0
Amaranthus retroflexus L.	0±0	579.2±1295.1
Ambrosia artemisiifolia L.	0±0	0±0
Ammannia auriculata Willd.	0±0	0±0
Ammannia coccinea Rottb.	0±0	3.2±7.2
Andropogon virginicus L.	0±0	0±0
Bidens frondosa L.	0±0	0±0
Bidens cernua L.	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0
Brassica hirta Moench.	0±0	0±0
Cephalanthus occidentalis L.	3.2±7.2	0±0
Cyperus aristatus	0±0	0±0
Cyperus erythrorhizos Muhl.	128.0±58.8	3.2±7.2*
Cyperus ferruginescens	3.2±7.2	51.2±26.3
Cyperus iria L.	0±0	0±0
Cyperus pseudovegetus Steudel	0±0	3.2±7.2
Cyperus strigosus L.	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	332.8±247.5
Echinochloa crusgalli (L.) P. Beauv	0±0	409.6±184.0
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0
Eclipta prostrata (L.) L.	16.0±35.8	0±0
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0
Eleocharis obtusa	0±0	476.8±86.5*
Eragrotis hypnoides (Lam.) BSP.	0±0	0±0
Eragrotis reptans (Michx.) Nees	0±0	0±0
Erigeron philadephicus L.	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0
Galium tinctorium L.	0±0	0±0

Appendix 6 (cont.)

Species	Cypress52 0	Cypress51 10
Gratiola neglecta Torr.	0±0	35.2±34.7
Gratiola virginiana L.	1625.6±1733.1	16.0±27.7
Heteranthera limosa (Swartz) Willd.	0±0	0±0
Hypericum mutilum L.	3.2±7.2	3.2±7.2
Ipomoea lacunosa L.	0±0	0±0
Iva annua L.	0±0	0±0
Juncus bufonius L.	0±0	3.2±7.2
Juncus marginatus Rotsk.	0±0	128.0±63.0
Juncus tenuis	3.2±7.2	608.0±243.2
Krigia caespitosa	0±0	0±0
Leersia oryzoides (L.) Swartz	9.6±14.3	160.0±75.9*
Lindernia dubia (L.) Pennel.	188.0±68.3	0±0
Ludwigia decurrens (Jussiaea) Walter	22.4±50.1	0±0
Ludwigia polycarpa Short & Peter	144.0±115.9*	28.8±48.5
Mimulus alatus Aiton	0±0	0±0
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0
Muhlenbergia schrberi J. F. Gmelin	0±0	0±0
Oxalis stricta L.	0±0	0±0
Panicum dichotomiflorum Michx.	0±0	6.4±8.8*
Paspalum fluitans (Elliott) Kunth.	0±0	0±0
Penthorum sedoides L.	262.4±108.9	38.4±77.2
Pilea pumila (L.) A. Gray	9.6±21.5	0±0
Plantago virginica L.	6.4±14.3	0±0
Poa compressa L.	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0
Ranunculus abortivus L.	0±0	0±0
Ranunculus scleratus L.	0±0	0±0
Rorippa sessiflora	0±0	0±0
Senecio glabellus Poir.	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0
Typha latifolia L.	0±0	0±0
Verbena sp.	0±0	38.4±85.9
Veronica peregrina L.	0±0	0±0
Xanthium strumarium	0±0	0±0
unknown Cyperaceae	96.0±101.5	130.2±78.7
unknown Juncaceae	0±0	6.4±14.3
unknown dicot	476.8±594.9	0±0
unknown monocot	0±0	0±0
unknown Poaceae	435.2±548.1	886.4±1268.1
unknown woody	3.2±7.2	0±0
unknown composite	0±0	0±0
unknown fern	0±0	0±0
unknown	0±0	0±0
Total Seeds	3439.2±3508.7	5215.9±3915.4

Appendix 7. Seed banks (numbers of seeds m^{-2}) of sites unfarmed and farmed for various lengths of time near Section 8 Woods of the Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Section 8 Woods No. (time farmed)	
	Sect 8-58	Sect 8-57
Species	(0)	(15)
Abutilon theophrasti Medikus	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0
Alopecurus carolinianus Walter	0±0	0±0
Amaranthus retroflexus L.	0±0	0±0
Ambrosia artemisiifolia L.	0±0	0±0
Ammannia auriculata Willd.	0±0	105.6±60.5
Ammannia coccinea Rottb.	3.2±7.2*	121.6±73.8*
Andropogon virginicus L.	0±0	0±0
Bidens frondosa L.	0±0	0±0
Bidens cernua L.	0±0	0±0
Boehmeria cylindrica (L.) Swartz	70.4±57.2	3.2±7.2
Brassica hirta Moench.	0±0	0±0
Cephalanthus occidentalis L.	0±0	0±0
Cyperus aristatus	0±0	0±0
Cyperus erythrorhizos Muhl.	9.6±14.3	3.2±7.2
Cyperus ferruginescens	0±0	0±0
Cyperus iria L.	0±0	0±0
Cyperus pseudovegetus Steudel	0±0	0±0
Cyperus strigosus L.	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	0±0
Echinochloa crusgalli (L.) P. Beauv	32.0±49.3	0±0
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0
Eclipta prostrata (L.) L.	185.6±264.9	25.6±57.2
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0
Eleocharis obtusa	9.6±21.5	528.0±143.6
Eragrotis hypnoides (Lam.) BSP.	0±0	0±0
Eragrotis reptans (Michx.) Nees	0±0	0±0
Erigeron philadephicus L.	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0
Galium tinctorium L.	0±0	0±0

Appendix 7 (cont.)

Species	Sect 8-58 (0)	Sect 8-57 (15)
Gratiola neglecta Torr.	0±0	76.8±111.7
Gratiola virginiana L.	409.6±678.8	252.8±208.4
Heteranthera limosa (Swartz) Willd.	0±0	0±0
Hypericum mutilum L.	0±0	22.4±41.7
Ipomoea lacunosa L.	0±0	0±0
Iva annua L.	0±0	0±0
Juncus bufonius L.	0±0	0±0
Juncus marginatus Rotsk.	0±0	0±0
Juncus tenuis	0±0	57.6±24.3
Krigia caespitosa	0±0	0±0
Leersia oryzoides (L.) Swartz	16.0±22.6	3.2±7.2
Lindernia dubia (L.) Pennel.	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0
Ludwigia polycarpa Short & Peter	0±0	3.2±7.2*
Mimulus alatus Aiton	0±0	0±0
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0
Muhlenbergia schrberi J. F. Gmelin	0±0	0±0
Oxalis stricta L.	0±0	3.2±7.2
Panicum dichotomiflorum Michx.	0±0	6.4±8.8
Paspalum fluitans (Elliott) Kunth.	44.8±100.2	0±0
Penthorum sedoides L.	278.4±208.8	0±0
Pilea pumila (L.) A. Gray	0±0	0±0
Plantago virginica L.	0±0	0±0
Poa compressa L.	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0
Ranunculus abortivus L.	0±0	0±0
Ranunculus scleratus L.	0±0	0±0
Rorippa sessiflora	0±0	0±0
Senecio glabellus Poir.	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0
Typha latifolia L.	3.2±7.2	3.2±7.2
Verbena sp.	0±0	0±0
Veronica peregrina L.	0±0	108.6±76.2
Xanthium strumarium	0±0	0±0
unknown Cyperaceae	22.4±44.5	323.2±532.2
unknown Juncaceae	0±0	0±0
unknown dicot	3.2±7.2	0±0
unknown monocot	0±0	0±0
unknown Poaceae	169.1±286.6	160.0±127.5
unknown woody	0±0	0±0
unknown composite	3.2±7.2	0±0
unknown fern	0±0	0±0
unknown	0±0	0±0
Total Seeds	1260.3±1777.5	1807.8±1501.9

Appendix 8. Seed banks (numbers of seeds m^{-2}) of sites unfarmed and farmed for various lengths of time near Deer Pond, Upper Cache. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Deer Pond Site No. (time farmed)					
	Deer53	Deer59	Deer60	Deer63	Deer61	Deer62
Species	0	1	5	5	15	15
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0	0±0	0±0	0±0	0±0
Alopecurus carolinianus Walter	0±0	0±0	3.2±7.2	0±0	6.4±14.3*	3.2±7.2
Amaranthus retroflexus L.	0±0	0±0	3.2±7.2	0±0	3.2±7.2	0±0
Ambrosia artemisiifolia L.	0±0	0±0	0±0	0±0	0±0	0±0
Ammannia auriculata Willd.	0±0	35.2±41.4	54.4±33.2*	6.4±14.3*	0±0	48.0±40.8
Ammannia coccinea Rottb.	3.2±7.2*	22.4±31.2	51.2±44.4	249.6±70.3	9.6±8.8*	1382.4±710.9
Andropogon virginicus L.	0±0	0±0	0±0	0±0	0±0	0±0
Bidens frondosa L.	0±0	0±0	0±0	3.2±7.2	0±0	0±0
Bidens cernua L.	0±0	0±0	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	0±0	0±0	0±0
Brassica hirta Moench.	0±0	0±0	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	51.2±34.7	0±0	0±0	0±0	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0	0±0	0±0
Cyperus erythrorhizos Muhl.	28.8±20.9	89.6±53.8	3.2±7.2	3.2±7.2	3.2±7.2	3.2±7.2
Cyperus ferruginescens	0±0	25.6±57.2	0±0	3.2±7.2	3.2±7.2	32±7.2
Cyperus iria L.	0±0	0±0	0±0	0±0	0±0	0±0
Cyperus pseudovegetus Steudel	0±0	0±0	0±0	0±0	0±0	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	3.2±7.2	3.2±7.2	3.2±7.2	22.4±33.2	0±0	16.0±19.6
Echinochloa crusgalli (L.) P. Beauv	0±0	6.4±8.8	22.4±14.3	0±0	3.2±7.2*	6.4±8.8*
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0	0±0	0±0	0±0	0±0
Eclipta prostrata (L.) L.	6.4±14.3	12.8±20.9	38.4±53.8	12.8±13.4	16.0±22.6	89.6±57.2

Appendix 8 (cont.)

Species	Deer53 0	Deer59 1	Deer60 5	Deer63 5	Deer61 15	Deer62 15
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	57.6±128.8*	0±0	9.6±21.5*
Eleocharis obtusa	0±0	12.8±20.9	44.8±26.3*	406.4±135.1	6.4±8.8*	256.0±98.0
Eragrotis hypnoides (Lam.) BSP.	0±0	0±0	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	0±0	0±0	0±0	0±0	0±0	0±0
Erigeron philadephicus L.	0±0	0±0	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0	0±0	0±0
Galium tinctorium L.	0±0	0±0	3.2±7.2	3.2±7.2	6.4±14.3	16.0±16.0
Gratiola neglecta Torr.	3.2±7.2*	3.2±7.2*	19.2±28.6	281.6±93.7	252.8±79.5	790.4±200.0
Gratiola virginiana L.	848.0±1440.0	2032.0±1312.0	976.0±902.6	112.0±153.1	1052.8±2248.3	556.8±490.1
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0	0±0	0±0
Hypericum mutilum L	22.4±31.2	0±0	28.8±28.6	444.8±390.4	25.6±31.2	54.4±55.0
Ipomoea lacunosa L.	0±0	0±0	0±0	0±0	0±0	0±0
Iva annua L.	0±0	0±0	0±0	0±0	0±0	0±0
Juncus bufonius L.	12.8±28.6	3.2±7.2	0±0	0±0	0±0	0±0
Juncus marginatus Rotsk.	0±0	0±0	3.2±7.2	28.8±20.9	128.0±58.8	0±0
Juncus tenuis	0±0	6.4±14.3	179.2±77.9	540.8±102.7	492.8±170.2	236.8±38.2
Krigia caespitosa	0±0	0±0	0±0	0±0	0±0	0±0
Leersia oryzoides (L.) Swartz	6.4±8.8	0±0	28.8±64.4*	0±0	0±0	0±0
Lindernia dubia (L.) Pennel.	0±0	0±0	0±0	0±0	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short & Peter	131.2±66.4	0±0	9.6±21.5	64.0±40.8*	0±0	41.6±93.0
Mimulus alatus Aiton	0±0	0±0	0±0	0±0	0±0	0±0

Appendix 8 (cont.)

Species	Deer53 0	Deer59 1	Deer60 5	Deer63 5	Deer61 15	Deer62 15
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0	0±0	0±0
Muhlenbergia schrberi J. F. Gmelin	0±0	0±0	0±0	0±0	0±0	0±0
Oxalis stricta L.	0±0	0±0	0±0	3.2±7.2	12.8±20.9	12.8±20.9
Panicum dichotomiflorum Michx.	0±0	3.2±7.2	12.8±13.4	6.4±8.8	22.4±18.2	6.4±8.8*
Paspalum fluitans (Elliott) Kunth.	12.8±28.6	0±0	198.4±443.6	0±0	0±0	0±0
Penthorum sedoides L.	12.8±20.9	0±0	96.0±67.9	32.0±29.9	0±0	3.2±7.2
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	0±0	0±0	0±0
Plantago virginica L.	0±0	0±0	6.4±14.3	0±0	0±0	0±0
Poa compressa L.	0±0	0±0	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0	0±0	0±0	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0	0±0	0±0	0±0	0±0
Ranunculus abortivus L.	0±0	0±0	0±0	0±0	0±0	0±0
Ranunculus scleratus L.	0±0	0±0	0±0	0±0	0±0	0±0
Rorippa sessiflora	0±0	0±0	6.4±14.3	0±0	0±0	9.6±14.3
Senecio glabellus Poir.	0±0	0±0	0±0	0±0	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0	0±0	0±0
Typha latifolia L.	3.2±7.2	0±0	0±0	0±0	0±0	3.2±7.2*
Verbena sp.	0±0	0±0	0±0	0±0	0±0	3.2±7.2
Veronica peregrina L.	0±0	0±0	3.2±7.2	3.2±7.2	144.0±131.9	19.2±17.5
Xanthium strumarium	0±0	0±0	6.4±14.3	0±0	0±0	0±0
unknown Cyperaceae	6.4±14.3	16.1±35.9	172.8±121.4	51.2±47.2	32.0±25.2	96.0±84.4
unknown Juncaceae	0±0	0±0	3.2±7.2	0±0	0±0	0±0
unknown dicot	3.2±7.2	89.6±207.5	16.0±35.8	0±0	0±0	0±0
unknown monocot	0±0	0±0	0±0	0±0	0±0	0±0
unknown Poaceae	44.8±54.46	134.4±107.0	236.4±336.7	217.6±171.8	260.4±472.2	201.6±356.3
unknown woody	0±0	0±0	0±0	0±0	0±0	0±0
unknown composite	9.6±21.5	3.2±7.2	0±0	44.8±72.6	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0	0±0	0±0
Total Seeds	1209.6±1812.6	2499.3±1946.9	2230.0±2414.9	2598.4±1570.2	2481.2±3354.0	3868.8±1621.2

Appendix 9. Seed banks (numbers of seeds m^{-2}) of sites unfarmed and farmed for various lengths of time near Horseshoe Lake of the Cache River Region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Horseshoe Lake Site No. (time farmed)			
	Horse72	Horse73	Horse75	Horse76
Species	0	25	25	25
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0	3.2±7.2	0±0
Alopecurus carolinianus Walter	0±0	6.4±8.8	0±0	6.4±8.8
Amaranthus retroflexus L.	0±0	0±0	236.8±41.1	35.2±39.8
Ambrosia artemisiifolia L.	0±0	0±0	0±0	0±0
Ammannia auriculata Willd.	0±0	3.2±7.2*	25.6±24.3	76.8±111.6
Ammannia coccinea Rottb.	25.6±48.8*	3.2±7.2	112.0±37.5	185.6±147.8
Andropogon virginicus L.	0±0	0±0	0±0	0±0
Bidens frondosa L.	0±0	0±0	0±0	0±0
Bidens cernua L.	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	0±0	0±0	0±0	0±0
Brassica hirta Moench.	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	3.2±7.2	0±0	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0
Cyperus erythrorhizos Muhl.	0±0	3.2±7.2	6.4±14.3	137.6±298.8
Cyperus ferruginescens	0±0	0±0	0±0	0±0
Cyperus iria L.	0±0	0±0	0±0	0±0
Cyperus pseudovegetus Steudel	0±0	0±0	6.4±14.3	6.4±14.3
Cyperus strigosus L.	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	0±0	3.2±7.2*	0±0
Echinochloa crusgalli (L.) P. Beauv	19.2±42.9	16.0±35.8	16.0±16.0	0±0
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0	0±0	0±0
Eclipta prostrata (L.) L.	0±0	35.2±51.1	96.0±51.8	131.2±99.5

Appendix 9 (cont.)

Species	Horse72 0	Horse73 25	Horse75 25	Horse76 25
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0
Eleocharis obtusa	3.2±7.2	6.4±8.8*	6.4±14.3	3.2±7.2
Eragrotis hypnoides (Lam.) BSP.	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	0±0	0±0	0±0	0±0
Erigeron philadephicus L.	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	3.2±7.2
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0
Galium tinctorium L.	0±0	0±0	0±0	3.2±7.2
Gratiola neglecta Torr.	0±0	3.2±7.2	12.8±28.6	44.8±100.2
Gratiola virginiana L.	316.8±308.7	803.2±804.5	1587.2±689.3	604.8±647.5
Heteranthera limosa (Swartz) Willd.	0±0	0±0	0±0	0±0
Hypericum mutilum L.	6.4±14.3	6.4±14.3	0±0	6.4±14.3
Ipomoea lacunosa L.	0±0	0±0	0±0	0±0
Iva annua L.	0±0	0±0	0±0	0±0
Juncus bufonius L.	6.4±14.3	0±0	0±0	0±0
Juncus marginatus Rotsk.	0±0	0±0	0±0	0±0
Juncus tenuis	*3.2±7.2*	*0±0*	*0±0*	*22.4±14.3*
Krigia caespitosa	*0±0*	*0±0*	*0±0*	*0±0*
Leersia oryzoides (L.) Swartz	6.4±14.3	0±0	35.2±48.5	67.2±124.1
Lindernia dubia (L.) Pennel.	185.6±220.4	0±0	0±0	12.8±28.6
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short & Peter	3.2±7.2*	0±0	0±0	0±0
Mimulus alatus Aiton	0±0	0±0	0±0	0±0
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0

Appendix 9 (cont.)

Species	Horse72 0	Horse73 25	Horse75 25	Horse76 25
Muhlenbergia schrberi J. F. Gmelin	0±0	0±0	0±0	0±0
Oxalis stricta L.	0±0	0±0	6.4±14.3	3.2±7.2
Panicum dichotomiflorum Michx.	0±0	0±0	6.4±8.8	3.2±7.2
Paspalum fluitans (Elliott) Kunth.	198.4±443.6	0±0	3.2±7.2	233.6±470.5
Penthorum sedoides L.	406.4±465.5	0±0	16.0±35.8	0±0
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	0±0
Plantago virginica L.	0±0	0±0	0±0	0±0
Poa compressa L.	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0	0±0	0±0
Ranunculus abortivus L.	0±0	0±0	0±0	0±0
Ranunculus scleratus L.	0±0	0±0	0±0	0±0
Rorippa sessiflora	0±0	3.2±7.2	92.8±198.7	3.2±7.2
Senecio glabellus Poir.	0±0	0±0	0±0	3.2±7.2
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0
Typha latifolia L.	6.4±14.3*	9.6±14.3	28.8±30.8	12.8±20.9
Verbena sp.	0±0	0±0	0±0	0±0
Veronica peregrina L.	0±0	48.0±39.2	0±0	512.0±291.8
Xanthium strumarium	0±0	0±0	6.4±8.8	0±0
unknown Cyperaceae	80.0±120.8	102.4±203.3	63.0±121.9	70.4±140.8
unknown Juncaceae	0±0	0±0	0±0	0±0
unknown dicot	19.2±43.0	3.2±7.2	3.2±7.2	0±0
uknown monocot	0±0	0±0	0±0	3.2±7.2
unknown Poaceae	300.8±315.0	496.0±949.1	361.6±289.8	188.8±155.7
unknown woody	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0
unknown fern	0±0	0±0	0±0	0±0
unknown	0±0	0±0	0±0	0±0
Total Seeds	1590.4±2094.7	1548.8±2106.2	2735.0±1717.7	2368.0±2786.9

Appendix 10. Seed banks (number of seeds m^{-2}) of sites unfarmed and farmed for various lengths of time near Mounds of the Cache River region. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Mounds Site No. (time farmed)			
Species	Mounds77 (0)	Mounds78 (13)	Mounds79 (13)	Mounds80 (13)
Abutilon theophrasti Medikus	0±0	0±0	0±0	0±0
Agrostis perennans (Walter) Tuckerman	0±0	0±0	0±0	0±0
Alopecurus carolinianus Walter	0±0	3.2±7.2	0±0	128.0±60.9
Amaranthus retroflexus L.	3.2±7.2	0±0	0±0	0±0
Ambrosia artemisiifolia L.	0±0	0±0	0±0	0±0
Ammannia auriculata Willd.	51.2±114.5*	0±0	6.4±14.3*	12.8±28.6*
Ammannia coccinea Rottb.	166.4±372.1	9.6±8.8*	32.0±29.9*	41.6±38.5
Andropogon virginicus L.	0±0	0±0	0±0	0±0
Bidens frondosa L.	0±0	0±0	0±0	0±0
Bidens cernua L.	0±0	0±0	0±0	0±0
Boehmeria cylindrica (L.) Swartz	6.4±14.3	0±0	0±0	0±0
Brassica hirta Moench.	0±0	0±0	0±0	0±0
Cephalanthus occidentalis L.	0±0	0±0	0±0	0±0
Cyperus aristatus	0±0	0±0	0±0	0±0
Cyperus erythrorhizos Muhl.	70.4±35.1	0±0	0±0	3.2±7.2
Cyperus ferruginescens	0±0	0±0	0±0	6.4±14.3
Cyperus iria L.	0±0	0±0	0±0	0±0
Cyperus pseudovegetus Steudel	0±0	0±0	0±0	0±0
Cyperus strigosus L.	0±0	0±0	0±0	0±0
Digitaria ischaemun (Schreber) Muhl	0±0	0±0	0±0	0±0
Digitaria sanguinalis (L.) Scop.	0±0	0±0	0±0	0±0
Echinochloa crusgalli (L.) P. Beauv	60.8±110.0	112.0±197.6	92.8±92.2	28.8±32.8.
Echinochloa muricata (P. Beauv.) Fern.	0±0	0±0	0±0	0±0
Eclipta prostrata (L.) L.	131.2±99.5	3.2±7.2	0±0	16.0±11.3

Appendix 10 (cont.)

Species	Mounds77 (0)	Mounds78 (13)	Mounds79 (13)	Mounds80 (13)
Elatine minima (Nutt.) Fischer & C. A. Meyer	0±0	0±0	0±0	0±0
Elatine triandra Schkuhr.	0±0	0±0	0±0	0±0
Eleocharis acicularis (L.) Roemer & Schultes	0±0	0±0	0±0	0±0
Eleocharis obtusa	0±0	0±0	0±0	35.2±32.8
Eragrotis hypnoides (Lam.) BSP.	0±0	0±0	0±0	0±0
Eragrotis reptans (Michx.) Nees	0±0	0±0	0±0	0±0
Erigeron philadephicus L.	0±0	0±0	0±0	0±0
Eupatorium fistulusum Barratt.	0±0	0±0	0±0	0±0
Euphorbia marginata Pursh.	0±0	0±0	0±0	0±0
Fimbristylis autumnalis (L.) Roemer & Schultes	0±0	0±0	0±0	22.4±26.8
Galium tinctorium L.	0±0	0±0	0±0	0±0
Gratiola neglecta Torr.	3.2±7.2	25.6±57.2	3.2±7.2*	16.0±27.7
Gratiola virginiana L.	2384.0±3246.6	1552.0±3319.6	92.8±113.3	419.2±363.5
Heteranthera limosa (Swartz) Willd.	0±0	12.8±20.9	0±0	0±0
Hypericum mutilum L.	0±0	0±0	3.2±7.2	76.8±105.8
Ipomoea lacunosa L.	6.4±8.8	0±0	0±0	0±0
Iva annua L.	0±0	0±0	0±0	0±0
Juncus bufonius L.	0±0	19.2±42.9	0±0	0±0
Juncus marginatus Rotsk.	0±0	0±0	0±0	0±0
Juncus tenuis	0±0	0±0	0±0	0±0
Krigia caespitosa	0±0	0±0	0±0	0±0
Leersia oryzoides (L.) Swartz	25.6±57.2	6.4±8.8	28.8±55.9	67.2±80.3*
Lindernia dubia (L.) Pennel.	0±0	28.8±64.4	0±0	0±0
Ludwigia decurrens (Jussiaea) Walter	0±0	0±0	0±0	0±0
Ludwigia polycarpa Short & Peter	3.2±7.2	3.2±7.2*	0±0	12.8±20.9
Mimulus alatus Aiton	0±0	0±0	0±0	0±0
Muhlenbergia frondosa (Poiret) Fern.	0±0	0±0	0±0	0±0

Appendix 10 (cont.)

Species	Mounds77 (0)	Mounds78 (13)	Mounds79 (13)	Mounds80 (13)
Muhlenbergia schreberi J. F. Gmelin	0±0	0±0	0±0	0±0
Oxalis stricta L.	9.6±21.5	6.4±8.8	3.2±7.2	12.8±13.4
Panicum dichotomiflorum Michx.	6.4±8.8	3.2±7.2	0±0	3.2±7.2
Paspalum fluitans (Elliott) Kunth.	25.6±48.8	0±0	0±0	166.4±372.1
Penthorum sedoides L.	28.8±48.5	0±0	0±0	0±0
Pilea pumila (L.) A. Gray	0±0	0±0	0±0	0±0
Plantago virginica L.	0±0	0±0	0±0	0±0
Poa compressa L.	0±0	0±0	0±0	0±0
Polygonum pensylvanicum L.	0±0	0±0	0±0	0±0
Polygonum punctatum Elliott.	0±0	0±0	0±0	9.6±21.5
Ranunculus abortivus L.	0±0	0±0	0±0	0±0
Ranunculus scleratus L.	0±0	0±0	0±0	0±0
Rorippa sessiflora	6.4±8.8	3.2±7.2	0±0	0±0
Senecio glabellus Poir.	0±0	0±0	0±0	0±0
Setaria faberi R. Herrm.	0±0	0±0	0±0	0±0
Typha latifolia L.	16.0±27.7	3.2±7.2*	3.2±7.2*	12.8±28.6*
Verbena sp.	0±0	0±0	0±0	0±0
Veronica peregrina L.	1100.8±2416.9	192.0±68.8	0±0	54.4±67.5
Xanthium strumarium	0±0	0±0	0±0	0±0
unknown Cyperaceae	25.6±24.3	89.0±192.5	12.8±13.4	188.8±372.0
unknown Juncaceae	0±0	0±0	0±0	0±0
unknown dicot	16.0±28.6	3.2±7.2	0±0	0±0
unknown monocot	0±0	6.4±14.3	0±0	0±0
unknown Poaceae	345.0±588.3	115.2±242.6	121.6±57.2	2077.6±4074.4
unknown woody	0±0	0±0	0±0	0±0
unknown composite	0±0	0±0	0±0	0±0
unknown fern	0±0	0±0	112.0±114.8	0±0
unknown	0±0	0±0	0±0	0±0
Total Seeds	4490.4±7301.9	2197.8±4297.6	512.0±519.8	3412.0±5807.7

Appendix 11. Seed banks at elevations at three sites including the Crawford Tract, east and west of the former town of Rago along the Cache River, southern Illinois. The elevations of the soil collection sites for the seed bank study correspond to the elevations of the seed traps in the seed dispersal study. An "*" indicates that the highest number of seeds germinated in the flooded treatment.

	Elevation (meters above sea level)					
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Acalypha rhomboidea						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2*	0.0	0.0
Rago West	0.0	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Acer saccharum						
Owl Pond	3.2 ± 7.2	0.0	0.0	0.0	3.2 ± 7.2	0.0
Rago West	3.2 ± 7.2	0.0	6.4 ± 8.8	0.0	0.0	0.0
Rago East	0.0	6.4 ± 14.3	0.0	0.0	3.2 ± 7.2	0.0
Agrostis perennans						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
RagoWest	0.0	0.0	22.4 ± 31.2	9.6 ± 14.3	3.2 ± 7.2	0.0
Rago East	0.0	35.2 ± 55.9*	28.8 ± 55.9	0.0	12.8 ± 28.6	0.0
Alopecurus carolinianus						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2	0.0	0.0
Rago West	0.0	3.2 ± 7.2	25.6 ± 14.3	54.4 ± 86.6	6.4 ± 8.8	0.0
Rago East	6.4 ± 8.8*	19.2 ± 26.3	144.0 ± 54.3	64.0 ± 54.3	83.2 ± 23.7	0.0
Amaranthus retroflexus						
Owl Pond	3.2 ± 7.2	0.0	3.2 ± 7.2*	0.0	0.0	0.0
Rago West	0.0	32.0 ± 48.3	16.0 ± 22.6	0.0	0.0	0.0
Rago East	3.2 ± 7.2	12.8 ± 13.4	230.4 ± 81.9	3.2 ± 7.2	0.0	0.0
Ambrosia artemisiifola						
Owl Pond	0.0	0.0	0.0	6.4 ± 8.8	3.2 ± 7.2	0.0
Rago West	0.0	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago East	0.0	3.2 ± 7.2	0.0	0.0	0.0	0.0

	Elevation (meters above sea level)					
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Ammannia coccinea						
Owl Pond	6.4 ± 14.3	0.0	3.2 ± 7.2	19.2 ± 42.9	9.6 ± 14.3*	6.4 ± 14.3
Rago West	0.0	9.6 ± 14.3	6.4 ± 14.3*	3.2 ± 7.2	0.0	0.0
Rago East	3.2 ± 7.2	3.2 ± 7.2	12.8 ± 13.4	19.2 ± 26.3*	44.8 ± 61.3*	0.0
Ammannia auriculata						
Owl Pond	0.0	0.0	0.0	6.4 ± 14.3*	0.0	0.0
Rago West	0.0	0.0	9.6 ± 21.5*	3.2 ± 7.2*	0.0	3.2 ± 7.2*
Rago East	3.2 ± 7.2*	0.0	3.2 ± 7.2*	3.2 ± 7.2*	3.2 ± 7.2*	0.0
Ammannia sp.						
Owl Pond	0.0	0.0	6.4 ± 8.8	6.4 ± 14.3	6.4 ± 14.3*	0.0
Rago West	3.2 ± 7.2*	16.0 ± 22.6	9.6 ± 21.5*	3.2 ± 7.2*	3.2 ± 7.2*	3.2 ± 7.2*
Rago East	0.0	12.8 ± 20.7*	12.8 ± 17.5*	0.0	12.8 ± 20.7*	0.0
Aster sp.						
Owl Pond	0.0	70.4 ± 157.4	12.8 ± 28.6	3.2 ± 7.2	0.0	0.0
Rago West	12.8 ± 28.6	32.0 ± 45.3	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	9.6 ± 14.3	0.0	0.0	0.0	0.0
Avena sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	19.2 ± 42.9
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Bidens frondosa						
Owl Pond	0.0	0.0	3.2 ± 7.2	3.2 ± 7.2*	0.0	0.0
Rago West	3.2 ± 7.2	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	6.4 ± 14.3*	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Boehmeria cylindrica						
Owl Pond	6.4 ± 14.3	0.0	0.0	16.0 ± 11.3	0.0	0.0
Rago West	25.6 ± 40.2	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago East	0.0	3.2 ± 7.2	0.0	9.6 ± 21.5	3.2 ± 7.2	0.0
Brassica hirta						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	3.2 ± 7.2	0.0	0.0	0.0	6.4 ± 8.8
Callitriche terrestris						
Owl Pond	0.0	0.0	0.0	0.0	0.0	3.2 ± 7.2
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Carex sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	19.2 ± 34.7	0.0	0.0	0.0	0.0	0.0
Rago East	3.2 ± 7.2	0.0	0.0	0.0	0.0	0.0
Cassia fascilulata						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	6.4 ± 14.3	0.0	0.0	0.0	0.0	0.0
Cephalanthus occidentalis						
Owl Pond	12.8 ± 28.6*	9.6 ± 8.8	6.4 ± 8.8	6.4 ± 8.8	0.0	0.0
Rago West	19.2 ± 26.3	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	12.8 ± 13.4	0.0	0.0
Cerastium nutans						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	19.2 ± 23.2	0.0	6.4 ± 14.4	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	3.2 ± 7.2

	Elevation (meters above sea level)					
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Chamaesyce supina						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	19.2 ± 29.7	0.0	0.0	0.0	0.0
Conyza canadensis						
Owl Pond	0.0	0.0	3.2 ± 7.2	12.8 ± 20.9	0.0	6.4 ± 14.3
Rago West	0.0	0.0	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	3.2 ± 7.2	0.0	44.8 ± 49.8	28.8 ± 23.7	3.2 ± 7.2
Convolvulus sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	3.2 ± 7.2	0.0	0.0	0.0
Cyperus sp.						
Owl Pond	19.2 ± 43.0	0.0	0.0	0.0	3.2 ± 7.2*	0.0
Rago West	0.0	0.0	0.0	0.0	3.2 ± 7.2*	0.0
Rago East	12.8 ± 28.6	9.6 ± 21.5	19.2 ± 42.9	3.2 ± 7.2	0.0	0.0
Cyperus iria						
Owl Pond	3.2 ± 7.2	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Cyperus ferruginescens						
Owl Pond	57.6 ± 77.2	54.4 ± 52.6	67.2 ± 58.1	108.8 ± 217.4	6.4 ± 14.3	6.4 ± 8.8
Rago West	44.8 ± 54.7	48.0 ± 66.0	6.4 ± 8.8	3.2 ± 7.2	0.0	0.0
Rago East	89.6 ± 50.1	108.8 ± 93.6	12.8 ± 17.5	22.4 ± 14.3	12.8 ± 20.9	0.0

	Elevation (meters above sea level)					
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Cyperus esculentus						
Owl Pond	0.0	0.0	6.4 ± 14.3*	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	3.2 ± 7.2*	0.0	0.0	0.0
Cyperus erythrorhizos						
Owl Pond	486.4 ± 305.8	124.8 ± 105.8	112.0 ± 112.6	147.2 ± 77.9	156.8 ± 106.4	16.0 ± 19.6
Rago West	150.4 ± 150.3	144.0 ± 71.6	51.2 ± 57.0	6.4 ± 14.3	6.4 ± 14.3	0.0
Rago East	73.6 ± 46.1	185.6 ± 119.0	48.0 ± 40.8	76.8 ± 34.7	28.8 ± 13.4	3.2 ± 7.2
Digitaria sanguinalis						
Owl Pond	0.0	0.0	0.0	0.0	6.4 ± 14.3	3.2 ± 7.2*
Rago West	0.0	0.0	6.4 ± 14.3	0.0	0.0	0.0
Rago East	9.6 ± 21.5*	6.4 ± 14.3*	3.2 ± 7.2	3.2 ± 7.2*	0.0	0.0
Digitaria Ischaemum						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2*	73.6 ± 107.5	9.6 ± 14.3
Rago West	0.0	3.2 ± 7.2	0.0	0.0	0.0	6.4 ± 14.3
Rago East	0.0	3.2 ± 7.2	6.4 ± 8.7	22.4 ± 50.1	0.0	0.0
Echinochloa crusgalli						
Owl Pond	6.4 ± 14.3	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	6.4 ± 8.8
Rago East	0.0	0.0	6.4 ± 14.3	3.2 ± 7.2	9.6 ± 14.3	3.2 ± 7.2
Echinochloa muricata						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	3.2 ± 7.2	54.4 ± 121.6	0.0	3.2 ± 7.2	0.0
Rago East	0.0	28.8 ± 55.9	0.0	0.0	0.0	9.6 ± 14.3
Echinochloa sp.						
Owl Pond	6.4 ± 8.8	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago East	6.4 ± 14.3	41.6 ± 57.2	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Eclipta prostrata						
Owl Pond	0.0	12.8 ± 28.6	6.4 ± 8.8	25.6 ± 35.1	19.2 ± 26.3*	3.2 ± 7.2
Rago East	0.0	6.4 ± 14.3	0.0	6.4 ± 8.8	0.0	0.0
Rago West	12.8 ± 20.1	156.8 ± 86.5	28.8 ± 26.3	12.8 ± 13.4*	38.4 ± 29.1	3.2 ± 7.2
Eleocharis obtusa						
Owl Pond	0.0	0.0	0.0	0.0	3.2 ± 7.2	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	3.2 ± 7.2	0.0	0.0	0.0	0.0	0.0
Elymus sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	6.4 ± 14.3	0.0	0.0	544.0 ± 141.8	271.0 ± 127.5	179.2 ± 170.1
Rago East	9.6 ± 21.5	0.0	0.0	0.0	0.0	12.8 ± 28.6
Equisetum sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	3.2 ± 7.2
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Eragrostis hypnoides						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	182.4 ± 407.9	128.0 ± 286.2	0.0	0.0	0.0	0.0
Eragrostis poaeoides.						
Owl Pond	3.2 ± 7.2*	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago West	6.4 ± 14.3	12.8 ± 28.6	0.0	0.0	0.0	3.2 ± 7.2
Rago East	579.2 ± 440.2	342.4 ± 338.0	12.8 ± 20.7	6.4 ± 14.3*	0.0	0.0
Erigeron philadelphicus						
Owl Pond	0.0	0.0	0.0	0.0	0.0	9.6 ± 8.6
Rago West	0.0	3.2	0.0	0.0	0.0	9.6 ± 14.3
Rago East	25.6 ± 57.2	89.6 ± 200.4	51.2 ± 28.6	0.0	0.0	64.0 ± 70.7

Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
			Elevation (meters above sea level)			
Euphorbia maculata						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	6.4 ± 8.8	6.4 ± 14.3	0.0	6.4 ± 14.3	0.0
RagoEast	0.0	9.6 ± 14.3	0.0	0.0	3.2 ± 7.2	0.0
Euphorbia hexagona						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	32.0 ± 71.6	0.0	0.0	6.4 ± 14.3	0.0
Rago East	0.0	16.0 ± 35.8	0.0	0.0	3.2 ± 7.2	0.0
Euphorbia obtusata						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	9.6 ± 21.5	6.4 ± 14.3	0.0	0.0	0.0
Rago East	0.0	6.4 ± 14.3	0.0	0.0	0.0	0.0
Festuca sp.						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2	25.6 ± 14.3*	73.6 ± 79.7
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Fimbristylis autumnalis						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	3.2 ± 7.2	3.2 ± 7.2	0.0
Gratiola sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Gratiola virginana						
Owl Pond	0.0	672.0 ± 962.7	176.0 ± 393.5	0.0	0.0	0.0
Rago West	2.8 ± 64.4	3.2 ± 7.2	0.0	12.8 ± 28.6	19.2 ± 42.9	0.0
Rago East	646.4 ± 1383.1	102.4 ± 220.1	176.0 ± 317.6	275.2 ± 606.46	3.2 ± 7.16	6.4 ± 14.3
Gratiola neglecta						
Owl Pond	0.0	0.0	0.0	0.0	9.6 ± 21.5*	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	70.4 ± 157.4	0.0
Heliotropum indicum						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	6.4 ± 14.4	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Heteranthera dubia						
Owl Pond	0.0	0.0	0.0	0.0	3.2 ± 7.2	0.0
Rago West	0.0	6.4 ± 14.4	16.0 ± 27.7	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	3.2 ± 7.2	0.0	0.0
Hypericum multilum						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2	0.0	0.0
Rago West	3.2 ± 7.2	0.0	0.0	0.0	0.0	25.6 ± 57.2
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Ipomoea sp.						
Owl Pond	0.0	0.0	0.0	6.4 ± 8.8*	6.4 ± 14.4	3.2 ± 7.2
Rago West	0.0	9.6 ± 14.3	0.0	0.0	0.0	0.0
Rago East	0.0	3.2 ± 7.2	0.0	0.0	0.0	0.0

	Elevation (meters above sea level)					
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Juncus tenuis						
Owl Pond	0.0	128.0 ± 285.2	281.6 ± 186.8	384.0 ± 270.6	105.6 ± 78.1	201.6 ± 335.4
Rago West	3.2 ± 7.2	0.0	0.0	6.4 ± 8.8	3.2 ± 7.2	0.0
Rago East	0.0	0.0	3.2 ± 7.2	0.0	3.2 ± 7.2	3.2 ± 7.2
Krigia oppositifolia						
Owl Pond	0.0	0.0	0.0	0.0	12.8 ± 20.9	0.0
Rago West	0.0	0.0	0.0	3.2 ± 7.2	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	16.0 ± 28.1	0.0
Leersia virginica						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	32.0 ± 43.8	0.0	0.0	0.0	0.0
Rago East	0.0	28.8 ± 64.4	0.0	0.0	0.0	0.0
Leersia oryziodes						
Owl Pond	44.8 ± 70.1	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	6.4 ± 14.3*	0.0	19.2 ± 42.9	0.0	0.0
Rago East	96.0 ± 64.0	32.0 ± 71.6*	0.0	0.0	0.0	0.0
Leersia sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	51.2 ± 65.4	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Leptochloa panicoides						
Owl Pond	0.0	0.0	0.0	0.0	19.2 ± 42.9*	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	3.2 ± 7.2*	163.2 ± 154.5	0.0	44.8 ± 65.4	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Leptochloa filliformis						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	3.2 ± 7.2	16.0 ± 35.8	0.0	6.4 ± 8.8	32.0 ± 32.0
Rago East	0.0	16.0 ± 35.8*	12.8 ± 17.5	60.8 ± 65.4	12.8 ± 13.4	0.0
Ludwigia decurrens						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	6.4 ± 8.8	3.2 ± 7.2	3.2 ± 7.2	3.2 ± 7.2*	0.0	0.0
Ludwigia palustris						
Owl Pond	3.2 ± 7.2	9.6 ± 21.5	3.2 ± 7.2	16.0 ± 22.6*	3.2 ± 7.2	0.0
Rago West	0.0	3.2 ± 7.2	0.0	0.0	0.0	0.0
Rago East	0.0	3.2 ± 7.2	0.0	3.2 ± 7.2	3.2 ± 7.2	0.0
Ludwigia polycarpa						
Owl Pond	0.0	35.2 ± 53.5	57.6 ± 79.7	25.6 ± 40.2	0.0	0.0
Rago West	3.2 ± 7.2	3.2 ± 7.2	3.2 ± 7.2*	0.0	0.0	0.0
Rago East	3.2 ± 7.2	0.0	0.0	3.2 ± 7.2	0.0	0.0
Ludwigia sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	6.4 ± 14.3	0.0	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Melilotus alba						
Owl Pond	0.0	0.0	9.6 ± 21.5	0.0	0.0	22.4 ± 18.2
Rago West	0.0	0.0	0.0	3.2 ± 7.2	16.0 ± 11.3	6.4 ± 14.3
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Mimulus alatus						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	3.2 ± 7.2	3.2 ± 7.2	0.0
Rago East	3.2 ± 7.2*	0.0	0.0	0.0	0.0	0.0
Mollugo verticellata						
Owl Pond	0.0	0.0	3.2 ± 7.2	3.2 ± 7.2	22.4 ± 35.1	48.0 ± 53.1
Rago West	0.0	22.4 ± 31.2	3.2 ± 7.2	3.2 ± 7.2	0.0	0.0
Rago East	147.2 ± 329.1	3.2 ± 7.2	3.2 ± 7.2	0.0	3.2 ± 7.2	0.0
Muhlenbergia frondosa						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	6.4 ± 14.3*	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Muhlenbergia shreberi						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	19.2 ± 42.9
Myosurus minimus						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	16.0 ± 19.6	3.2 ± 7.2	0.0	0.0
Rago East	0.0	0.0	0.0	12.8 ± 28.6	0.0	19.2 ± 42.9

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Oenothera fructicosa						
Owl Pond	0.0	0.0	0.0	3.2± 7.2	0.0	0.0
Rago West	0.0	0.0	3.2±7.2	0.0	0.0	0.0
Rago East	0.0	0.0	6.4±3.2	9.6±21.5	0.0	0.0
Oxalis stricta						
Owl Pond	0.0	0.0	28.8±64.4	9.6±14.3	6.4±14.3	0.0
Rago West	6.4±14.3	28.8±20.86	25.6±41.72	19.2±34.7	6.4± 8.8	70.4±124.8
Rago East	6.4±14.3	9.6± 8.8	25.6±40.2	3.2± 7.2	57.6±58.4	22.4± 26.8
Panicum sp.						
Owl Pond	9.6±21.5	0.0	0.0	0.0	44.8±57.0	6.4±8.8
Rago West	6.4±14.3	19.2±26.3	0.0	0.0	0.0	6.4±8.8
Rago East	3.2± 7.2	67.2±60.3	12.8±13.4	22.4±18.2	3.2± 7.2	0.0
Panicum dichotomiflorum						
Owl Pond	0.0	0.0	9.6±21.5	3.2± 7.2*	6.4±14.3*	3.2±7.2*
Rago West	6.4±14.3	6.4± 8.8*	0.0	0.0	0.0	3.2±7.2*
Rago East	0.0	76.8±162.9*	9.6±21.5*	19.2±42.9*	6.4± 8.8	0.0
Panicum capillare						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	3.2±7.2	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Paspalum fluitans						
Owl Pond	0.0	6.4±14.3*	6.4±14.3	96.0±214.7	0.0	0.0
Rago West	6.4±14.3	0.0	0.0	48.0±107.3	0.0	0.0
Rago East	6.4±14.3	0.0	0.0	64.0±143.1	0.0	0.0
Penthorum sedoides						
Owl Pond	9.6±14.4	9.6±14.3	35.2±36.5	35.2±70.1	25.6±41.7	0.0
Rago West	48.0±63.0	41.6±84.4	0.0	0.0	0.0	6.4±14.3
Rago East	0.0	3.2± 7.2*	0.0	0.0	0.0	12.8±28.6

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Phyla nodiflora						
Owl Pond	0.0	0.0	0.0	0.0	3.2 ± 7.2	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	6.4 ± 14.3	0.0	0.0	0.0	0.0	0.0
Platanus occidentalis						
Owl Pond	0.0	0.0	3.2 ± 7.2	9.6 ± 21.5	0.0	0.0
Rago West	12.8 ± 13.4	3.2 ± 7.2	0.0	3.2 ± 7.2	6.4 ± 14.3	6.4 ± 14.3
Rago East	3.2 ± 7.2	9.6 ± 14.3	3.2 ± 7.2	16.0 ± 22.6	3.2 ± 7.2	0.0
Poa sp.						
Owl Pond	0.0	0.0	0.0	0.0	25.6 ± 57.2	0.0
Rago West	0.0	0.0	9.6 ± 14.3	0.0	0.0	0.0
Rago East	51.2 ± 14.5*	0.0	0.0	0.0	0.0	0.0
Polygonatm bifloratum						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	25.6 ± 57.2	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Polygonum pensylvanicum						
Owl Pond	19.2 ± 42.9	0.0	28.8 ± 64.4	0.0	0.0	0.0
Rago West	0.0	0.0	102.4 ± 114.6	12.8 ± 13.4	0.0	0.0
Rago East	3.2 ± 7.2	6.4 ± 8.8	41.6 ± 33.2	121.6 ± 93.7	73.6 ± 53.8	70.4 ± 47.5
Polygonum sp.						
Owl Pond	3.2 ± 7.2	0.0	0.0	0.0	0.0	0.0
Rago West	3.2 ± 7.2*	0.0	121.6 ± 237.7	6.4 ± 14.3	0.0	3.2 ± 7.2
Rago East	9.6 ± 21.5	3.2 ± 7.2	9.6 ± 14.3	19.2 ± 42.9	9.6 ± 14.3	6.4 ± 8.8
Populus deltoides						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	3.2 ± 7.2	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Ranunculus abortivus						
Owl Pond	0.0	0.0	0.0	0.0	12.8 ± 28.7	0.0
Rago West	0.0	0.0	51.2 ± 78.5	6.4 ± 8.8	6.4 ± 8.8	3.2 ± 7.2
Rago East	0.0	0.0	0.0	32.0 ± 57.2	38.4 ± 45.2	9.6 ± 14.4
Rorippa sessiliflora						
Owl Pond	3.2 ± 7.2	0.0	12.8 ± 20.7	22. ± 41.7	0.0	0.0
Rago West	0.0	6.4 ± 14.3	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	374.4 ± 236.1	38.4 ± 29.1	9.6 ± 21.5	3.2 ± 7.2	0.0
Rumex verticillata						
Owl Pond	0.0	0.0	0.0	0.0	0.0	12.8 ± 23.1
Rago West	0.0	0.0	0.0	0.0	16.0 ± 27.7	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Sagittaria sp.						
Owl Pond	0.0	0.0	3.2 ± 7.2	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Salix sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	6.4 ± 14.3	0.0	0.0	19.2 ± 42.9	0.0	25.6 ± 48.8
Rago East	0.0	0.0	0.0	0.0	0.0	3.2 ± 7.2
Setaria sp.						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	6.4 ± 8.8*	3.2 ± 7.2	0.0	9.6 ± 14.3	3.2 ± 7.2	6.4 ± 8.8
Rago East	0.0	3.2 ± 7.2	25.6 ± 40.2	64.0 ± 59.9	92.8 ± 57.0	16.0 ± 19.6
Senecio glabellus						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	6.4 ± 8.8	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	3.2 ± 7.2	3.2 ± 7.2	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Setaria faberi						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	48.0 ± 53.1	22.4 ± 35.1	38.4 ± 77.2	12.8 ± 28.6
Sibara virginica						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	12.8 ± 13.4	150.4 ± 126.8	51.2 ± 47.2	3.2 ± 7.2	0.0
Rago East	0.0	0.0	0.0	70.4 ± 73.8	16.0 ± 22.6	3.2 ± 7.2
Sida spinosa						
Owl Pond	0.0	0.0	3.2 ± 7.2	19.2 ± 17.5	6.4 ± 8.7	0.0
Rago West	0.0	16.0 ± 22.6	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Stellaria sp.						
Owl Pond	0.0	0.0	0.0	0.0	35.2 ± 78.7	6.4 ± 14.3
Rago West	0.0	19.2 ± 42.9	0.0	0.0	0.0	3.2 ± 7.2
Rago East	0.0	0.0	0.0	25.6 ± 57.2	6.4 ± 14.3	0.0
Taraxacum offincinale						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2	3.2 ± 7.2	0.0
Rago West	3.2 ± 7.2	9.6 ± 14.3	12.8 ± 20.9	9.6 ± 14.3	32.0 ± 71.6	3.2 ± 7.2
Rago East	6.4 ± 14.3	0.0	0.0	12.8 ± 13.4	22.4 ± 35.1	9.6 ± 14.3
Trifolium hybridum						
Owl Pond	0.0	0.0	19.2 ± 42.9	0.0	0.0	48.0 ± 40.8
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Typha latifolia						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	3.2 ± 7.2
Rago East	0.0	0.0	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Valerinella radiata						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	6.4 ± 14.3
Verbena sp.						
Owl Pond	0.0	0.0	6.4 ± 14.3	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	6.4 ± 14.3	51.2 ± 61.3	0.0
Veronica peregrina						
Owl Pond	25.6 ± 57.2	0.0	25.6 ± 14.3	38.4 ± 60.5	425.6 ± 132.7	16.0 ± 22.6
Rago West	9.6 ± 14.3	153.6 ± 58.4	454.4 ± 132.2	579.2 ± 575.2	598.4 ± 321.9	761.6 ± 850.9
Rago East	9.6 ± 14.3	396.8 ± 121.5	243.2 ± 118.9	582.4 ± 774.5	390.4 ± 188.8	204.6 ± 102.9
Viola rafinesquii						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	3.2 ± 7.2	0.0	0.0	3.2 ± 7.2
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Xanthium spinosum						
Owl pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	3.2 ± 7.2*	3.2 ± 7.2	0.0	0.0	3.2 ± 7.2*	0.0
Unknown Asteraceae #1						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	6.4 ± 8.8	0.0	0.0	0.0	0.0
Rago East	0.0	9.6 ± 14.3	0.0	0.0	6.4 ± 14.3	0.0
Unknown Asteraceae #2						
Owl Pond	0.0	0.0	0.0	3.2 ± 7.2	0.0	3.2 ± 7.2
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Unknown Asteraceae #3						
Owl Pond	0.0	0.0	0.0	0.0	12.8 ± 20.9	3.2 ± 7.2
Rago West	0.0	0.0	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	3.2 ± 7.2
Unknown Cyperaceae #1						
Owl Pond	9.6 ± 21.5	0.0	0.0	9.6 ± 21.5	9.6 ± 21.5	0.0
Rago West	6.4 ± 14.3	0.0	3.2 ± 7.2	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	3.2 ± 7.2	0.0	0.0
Unknown Cyperaceae #2						
Owl Pond	0.0	172.8 ± 148.	204.8 ± 206.6	332.8 ± 283.6	137.6 ± 51.4	112.0 ± 91.9
Rago West	25.6 ± 33.2	0.0	0.0	3.2 ± 7.2	0.0	0.0
Rago East	0.0	0.0	3.2 ± 7.2	16.0 ± 27.7	6.4 ± 8.8	22.4 ± 24.3
Unknown Cyperaceae #3						
Owl Pond	0.0	0.0	0.0	16.0 ± 35.8	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Cyperaceae #4						
Owl Pond	12.8 ± 28.6	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Cyperaceae #5						
Owl Pond	0.0	0.0	6.4 ± 14.3	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Cyperaceae #6						
Owl Pond	0.0	32.0±71.6	25.6±57.2	51.2±114.5	22.4±50.1	0.0
RagoWest	3.2±7.2	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0

		Elevation (meters above sea level)				
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Unknown Cyperaceae #7						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	6.4±14.3	0.0	0.0	0.0
Rago East	0.0	9.6±21.5	0.0	6.4±14.3	0.0	0.0
Unknown Fabaceae # 17						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	3.2±7.2	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #6						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	3.2±7.2	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #10						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	3.2±7.2	0.0	0.0	0.0	0.0
Unknown Gramineae #13						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	3.2±7.2*	0.0	0.0	0.0
Unknown Gramineae #14						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	41.6±93.0*	0.0	0.0	0.0	0.0
Unknown Gramineae #15						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	9.6±21.5	0.0	3.2±7.2	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0

Species	98.2885	100.0932	Elevation (meters above sea level) 100.2436	101.1279	102.0175	102.4534
Unknown fern #1						
Owl Pond	0.0	0.0	3.2±7.2	0.0	0.0	0.0
Rago West	9.6±14.3	0.0	0.0	0.0	0.0	0.0
Rago East	6.4±14.3	0.0	0.0	0.0	0.0	0.0
Unknown herb #1						
Owl Pond	0.0	0.0	6.4±14.3	0.0	0.0	0.0
Rago West	3.2±7.2	0.0	3.2±7.2	9.6±21.5	22.4±50.1	16.0±35.8
Rago East	0.0	16.0±35.8	3.2±7.2	0.0	6.4±14.3	3.2±7.2
Unknown herb #2						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	6.4±14.3	0.0
Rago East	0.0	0.0	0.	0.0	0.0	0.0
Unknown herb #3						
Owl Pond	0.0	6.4±14.3*	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	16.0±35.8*	0.0	0.0	0.0	0.0	0.0
Unknown monocot #1						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	3.2±7.2
Unknown non-herb #1						
Owl Pond	105.6±38.5	73.6±44.7	83.2±17.5	86.4±26.8	6.4± 8.8	0.0
Rago West	73.6± 8.8	86.4±18.2	9.6±14.3	35.2±34.7	3.2± 7.2	0.0
Rago East	99.2±36.5	70.4±47.5	80.0±37.5	64.0±40.8	41.6±35.1	12.8±28.6
Unknown non-herb #2						
Owl Pond	38.4±35.1	51.2±49.8	6.4±14.3	9.6±21.5	9.6±21.5	32.0±43.8
Rago West	6.4±14.3	44.8±38.2	19.2±42.9	12.8±28.6	25.6±35.1	0.0
Rago East	41.6±44.7	35.2±51.1	35.2±34.7	19.2±28.6	25.6±35.1	0.0

	Elevation (meters above sea level)					
Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Unknown non-herb #3						
Owl Pond	35.2±36.5	44.8±47.2	32.0±33.9	70.4±14.3	25.6±35.1	48.0±45.3
Rago West	70.4±29.1	48.0±45.3	12.8±20.9	60.8±13.4	54.4±50.1	54.4±31.2
Rago East	25.6±21.5	48.0±27.7	3.2± 7.2	28.8±26.3	22.4±35.1	41.6±38.5
Unknown non-herb #4						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	3.2±7.2	0.0	0.0	12.8±28.6
Rago East	0.0	12.8±28.6	0.0	0.0	0.0	0.0
Unknown non-herb #5						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	16.0±22.6	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	3.2±7.2	0.0	0.0	0.0	0.0
Unknown woody sp. #1						
Owl Pond	0.0	0.0	0.0	0.0	0.0	3.2±7.2
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Total						
Owl Pond	943.8±1459.1	1820.8±2073.2	3228.8±1666.3	1618.8±1845.5	1826.8±1449.2	1200.0±2015.4
Rago West	639.6±1070.4	1132.8±1253.2	1436.8±1564.1	1584.0±1345.7	1163.8± 825.2	1433.6±1830.2
Rago East	2288.0±3342.7	2851.2±3133.6	1435.4±1306.5	1957.6±2966.9	1337.6±1945.7	620.6± 691.7

Species	Elevation (meters above sea level) 98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
Unknown Gramineae #16						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	38.4±85.9
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #17						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	86.4±81.3
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #18						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	16.0±19.6*	0.0	0.0	0.0	0.0
Rago East	0.0	3.2± 7.2*	0.0	0.0	0.0	0.0
Unknown Gramineae #19						
Owl Pond	0.0	3.2±7.2	0.0	0.0	0.0	6.4±14.3
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #21						
Owl Pond	0.0	0.0	0.0	0.0	0.0	12.8±28.6*
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #22						
Owl Pond	0.0	0.0	0.0	0.0	0.0	3.2±7.2*
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #23						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	32.0±37.5*	19.2±42.9*	0.0	0.0	0.0	0.0

Species	98.2885	100.0932	100.2436	101.1279	102.0175	102.4534
			Elevation (meters above sea level)			
Unknown Gramineae #24						
Owl Pond	0.0	0.0	0.0	0.0	3.2±7.2*	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #25						
Owl Pond	0.0	0.0	0.0	0.0	3.2±7.2*	432.0±967.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #26						
Owl Pond	0.0	0.0	0.0	0.0	28.8±39.8	28.8±39.8
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown Gramineae #28						
Owl Pond	0.0	0.0	0.0	0.0	0.0	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	22.4±50.1
Rago East	0.0	0.0	0.0	0.0	0.0	0.0
Unknown dicot #1						
Owl Pond	3.2± 7.2	0.0	0.0	3.2±7.2	3.2± 7.2	25.6±36.8
Rago West	0.0	0.0	41.6±69.4	3.2±7.2	12.8±28.6	9.6±14.3
Rago East	9.6±14.3	0.0	5.3±13.1	0.0	6.4±14.3	0.0
Unknown dicot #2						
Owl Pond	6.4±14.3	19.2±28.6*	19.2±28.6*	3.2±7.2*	9.6±21.5	0.0
Rago West	3.2± 7.2	6.4±14.3	0.0	0.0	0.0	0.0
Rago East	6.4±14.3	0.0	16.0±35.8	0.0	0.0	0.0
Unknown dicot #3						
Owl Pond	0.0	0.0	0.0	0.0	16.0±35.8	0.0
Rago West	0.0	0.0	0.0	0.0	0.0	0.0
Rago East	0.0	0.0	0.0	0.0	0.0	0.0