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Par Pond Vegetation Status Summer 1995 - July Survey Descriptive Summary

by
H. E. Mackey
Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808
R. S. Riley

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Abstract

A survey of the emergent shoreline aquatic plant communities began in June 1995, three months after the refilling of Par Pond to approximately 200 feet (61 meters) above mean sea level, and continued with this July survey. Aquatic plant communities, similar to the pre-drawdown Par Pond communities, are becoming reestablished. Beds of maidencane (*Panicum hemitomon*), lotus (*Nelumbo lutea*), water lily (*Nymphaea odorata*), and watershield (*Brasenia schreberi*) are now extensive and well established. In addition, within isolated coves, extensive beds of water lilies and spike-rush (*Eleocharis* sp.) are common. Cattail occurrence has increased since refill, but large beds common to Par Pond prior to the drawdown have not formed. Invasion of willow (*Salix* sp.) and red maple (*Acer rubrum*) occurred along the lake shoreline during drawdown. The red maples along the present shoreline are beginning to show evidence of stress and mortality from flooding over the past four months. Some of the willows appear to be stressed as well. The loblolly pines (*Pinus taeda*), which were flooded in all but the shallow shoreline areas, are now dead. Future surveys are planned for the growing seasons of 1995, 1996, and 1997, along with the evaluation of satellite data for mapping the areal extent of the macrophyte beds of Par Pond.

Introduction

Par Pond, a 2500-acre (1012-hectare) cooling water reservoir on the Savannah River Site (SRS), was created in 1958 by constructing an earthen dam across the upper reaches of the Lower Three Runs drainage system (Figure 1) (Wilde and Tilly 1985). Par Pond served as a recirculating, cooling water reservoir for R-Reactor until 1963 and for P-Reactor from 1961-1988. Nutrient-rich make-up water from the Savannah River was pumped into Par Pond to maintain a constant water level. P-Reactor operated approximately 70% of the time prior to 1988. During the summer, the temperature of the water entering Par Pond from Pond C ranged from 72 to 108° F (22 to 42° C) (Jones et al. 1979). Maximum shoreline water temperatures in the vicinity of the hot dam ranged from 90 to 95° F (32 to 35° C) (Liu et al. 1978). The thermal effluent cooled rapidly as it dispersed primarily through the southern half of the reservoir (Ezra and Tinney 1985). The north and west arms of Par Pond had temperatures at, or only slightly above, typical lake temperatures for the region (Liu et al. 1978).

The water level of Par Pond remained relatively stable, fluctuating typically less than 0.5 foot (0.15 meters) in most years. Natural invasion of macrophytes in the lake and along the shoreline occurred over the 33-year history of the lake, until mid-1991, when Par Pond was lowered from 200 feet (61 meters) above mean sea level (MSL) to 181 feet (55 meters) above MSL during a two-month period. Lowering the water level was deemed necessary to protect downstream residents from possible dam failure suggested by subsidence on the downstream slope of the dam. Prior to lowering in 1991, Par Pond was bordered by extensive beds of persistent and nonpersistent aquatic macro-

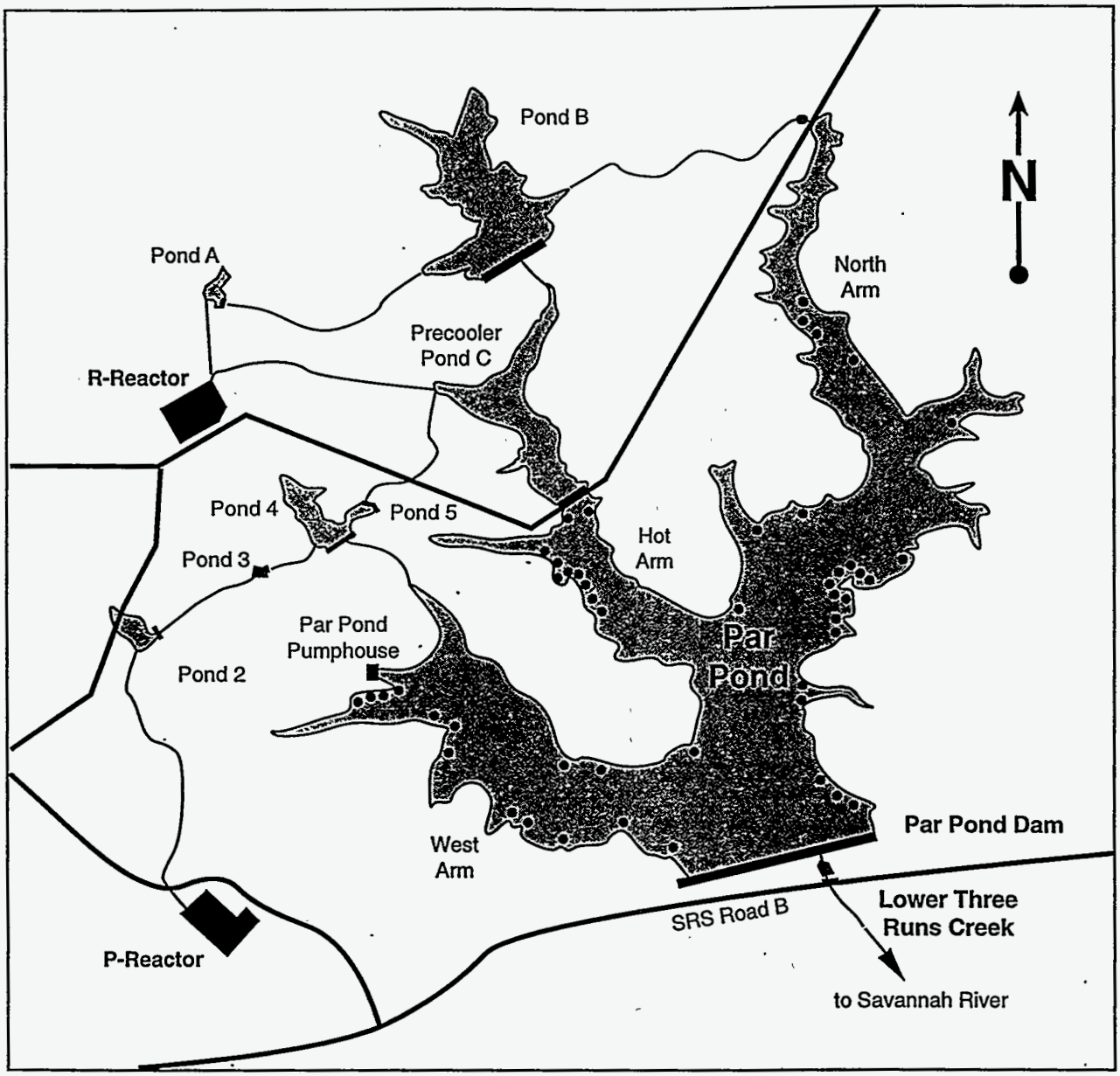

Figure 1. Map of Par Pond marked with locations of transects.

phytes. These beds often exceeded 66-131 feet (20-40 meters) in width (shoreline to deep water) and in several areas exceeded 328 feet (100 meters). For example, from 1988, 1989, and 1990 SPOT satellite data, it was estimated that along the shoreline of Par Pond, 474 acres (192 hectares) of cattails (*Typha* spp.) or persistent emergent macrophytes were present during the 1988 growing season, 442 acres (179 hectares) during 1989, and 432 acres (175 hectares) during 1990. There were 371 acres (150 hectares) of water lilies (*Nymphaea odorata*) or other nonpersistent macrophytes in 1988, 311 acres (126 hectares) in 1989, and 368 acres (149 hectares) in 1990 (Narumalani 1993).

In 1987, 62 transects were established along the shoreline of Par Pond (Jensen et al. 1991, 1992a, 1992b, 1993; Jensen and Mackey 1991; Narumalani 1993). The dominant aquatic macrophyte patterns were recorded each spring (April or

May) and fall (September or October) from 1988 through June 1991, just prior to the lowering of the Par Pond water level. In these previous studies, the major species present in both the persistent (emergent, i.e., cattails) and nonpersistent (floating-leafed, i.e., water lily, lotus [*Nelumbo lutea*]) macrophyte categories were recorded, along with the width of each bed along the transects and estimates of percent cover by species at each transect. Spring and fall SPOT satellite data also were collected and analyzed for the 1988-1991 time period to provide estimates of area of coverage by major aquatic macrophyte category for the lake. These methods and data are summarized in the above mentioned references.

Beginning in June 1991, Par Pond was lowered from 200 feet (61 meters) above MSL to 181 feet (55 meters) above MSL. This lowering was sufficient to expose both the emergent and nonemergent macrophyte beds of the Par Pond shoreline to drying conditions; therefore, extensive macrophyte losses occurred. Initial surveys in August 1992 by F. W. Whicker (Personal communication, Savannah River Ecology Laboratory) indicated some reinvasion on the newly exposed shoreline. Plant succession was occurring on about 65% of the exposed lake bed with approximately 35% still barren. Grasses, sedges, and rushes were the dominant forms with a mixture of old-field species, including dog-fennel (*Eupatorium* sp.) and loblolly pine (*Pinus taeda*), which became more evident after spring 1993. In isolated pockets within coves of Par Pond, sufficient groundwater seepage or inflow from small streams allowed remnants of the Par Pond macrophyte communities to survive (e.g., beds of water lilies in the cove south of the Par Pond pump house [Figure 1]) as evident in late April 1995 vertical aerial photography. In mid-October 1994, after dam repairs were complete, the U.S. Department of Energy initiated the refill of Par Pond and by mid-March 1995, Par Pond approached its former full pool level of approximately 200 feet (61 meters) above MSL (Figure 2). The Par Pond water level has remained relatively constant since refill, fluctuating about 0.4 foot (0.12 meters).

Methods

Of the 62 transects along the Par Pond shoreline in June 1991, 48 were relocated in March 1995. Descriptive notes on the vegetation patterns at each transect were taken beginning in June 1995 to indicate the condition of any standing vegetation following refill and initial regrowth of macrophyte communities (Mackey and Riley 1996). Also, photographs of each transect were taken in June 1995. The transects were revisited in July 1995 and photographed. The species present were recorded along with a nominal estimate of percentage cover for any species appearing to occupy more than a "trace" (less than 0.1% of the water surface) (Phillips 1959; Mueller-Dombois and Ellenberg 1974). Two zones (an inner and an outer zone) were characterized on both surveys. Both zones started at the location pole of the transect marker used in 1988-1991 surveys to mark the boundary between the persistent emergent aquatic beds (i.e., primarily cattails, spike-rush [*Eleocharis* sp.]) and the nonpersistent floating-leafed macrophytes beds (i.e., water lilies and lotus). The inner zone extended from the transect shoreward and the outer zone extended from the transect to deeper water. Water depth at the transect marker averaged approximately 3.3 feet (1 meter) in previous surveys (Jensen et al. 1991, 1992a, 1992b, 1993; Jensen and Mackey 1991; Narumalani 1993).

Results

Since the refilling of Par Pond, most of the old-field species that invaded much of the exposed shoreline are now absent. For example, all the loblolly pines that were growing in both the outer and inner transect zones have died, except for those in the very shallow areas along the shoreline (Figures 3 and 4). The most common woody species along the Par Pond shoreline before refill were newly invaded willow (*Salix* spp.) and red maple

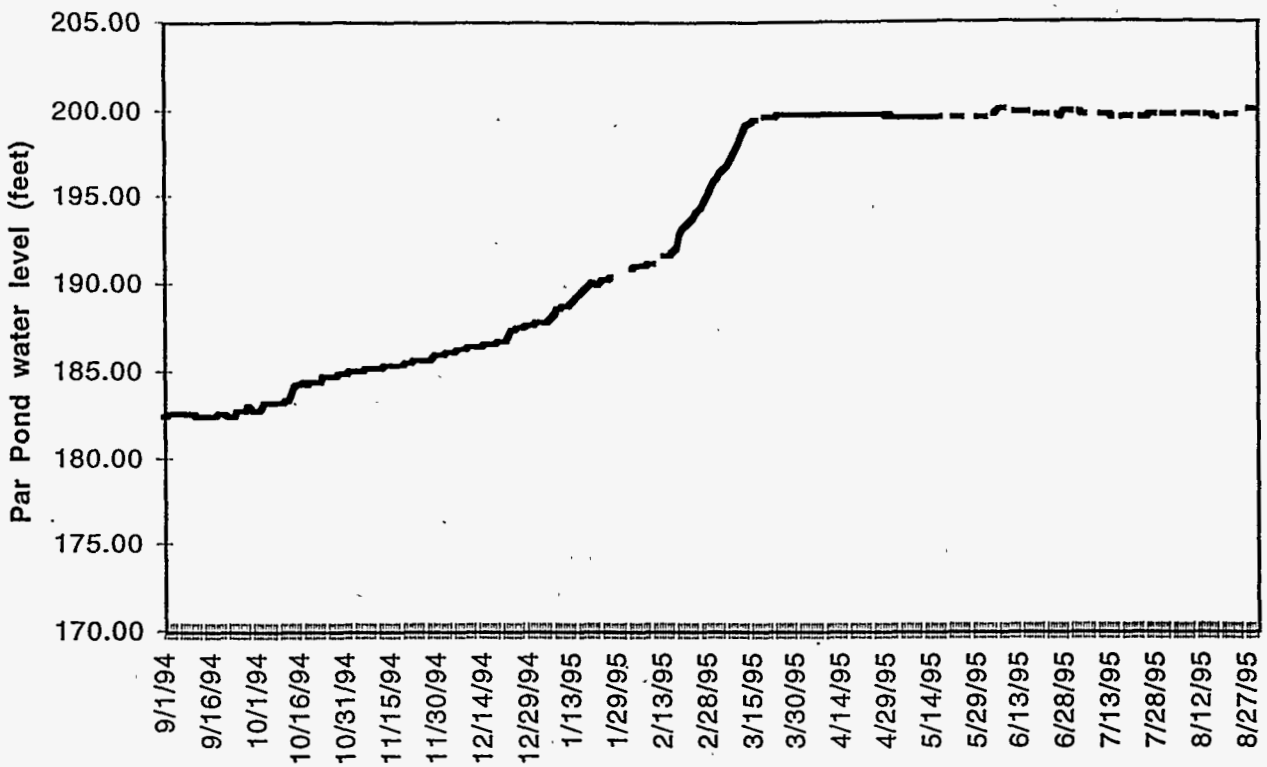

Figure 2. Rate of Par Pond refill during winter and early spring of 1995.

(*Acer rubrum*), but even these more flood-tolerant species are showing indications of stress and mortality from the continued flooding over the past four months (Figures 3 and 4; See Appendix A for common and scientific names of plants).

Maidencane (*Panicum hemitomon*) continues to be the most common macrophyte species along the shoreline, but lotus, water lily, and watershield (*Brasenia schreberi*) have increased from mid-June to late July. This increase in occurrence of these three species of macrophytes may be representative of widespread seed dispersion and availability from previous years. Figures 5 and 6 summarize estimates of herbaceous species percent occurrence (number of transects in which a species occurred divided by the total number of transects) at the inner and outer zones of Par Pond transects. Figures 7 and 8 summarize percent cover at the inner and outer zones of Par Pond transects for the most common herbaceous species observed at the transects during the June and July 1995 surveys.

Discussion and Conclusions

The shoreline aquatic vegetation of Par Pond is undergoing rapid redevelopment. Neither maidencane percent occurrence nor percent cover changed much between June and July surveys. Other dominant species which occurred in Par Pond prior to the drawdown continue to increase, especially lotus, water lily, watershield, and spike-rush. Cattails are present, but remain widely scattered; no major beds have developed to date. Areas formerly occupied by cattails prior to the drawdown are currently dominated by maidencane or remain as open water with occasional lotus, water lily, and watershield present. The water level in Par Pond for the first four months following refill has fluctuated about 0.4 foot (0.12 meters). This fluctuation may be the reason that a small band of primrose (*Ludwigia* sp.) has developed along areas of exposed shoreline. A similar band was observed at L Lake on SRS for the first few years after L Lake was filled in

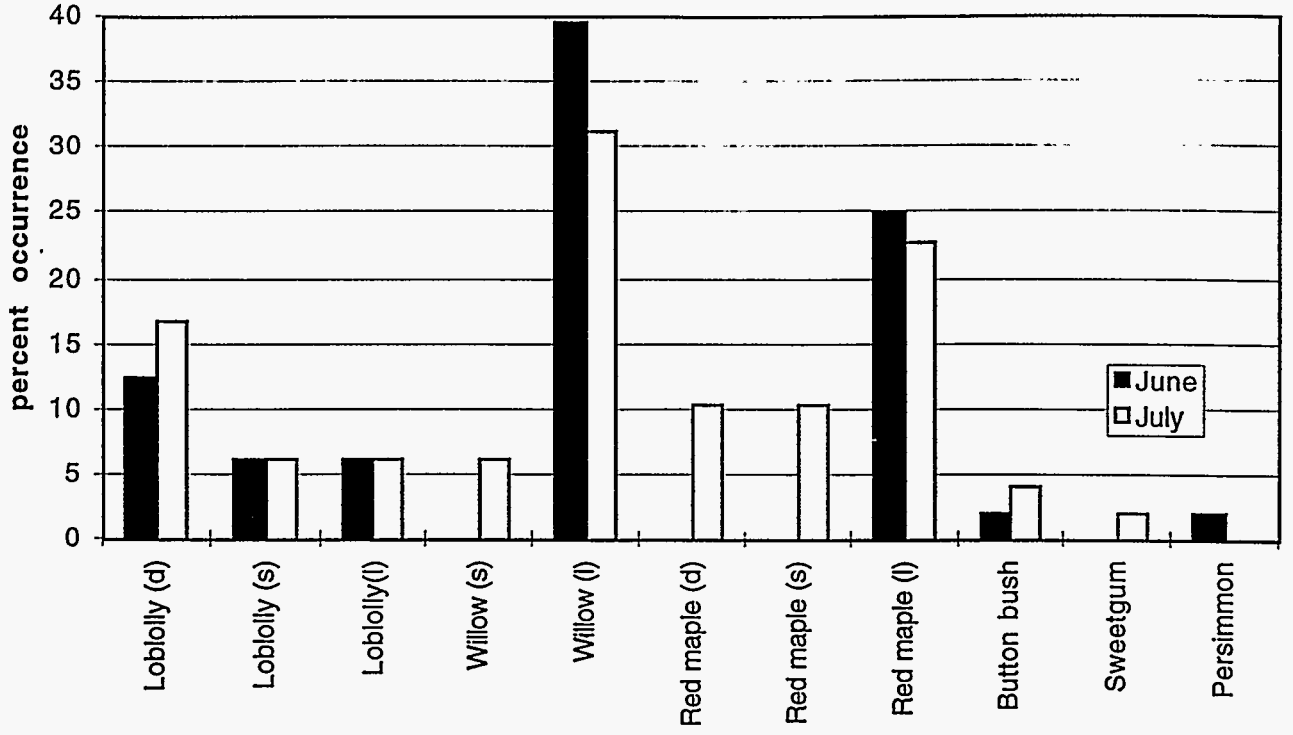

Figure 3. Woody species percent occurrence at the inner zones of Par Pond transects [(d) = dead; (s) = stress; (l) = living]. June and July 1995.

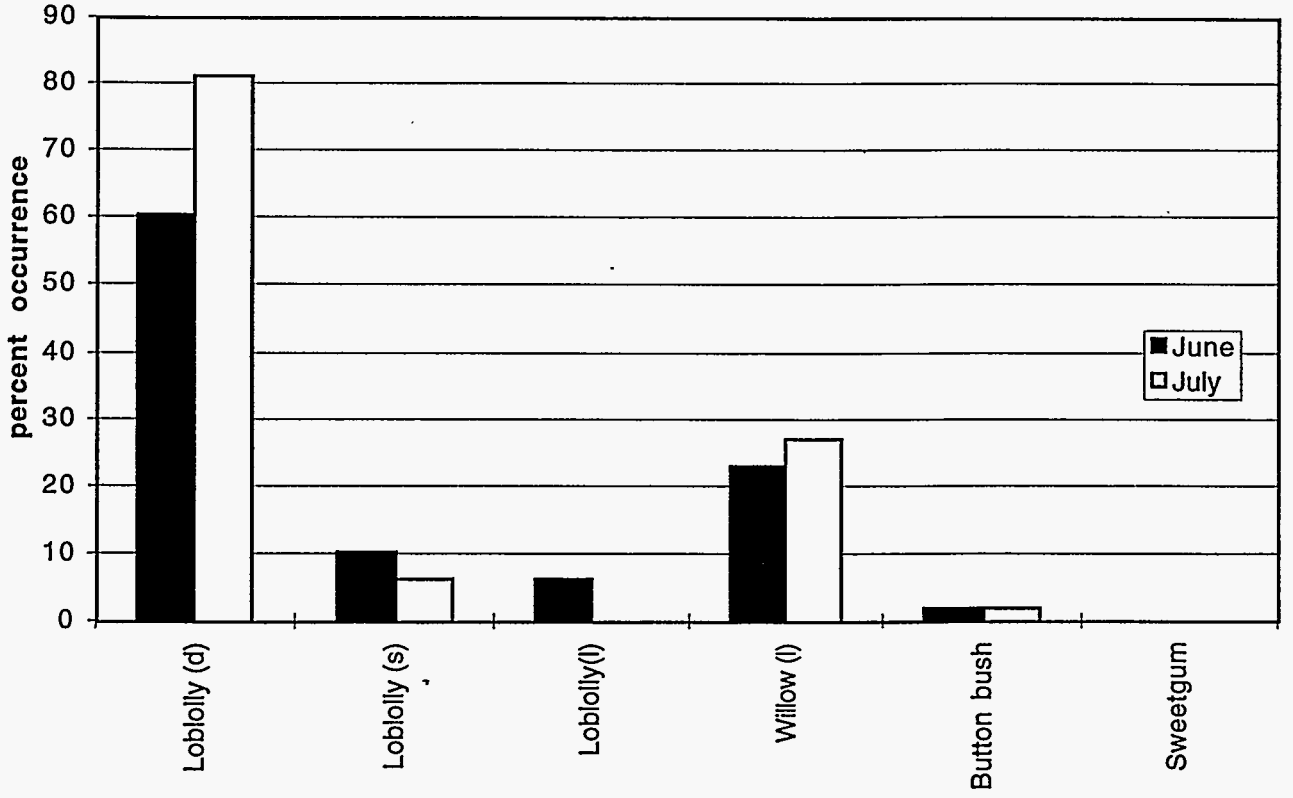

Figure 4. Woody species percent occurrence at the outer zones of Par Pond transects [(d) = dead; (s) = stress; (l) = living]. June and July 1995.

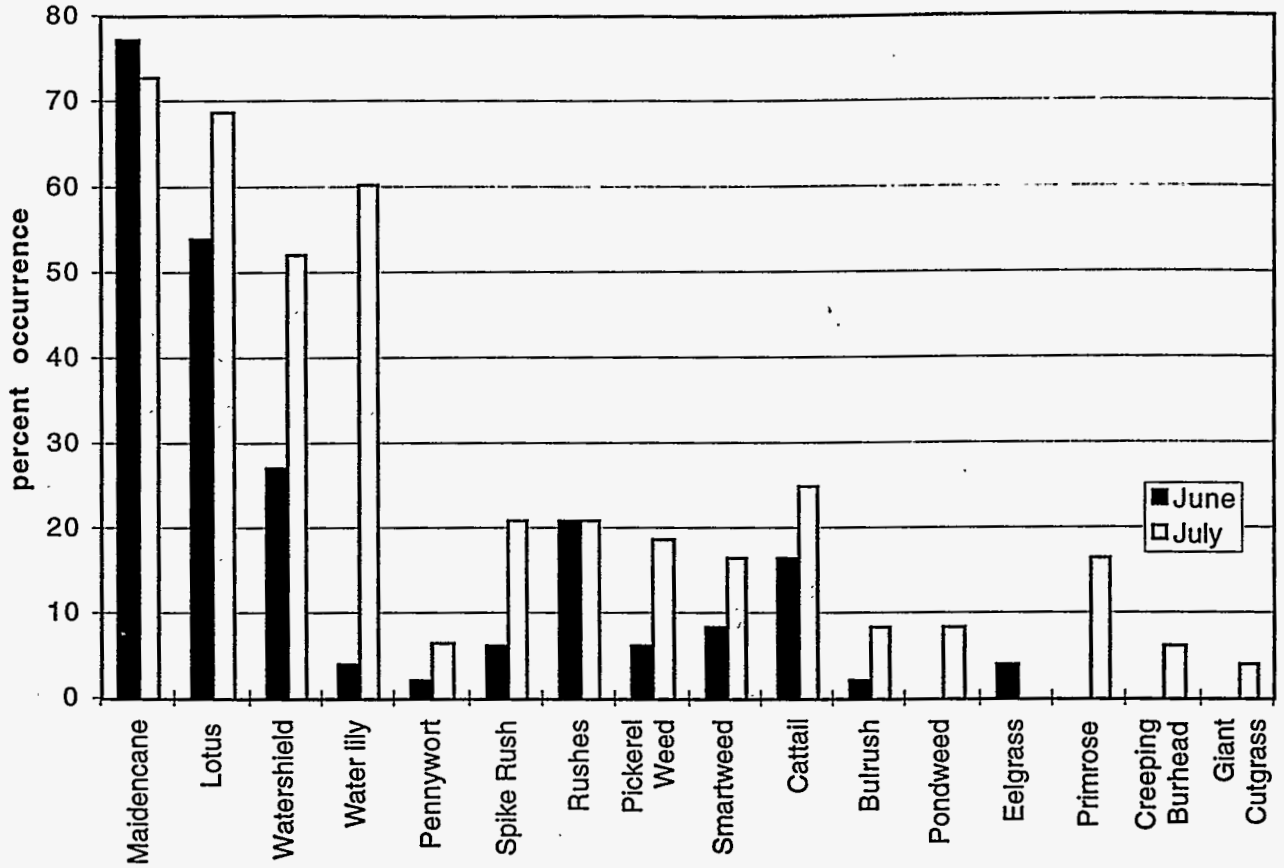

Figure 5. Herbaceous species percent occurrence at the inner zones of Par Pond transects [(d) = dead; (s) = stress; (l) = living]. June and July 1995.

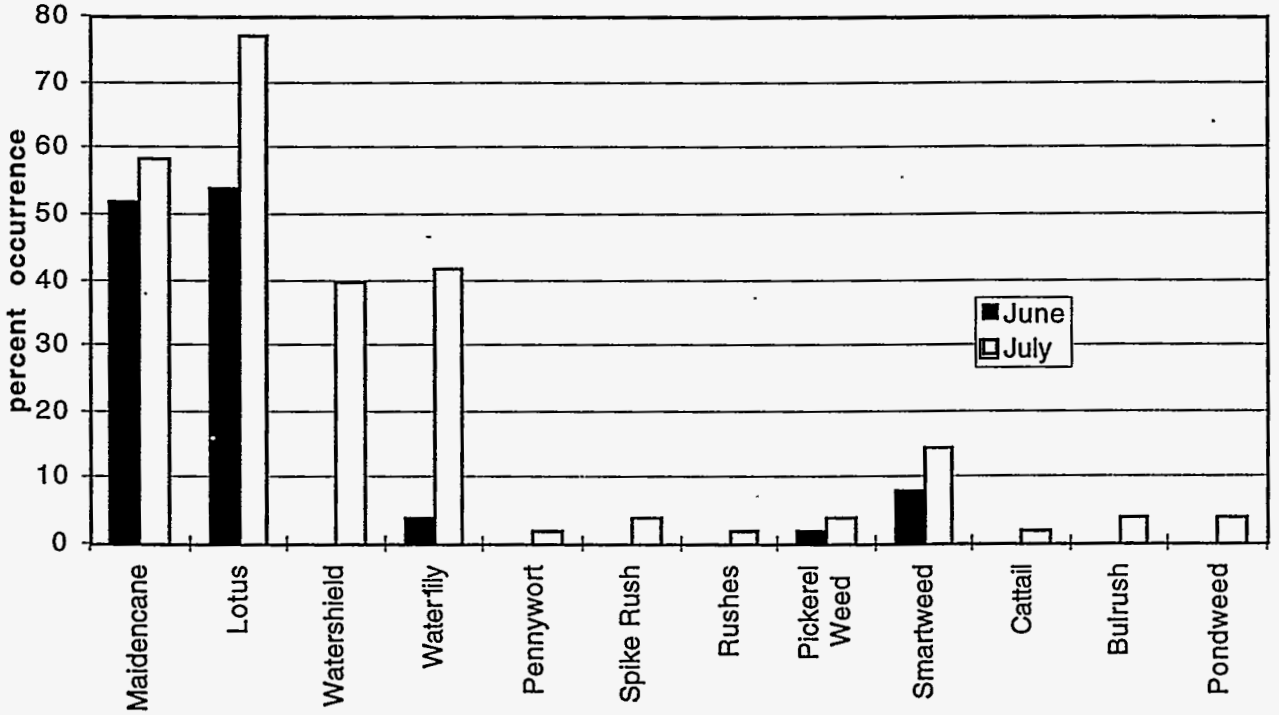

Figure 6. Herbaceous species percent occurrence at the outer zones of Par Pond transects. June and July 1995.

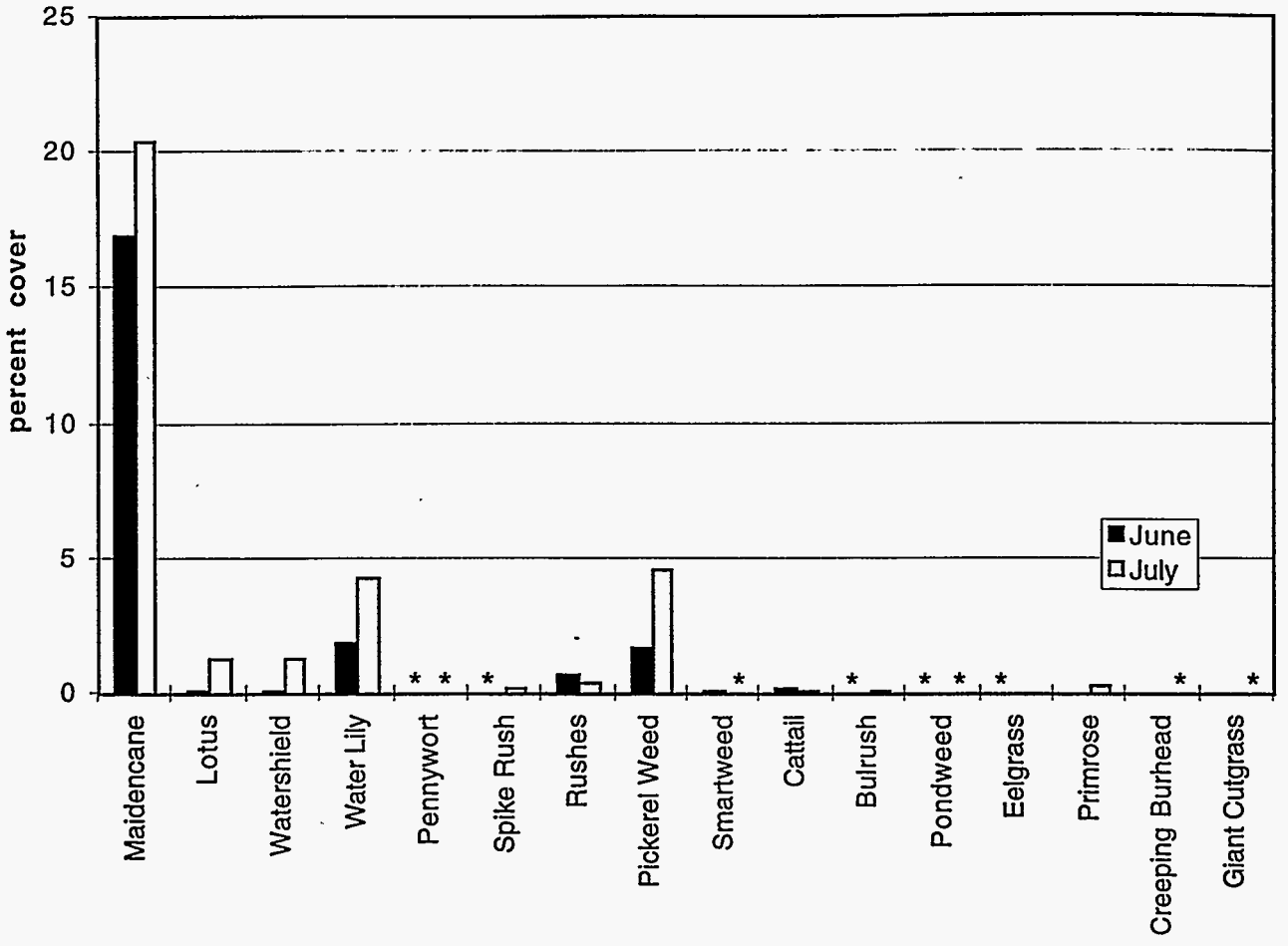

Figure 7. Herbaceous species percent cover at the inner zones of Par Pond transects. * Species with less than 0.05 percent cover: pennywort, spikerush, bulrush, pondweed, and eelgrass in June; pennywort, smartweed, pondweed, creeping burhead, and giant cutgrass in July. June and July 1995.

1985. Woody species such as loblolly pine, red maple, and willow are declining following the refill of Par Pond. These early surveys already are providing good evidence of the likely direction the Par Pond communities will take in their development.

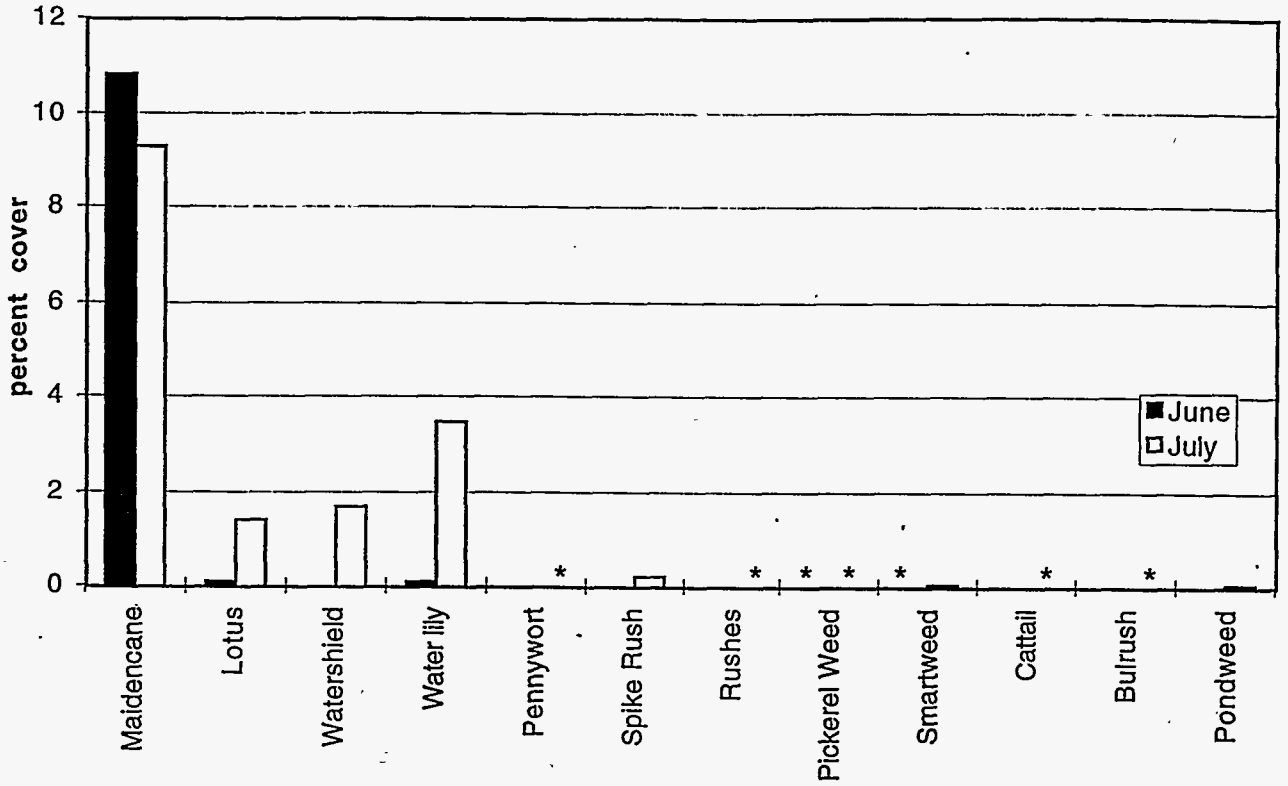

Figure 8. Herbaceous species percent cover in the outer zones of Par Pond transects. * Species with less than 0.05 percent cover: pickerel weed and smartweed in June; pennywort, rushes, pickerel weed, cattail, and bulrush in July. June and July 1995.

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Appendix A

Common and Scientific Names of Plants in this Report

Common Name	Scientific Name	Common Name	Scientific Name
bulrush	*Scirpus* sp.	pickerel weed	*Pontederia cordata*
button bush	*Cephalanthus occidentalis*	poke berry	*Phytolacca americana*
briars	*Rubus* spp.	pond weed	*Potamogeton* sp.
broom sedge	*Andropogon virginicus*	primrose	*Ludwigia* sp.
cattail	*Typha* spp.	red maple	*Acer rubrum*
creeping burhead	*Echinodorus* sp.	rush	*Juncus* spp.
dog fennel	*Eupatorium* sp.	smartweed	*Polygonum* sp.
eelgrass	*Vallisneria* sp.	spike-rush	*Eleocharis* sp.
giant cutgrass	*Zizaniopsis* sp.	sweetgum	*Liquidambar styraciflua*
loblolly pine	*Pinus taeda*	water grass	*Hydrochloa* sp.
lotus	*Nelumbo lutea*	water lily	*Nymphaea odorata*
maidencane	*Panicum hemitomon*	watershield	*Brasenia schreberi*
pennywort	*Hydroctyle* sp.	willow	*Salix* sp.
persimmon	*Diospyros virginiana*		