The Use of Early Detection and Rapid Response Protocol for the Control of Waterlettuce (*Pistia stratiotes* L.) in Powe Pond, Starkville, MS

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Waterlettuce is a free-floating aquatic plant that is not native to the United States. The floating growth habit and rapid reproduction allows waterlettuce to cover large expanses of water in short periods of time. Dense infestations reduce access and use of waterways, navigation, hydroelectric generation, and recreation. Ecologically, dense infestations of waterlettuce can cause reductions in dissolved oxygen which may lead to fish mortality; these infestations can also shade native submersed aquatic plants reducing the spatial heterogeneity and habitat for aquatic invertebrates.

On August 12, 2008, waterlettuce was identified growing in a small area of a 1.75 acre impoundment located in the Thad Cochran Research, Technology, and Economic Development Park, Starkville, MS. The waterlettuce has escaped the pond via a water control structure to a creek that transects the Research Park for several miles. The creek empties into Sand Creek (Northeast of the pond) which ultimately empties into the Tennessee Tombigbee Waterway 20 miles to the east. Therefore, the objectives of this study were to 1) eradicate the waterlettuce population in the pond, and 2) survey and eradicate any plants that have escaped into the outflow creek using aquatic labeled herbicides.

**Methods**
*Powe Pond:* Aerial imagery was used to calculate the spread rate of waterlettuce by analyzing imagery from May, June, and August 2008. Similar imagery...
was flown on September 19, 2008 prior to herbicide applications. On September 22, 2008 the aquatic herbicide penoxsulam (Galleon™) was applied to the water column from a boat using a weighted hose system to obtain an herbicide concentration of 50 μg L⁻¹ (ppb). Penoxsulam is a low use rate, slow acting systemic herbicide that inhibits branched chain amino acid production. Initial herbicide symptoms may take 4-6 weeks to appear, however growth inhibition is rapid. Following the initial herbicide application, three water samples were collected from the pond and shipped to the SePRO Research and Technology Campus in Whitakers, NC for herbicide residue determinations. Water samples were collected at 3, 14, 17, and 30 days after treatment (DAT). The water samples documented the herbicide concentration in the pond, ensured adequate exposure of the plants to the herbicide, and allowed for monitoring the herbicide concentration over time to determine if supplemental applications were needed to maintain the desired herbicide concentration. Photographs were taken weekly for 9 weeks after treatment (WAT) and then 1 year post treatment to document herbicide injury and overall control.

**Outflow Creek:** The creek was surveyed to identify how far the plants had moved from the pond and to apply the aquatic herbicide imazamox (Clearcast™) to plants growing in the creek. Imazamox was applied as a foliar application using a 3% by volume concentration. The surfactant DyneAmic™ was added to the spray solution at 1% v:v. Additional surveys were conducted in October 2008, May 2009, and September 2009 to ensure herbicide efficacy and waterlettuce eradication in the creek.

### Results and Discussion

**Waterlettuce Introduction and Growth:** Historic aerial imagery indicates that there was no waterlettuce in Powe Pond in August 2007 (Figure 1). Using similar imagery, it was observed that waterlettuce may have been introduced into the pond in June 2008 where it infested approximately 0.02 acres (Figure 2). However, by August 2008 waterlettuce occupied large areas of the pond and by September 2008 the entire pond surface was covered by waterlettuce, and subsequently reported to the Geosystems Research Institute (Figures 3 and 4; Photo 1). The waterlettuce infestation expanded approximately 0.03 acres day⁻¹ from June 2008 to September 2008.

<table>
<thead>
<tr>
<th>Herbicide (ppb)</th>
<th>3 DAT</th>
<th>14 DAT</th>
<th>17 DAT</th>
<th>30 DAT</th>
</tr>
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<tbody>
<tr>
<td>Penoxsulam</td>
<td>50.03</td>
<td>38.7</td>
<td>26.2</td>
<td>66.1</td>
</tr>
</tbody>
</table>

*Heavy rain following this sample date
Applied a follow up application on Oct. 20, 2008 of 30 ppb of penoxsulam to maintain 50 ppb concentration in the pond

**Table 1. Mean herbicide concentrations in Powe Pond following herbicide applications.**

Photo 1. Powe Pond in September 2008 prior to herbicide application.

Photo 2. Chlorosis of waterlettuce tissue following exposure to the herbicide penoxsulam.
Herbicide Efficacy and Monitoring: Herbicide residues in the water column indicate that sufficient concentrations of penoxsulam were maintained in the pond for at least 30 days (Table 1). Herbicide injury was noted on plants as early as 1 WAT by severe chlorosis and reddening of the outer leaves of waterlettuce (Photo 2). At 2 WAT the outer leaves began to deteriorate and chlorosis was observed in the center of plant rosettes (Photo 3). By 6 WAT plants were mostly chlorotic and areas of necrotic (brown) and dead plants were beginning to form (Photo 4). Severe rosette injury was observed at 7 WAT where the apical portions of the rosette necrotic and beginning to deteriorate (Photo 5). During this assessment period it was noted that small openings in the plant mat were beginning to form. At 8 WAT plants were severely chlorotic/necrotic with large holes beginning to form in the plant mat (Photo 6). By 9 WAT plants were completely necrotic, deteriorating, and sinking in the water column (Photo 7). A follow up assessment 1 year after treatment found Powe Pond to be completely free of waterlettuce (Photo 8). Waterlettuce was sensitive to the concentration of penoxsulam maintained in the water column as indicated by the early injury signs. Herbicide applications made in the fall, September and October, were also aided by frost in late November that killed any remaining plants. Waterlettuce in the outflow creek was also treated on September 22, 2008 along a 1 mile segment.
This treatment consisted of spot spraying individual plants or small collections of plants within the creek or along the creek bank. The creek was further surveyed during this time as it emptied into a larger creek that traversed the R.R. Foil Plant Research Center, at Mississippi State University; however no more plants were observed and therefore the spread of waterlettuce was stopped in the outflow creek. The outflow creek was surveyed again approximately 4 WAT (October 2008), and the waterlettuce was necrotic or dead during at this time. Additional surveys conducted in May September 2009 found no remaining waterlettuce in the outflow creek. Additionally there have been no reports of waterlettuce in the Tennessee Tombigbee Waterway downstream of the Powe Pond infestation.

By employing an Early Detection Rapid Response protocol the waterlettuce infestation was identified, and ultimately eradicated before it could spread further.

Photo 6. Powe Pond at 8 WAT where the waterlettuce mat is breaking up.

Photo 7. Necrotic waterlettuce at 9 WAT.

Photo 8. Powe Pond approximately 1 year after treatment with the herbicide penoxsulam.