The battle against undesirable aquatic growth is a very serious problem. It poses a threat to natural aquatic life as well as to man. But managing harmful aquatic vegetation and algal growth is not a simple matter.

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EDITORIAL

Integrated Pest Management (IPM) can be defined as the combination of two or more compatible management techniques, where the combined effect is symbiotic. In aquatic plant control, the management techniques generally revolve around the use of herbicidal, biological, mechanical, or some form of environmental manipulation, such as drawdown. Although some would argue the point, there is a place for IPM in aquatic plant management, and in fact it is practiced.

The most common IPM technique is the use of herbicides followed by grass carp stocking. Probably the most often recommended, this technique utilizes herbicides to rapidly decrease plant biomass and then stocking low densities of carp to control regrowth.

Another technique which has potential but at this point is rarely used, is drawdown in combination with herbicides. It may be possible in the future to integrate some of these techniques, however, much research is needed.

Mechanical controls are on occasion interrogated where it is desirable to remove most of the biomass mechanically and then follow with either herbicides or carp for suppression of regrowth. Mechanically clearing of trees and brush from ditch banks is most effective when followed by a stump or basal herbicide application.

A technique for IPM which I think needs more investigation, is the relationship between the water hyacinth weevil and herbicide controls. It has been documented that artificially concentrating weevils can effectively control regrowth. Mechanically clearing of trees and brush from ditch banks is most effective when followed by a stump or basal herbicide application.

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Weed Potential of Cone-Spur Bladderwort

_Utricularia biflora_

By

John R. Cassani
Lee County Hyacinth Control District
Fort Myers, Florida 33906

The bladdercwort family, Lentibulariaceae is comprised of two genera in the Southeastern U.S., _Pinguicula_ and _Utricularia_. Only a few of the 14 species of _Utricularia_ that occur in Florida cause significant problems, most notably _U. foliosa, U. purpurea, U. biflora_ and _U. floridana_. _Utricularia biflora_ has become a nuisance in a variety of habitats, particularly canals in southwest Florida and is being encountered as a weed more frequently in recent years. (Fig. 2).

_U. biflora_ Lam., synonymous with _U. pumila_ Walt., grows in a characteristic intertwined net-like form (Fig. 1), often forming dense floating mats. The only other _Utricularia_ species closely resembling _U. biflora_ is _U. fibrosa_ and differs from _U. fibrosa_ in having a shorter scape (a leafless flowering stem). In _U. biflora_ the scape reaches a length of about 10 cm, whereas in _U. fibrosa_ the scape attains 15 cm or longer.

_U. biflora_ is a rather widespread species occurring along the coastal plain from New England to Texas and in West Virginia, Arkansas, Oklahoma and New Mexico¹. Schardt and Nall² report _U. biflora_ primarily in slightly acidic shallow lakes and reservoirs in north and central Florida. Beal³ also reports that _U. biflora_ was found in somewhat acidic habitats (pH 4.6 - 7.0) in North Carolina. However, we find the plant at high densities in urban canals with pH ranges of 7.7 - 8.6 indicating that a relatively low pH is not necessarily a characteristic of its habitat. An inspection of _U. biflora_ herbarium specimens at the University of Florida indicate that this species occurs

throughout Florida in a variety of primarily lentic habitats including one on Big Pine Key as a southern extreme. _U. biflora_ is most often found growing in association with other aquatic macrophytes. I have observed dense growths of _U. biflora_ growing at a depth of 2 - 2.5 m, while thoroughly penetrating and possibly shading stands of _Chara_ and _Najas_ in an almost parasitic fashion. Since _Utricularia_ spp. lack roots, other submersed macrophytes seem to provide a stable substrate or matrix that keeps _U. biflora_ protected from excessive wind and wave action at the surface. It is doubtful that _U. biflora_ obtains any nutritive benefits from the macrophytes it is so closely associated with since it has bladders for capturing microcrustaceans as with other _Utricularia_ species (Fig. 1).

_U. biflora_ presents itself in its most obnoxious form usually in late summer when dense submersed growths detach and float to the surface. Boat traffic and the buoyancy derived from photosynthetic gases aid in its movement to the surface where it rivals most floating mats of filamentous algae as a pest. Despite its delicate form, I am always amazed how little _U._

---


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Fig. 1 Close-up of _U. biflora_ displaying filament-like stems and associated bladders.
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or them

or them

or them

or them

or them

or them

or them
Aquatics

Fig. 2

U. biflora it takes to foul the prop on our 25 HP outboard.

Heavy summer rains are sometimes very effective at dissipating floating mats and probably act as a natural control to keep this species from major weed status in some situations. This effect of heavy rain on dissipating the plant at the surface may be anticipated and utilized before scheduling herbicide treatments.

My observations of U. biflora in canals in Lee County indicate that it may be more sensitive to winter conditions of lower water temperature and shorter day length than associated Chara or Najas species. Between late November and March, when water temperatures average below 23°C in this area, U. biflora is rarely a problem and demonstrates a marked decline in biomass after October.

Schardt and Nall report that U. biflora has little wildlife value and I have found that grass carp prefer it less than Najas or Chara when occurring with these species. Grass carp should be stocked during the winter months in Florida when U. biflora is the primary target and the plant is at its lowest density.

The statewide occurrence of U. biflora in Florida has remained at about 60 - 70 sites during the last four years, primarily in lakes and canals comprising 700 -1,000 surface acres. The acreage estimate for canals in South Florida is probably underestimated since several hundred acres of U. biflora occur in the freshwater canal system in Lee County alone.

Another possible reason for its underestimation as a weed is that it is probably misidentified as a filamentous alga which is a mistake easily made unless it is examined closely. The emergent yellow flowers, often occurring quite densely during mid and late summer, are the best indication that the disgusting looking mat is something other than a filamentous alga. However, filamentous algae are occasionally found growing associated with U. biflora, and in mixed mats, the whole thing is sometimes written off understandably as just algae.

In summary, U. biflora has apparently adapted well to a variety of aquatic habitats over a broad geographic range. During its peak growth season of late summer in South Florida, it often outcompetes other native vegetation and requires management especially when it is highly visible in mat form at the surface.

Cancer Hazards from Pesticides

The possible lifetime cancer hazard from consuming residues of suspected pesticide carcinogens in the U.S. food supply is similar to that from drinking 1.6 quarts of chlorinated tap water per day. It is far less than the cancer hazard from daily consumption of a peanut butter sandwich or a mushroom. These comparisons are based on a pesticide study released by the National Academy of Sciences and on a new hazard-ranking technique developed by biochemist, Bruce Ames, and his colleagues at the University of California, Berkeley, and published in Science Magazine.

What are the Concentrations of Pesticides that can be Detected?

Current technology can measure levels as low as one part per billion (ppb). To comprehend how minute this is in terms that are easily understood, the following is offered:

<table>
<thead>
<tr>
<th>Term</th>
<th>Amount in</th>
<th>Length</th>
<th>Area</th>
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<td>parts per million</td>
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<td>189 miles 23 ac.</td>
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<td>(ppm)</td>
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<tr>
<td>parts per billion</td>
<td>1 inch in 1 ft. in</td>
<td>189,000 miles 23,000 acres</td>
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<tr>
<td>(ppb)</td>
<td></td>
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Literature Cited

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Large recreational lakes. Golf course ponds.
Drainage canals. Even drinking water reservoirs.
Sonar targets specific plants like hydrilla,
coontail, duckweed, water milfoil and many
others. And controls them all season long,
whether you apply before they come up or after.
But as effective as Sonar is against aquatic
weeds, the label doesn't restrict swimming,
fishing or drinking like other aquatic herbi-
cides. And when used according to label direc-
tions, it won't adversely affect your aquatic
environment*, water chemistry or quality,
or deplete water oxygen.
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use. Try Sonar. And weed out your water,
without the worry.
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*Trees and shrubs growing in water treated with Sonar may
be injured
Sonar®—(fluridone, Elanco)

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Sonar® controls weeds...

here & here & here & here & here & here
Publicly Funded Aquatic Plant Management Operations in Florida

By Brian V. Nelson and J. Michael Dupes
Florida Department of Natural Resources, Tallahassee, Florida
and U.S. Army Corps of Engineers, Jacksonville, Florida

The majority of aquatic plant management operations in Florida’s public waters are conducted under two publicly funded programs, the Cooperative Aquatic Plant Control Program and the State Funding for Aquatic Plant Control Program. Operations in navigable waters with public boat ramps are usually conducted under the Cooperative Program. Waters that do not meet the Cooperative Program eligibility criteria but are managed for public benefit by local government entities are eligible for funding under the State Program.

The Cooperative Program

Through a cooperative agreement with the Florida Department of Natural Resources (DNR), the United States Army Corps of Engineers (Corps) funds aquatic plant control operations within Florida under the Removal of Aquatic Growth Project (RAG), and the Aquatic Plant Control Program (APC). Operations in Federal Navigation Projects are funded 100 percent by the Corps under the RAG Project. Authorized navigation projects include the St. Johns, Withlacoochee, Crystal, Caloosahatchee, and Kissimmee Rivers and portions of Lake Okeechobee. Operations in other eligible waters not managed under the RAG Project are funded through the APC Program. Prior to Fiscal Year 1988, operations under the APC Program were funded 70 percent by the Corps and 30 percent by the state and local governments. The Water Resources Development Act of 1986 changed the cost share from 70/30 to 50/50. This change went into effect on October 1, 1987. The state matches the Corps funds for waterbodies which are navigable between counties. Local governments are responsible for providing matching funds for intracounty waters.

Field operations under the Cooperative Program are conducted by Corps crews or their contractors on the St. Johns River north of Highway 520, the Oklawaha River and Lake Rousseau. The majority of work, however, was performed by the water management districts and eight counties through contracts with the DNR.

The plants and acreages controlled under the Cooperative Program since 1984 are listed in Table 1. The acreage of water hyacinth and water lettuce requiring control decreased between 1984 and 1986. This trend was reversed in 1987 when increased efforts were necessary to regain reasonable control of floating vegetation on Lake Okeechobee. Approximately 6,300 acres were controlled there in 1986 while over 10,000 acres required control during 1987. This amount represents nearly one-third of the floating plants controlled statewide in 1987. The acreage of floating plants controlled each year can be used to judge the success of the program and the maintenance control concept on a statewide basis. Obviously, for the program to be successful, effective and consistent operations are necessary.

The types and amounts of herbicides utilized under the program are listed in Table 2. In addition to herbicide control, approximately 257 acres of plants were mechanically harvested. A summary of control costs by plant type and control method for 1987 appears in Table 3. These costs included salaries and benefits, equipment rental, herbicides, contractural work and indirect administrative costs.

During 1987, the total cost of operations under the RAG Project was $2,457,868. The cost of APC operations was $3,422,019. Local

<p>| TABLE 1. Acreage of plants controlled under the Cooperative Aquatic Plant Control Program. |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Floating*                           | 44,763                             | 37,616                             | 29,492                             | 33,671                             |
| Hydrilla                            | 7,161                              | 7,312                              | 9,447                              | 8,158                              |
| Alligatorweed                      | 74                                  | 180                                | 70                                 | 42                                 |
| Eurasian Watermilfoil              | 23                                  | 2                                  | 144                                | 25                                 |
| Cattail                            | 42                                  | 91                                 | 9                                  | 17                                 |
| Other Plants                       | 1,867                               | 2,489                              | 2,003                              | 1,299                              |</p>
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<th>53,930</th>
<th>47,690</th>
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<th>43,212</th>
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* Water hyacinth and water lettuce.
Sonar clearly tells its own story. With season-long aquatic weed control that other aquatic herbicides cannot deliver. Sonar targets specific plants like water lily, hydrilla, duckweed and many other weed problems. And controls them all season long whether you apply before they come up or after.

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* Trees and shrubs growing in water treated with Sonar may be injured.

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& lasts
Sonar applied February 23.

& lasts
45 days post-treatment.

& lasts
360 days post-treatment.
sponsors and cooperators provided $496,102 of the total dollars spent. The State of Florida’s share was $916,347.

State Funding Program
The DNR disburses funds through the State Funding for Aquatic Plant Control Program to local governments charged with the responsibility of managing aquatic plants. Participants in the 1987 program included eighteen cities, seventeen counties and thirty-five water control and other special districts. Waters eligible for funding are permanent bodies of water which local governments are financially responsible to maintain. The majority of waters managed under this program are ditches, canals and small man-made lakes.

This State Program was revised in 1986, through revisions to Section 16C-50, F.A.C.. The major change was the establishment of nine priority levels for the allocation of funds. The priority levels were based on two major factors: 1) the waters treated; sovereign lands (natural lakes and rivers) versus man-made canals and ditches whose ownership is claimed by local government entities, and 2) the plants controlled; exotic species versus native vegetation. Funding priority was given to the management of state owned waters and control of exotic species such as hydrilla and water hyacinth.

Prior to the establishment of the

| TABLE 2. Herbicides utilized under the Cooperative Aquatic Plant Control Program. |
|-----------------|--------|--------|--------|--------|
| 2,4-D           | 19,174 | 12,805 | 13,658 | 9,441  |
| 2,4-D Granular* | 54,000 | 65,000 | 67,198 | 3,600  |
| Aquathol K      | 23,940 | 22,349 | 34,541 | 23,646 |
| Aquathol Granular* | 50,621 | 56,330 | 14,804 | 63,359 |
| Copper Chelate  | 6,195  | 7,538  | 11,816 | 4,494  |
| Diquat          | 7,003  | 8,755  | 9,970  | 11,229 |
| Hydrothol 191   | 62     | 0      | 317    | 20     |
| Hydrothol 191*  | 120    | 2,480  | 0      | 0      |
| Hydout*         | 211    | 450    | 0      | 0      |
| Rodeo           | 307    | 440    | 586    | 256    |
| Sonar A.S.      | 589    | 315    | 459    | 1,371  |
| Sonar 5P/SRP*   | 16,147 | 16,158 | 29,500 | 75,966 |

* Indicates pounds, all other amounts are gallons.

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<td>$5,879,887</td>
<td>$136</td>
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</table>

* Water hyacinth and water lettuce

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priority system, available funds were allocated to grantees on an equal percentage basis for reasonably estimated aquatic plant management expenses. In 1985, the DNR provided 18 percent reimbursement. With the establishment of the priority funding system the DNR begins with the first priority level and allocates 50 percent of the approved control costs. Each subsequent priority level, in descending order, is funded at 50 percent until the available funds are insufficient to provide 50 percent reimbursement. At this level, reimbursement is at the highest percentage possible. Work in the remaining levels is not eligible for reimbursement.

During 1986, the two lowest priority levels, ditchbank plants (level 8) and planktonic algae (level 9), were not funded. In 1987, native plants in flood control waters (level 7) were added to the non-funded levels. Only four of the nine priority levels are being funded in 1988. These levels include all work in sovereign waters and the control of hydrilla, water hyacinth and water lettuce in non-sovereign waters.

Summaries of the plants controlled and herbicides utilized under the State Program from 1984 to 1987 appear in Table 4 and 5. Mechanical control operations were also conducted utilizing harvesters, draglines, towboats pulling A-frames, and backhoes. Slope mowers were used prior to 1986 when ditchbank mowing was reimbursed. Note that Tables 4 through 7, include only operations which were eligible for reimbursement. For example, the acreage of ditchbank plants controlled dropped from 4517 acres in 1985 to zero in 1986 and 1987. This occurred because the DNR no longer reimbursed for ditchbank control, not because ditchbank control was no longer conducted. In 1987, the decline in acreage of native plants controlled, especially filamentous algae, occurred for the same reason.

The total acreage controlled, dollars allocated and spent, and cost per acre for herbicide, mech-

TABLE 4. Acreage of plants controlled under the State Aquatic Plant Control Funding Program.

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<td>0</td>
<td>127</td>
<td>250</td>
<td>78</td>
</tr>
<tr>
<td>Hygrophila</td>
<td>121</td>
<td>99</td>
<td>164</td>
<td>404</td>
</tr>
<tr>
<td>Salvinia</td>
<td>18</td>
<td>142</td>
<td>3</td>
<td>179</td>
</tr>
<tr>
<td>Phragmites</td>
<td>0</td>
<td>124</td>
<td>269</td>
<td>90</td>
</tr>
<tr>
<td>Other Plants</td>
<td>1,102</td>
<td>540</td>
<td>615</td>
<td>288</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>43,763</td>
<td>44,184</td>
<td>43,267</td>
<td>30,733</td>
</tr>
</tbody>
</table>

* 1984 and 1985 totals include planktonic algae, 1986 and 1987 do not.

TABLE 5. Herbicides utilized under the State Aquatic Plant Control Funding Program.**

<table>
<thead>
<tr>
<th>HERBICIDE</th>
<th>1985</th>
<th>1986</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquathol Granular*</td>
<td>14,192</td>
<td>28,950</td>
<td>44,022</td>
</tr>
<tr>
<td>Aquathol K</td>
<td>15,059</td>
<td>18,355</td>
<td>13,981</td>
</tr>
<tr>
<td>Aquazine</td>
<td>0</td>
<td>56</td>
<td>0</td>
</tr>
<tr>
<td>Aquazine W.P.*</td>
<td>0</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>Banvel 720</td>
<td>2,175</td>
<td>996</td>
<td>564</td>
</tr>
<tr>
<td>Casaron*</td>
<td>1,200</td>
<td>1,300</td>
<td>0</td>
</tr>
<tr>
<td>Chelated Copper</td>
<td>24,836</td>
<td>37,181</td>
<td>14,421</td>
</tr>
<tr>
<td>Chelated Copper*</td>
<td>2,025</td>
<td>2,680</td>
<td>0</td>
</tr>
<tr>
<td>Copper Sulfate*</td>
<td>21,528</td>
<td>18,228</td>
<td>4,652</td>
</tr>
<tr>
<td>Dalapon*</td>
<td>9,333</td>
<td>4,233</td>
<td>0</td>
</tr>
<tr>
<td>Diquat</td>
<td>7,836</td>
<td>9,654</td>
<td>6,066</td>
</tr>
<tr>
<td>Hydrothol 191</td>
<td>1,248</td>
<td>1,414</td>
<td>1,233</td>
</tr>
<tr>
<td>Hydrothol 191 Granular*</td>
<td>3,060</td>
<td>6,560</td>
<td>11,200</td>
</tr>
<tr>
<td>Hydout*</td>
<td>0</td>
<td>1,000</td>
<td>110</td>
</tr>
<tr>
<td>Rodeo</td>
<td>11,201</td>
<td>12,589</td>
<td>11,492</td>
</tr>
<tr>
<td>Scout</td>
<td>21</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sonar A.S.</td>
<td>10</td>
<td>20</td>
<td>147</td>
</tr>
<tr>
<td>Sonar 5P/SRP*</td>
<td>480</td>
<td>7,920</td>
<td>16,524</td>
</tr>
<tr>
<td>2.4-D</td>
<td>1,454</td>
<td>1,962</td>
<td>1,112</td>
</tr>
<tr>
<td>2.4-D Granular*</td>
<td>68,550</td>
<td>8,820</td>
<td>15,400</td>
</tr>
</tbody>
</table>

* Indicates pounds, all other amounts are gallons.
** Ditchbank herbicides utilized under the program in 1985 are not listed.
TABLE 6. Summary of acres controlled, dollars spent and cost per acre for the State Aquatic Plant Control Funding Program.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres Controlled</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide</td>
<td>38,007</td>
<td>37,726</td>
<td>39,689</td>
<td>27,480</td>
</tr>
<tr>
<td>Mechanical</td>
<td>5,736</td>
<td>6,458</td>
<td>3,578</td>
<td>3,253</td>
</tr>
<tr>
<td>Biological</td>
<td>0</td>
<td>N/A**</td>
<td>5**</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>43,763</td>
<td>44,184</td>
<td>43,272</td>
<td>30,733</td>
</tr>
<tr>
<td>Dollars Spent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide</td>
<td>$4,744,395</td>
<td>$5,120,327</td>
<td>$5,476,788</td>
<td>$4,357,291</td>
</tr>
<tr>
<td>Mechanical</td>
<td>2,251,799</td>
<td>2,471,529</td>
<td>1,730,584</td>
<td>1,381,561</td>
</tr>
<tr>
<td>Biological</td>
<td>0</td>
<td>500</td>
<td>3,942</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$6,996,194</td>
<td>$7,592,356</td>
<td>$7,211,314</td>
<td>$5,738,852</td>
</tr>
<tr>
<td>Cost Per Acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide</td>
<td>$125</td>
<td>$136</td>
<td>$138</td>
<td>$159</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$391</td>
<td>$383</td>
<td>$484</td>
<td>$429</td>
</tr>
<tr>
<td>Biological</td>
<td>N/A</td>
<td>N/A</td>
<td>$888</td>
<td>N/A</td>
</tr>
<tr>
<td>Combined</td>
<td>$160</td>
<td>$172</td>
<td>$167</td>
<td>$187</td>
</tr>
<tr>
<td>Funds Allocated</td>
<td>$2,001,004</td>
<td>$1,711,513</td>
<td>$4,185,600</td>
<td>$3,472,926</td>
</tr>
<tr>
<td>Reimbursement</td>
<td>22%</td>
<td>18%</td>
<td>25% or 50%</td>
<td>34% or 50%</td>
</tr>
</tbody>
</table>

* Stocking of triploid grass carp not completed until 1986.
** Estimated control achieved as of 2/87.

TABLE 7. Public funds spent under the Cooperative and State Aquatic Plant Control Programs.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative Floating</td>
<td>$2,524,100</td>
<td>$2,326,800</td>
<td>$2,079,300</td>
<td>$2,148,580</td>
<td></td>
</tr>
<tr>
<td>Cooperative Floating*</td>
<td>431,675</td>
<td>360,114</td>
<td>590,040</td>
<td>843,597</td>
<td></td>
</tr>
<tr>
<td>Cooperative Subtotal</td>
<td>$2,955,775</td>
<td>$2,686,914</td>
<td>$2,669,340</td>
<td>$2,992,177</td>
<td></td>
</tr>
<tr>
<td>State Hydrilla</td>
<td>$2,280,400</td>
<td>$2,346,700</td>
<td>$2,752,600</td>
<td>$3,406,681</td>
<td></td>
</tr>
<tr>
<td>State Hydrilla Subtotal</td>
<td>$3,124,300</td>
<td>$3,552,794</td>
<td>$4,190,652</td>
<td>$5,435,860</td>
<td></td>
</tr>
<tr>
<td>Cooperative Other Plants</td>
<td>$238,750</td>
<td>$589,910</td>
<td>$443,147</td>
<td>$324,626</td>
<td></td>
</tr>
<tr>
<td>State Other Plants</td>
<td>5,722,684</td>
<td>6,026,198</td>
<td>4,463,222</td>
<td>2,866,076</td>
<td></td>
</tr>
<tr>
<td>State Subtotal</td>
<td>$6,961,434</td>
<td>$6,616,108</td>
<td>$4,406,369</td>
<td>$3,190,702</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$12,041,509</td>
<td>$12,855,816</td>
<td>$12,486,361</td>
<td>$11,618,739</td>
<td></td>
</tr>
</tbody>
</table>

* Water hyacinth and water lettuce.

anical and biological control methods for Fiscal Year 1984-1987 appear in Table 6. The majority (88 percent) of plants were controlled using herbicides. All control costs include salaries, benefits, equipment rental, herbicides, contractual work and indirect administrative costs. Of the $5,738,852 spent in 1987, approximately 92 percent was spent to control exotic species.

The combined amount of public funds spent under the Cooperative and State Programs for each plant category appears in Table 7. During 1987, State Program participants also controlled an estimated ten to twelve thousand acres of plants in the non-funded priority levels. This work is not included in the above tables since it was not eligible for reimbursement. Based on the average cost per acre for the State Program ($187.00), this work would increase the amount spent by State Program participants by at least two million dollars.

These acreage and cost figures represent only operations conducted under the Cooperative and State Funding Programs in public waters. Work conducted by private individuals, commercial applicators, or governmental agencies under the non-funded permitting program (Chapter 16C-20, F.A.C.) would make the acreage and cost estimates for aquatic plant management in Florida considerably higher.

Coming up in the Next Issue of Aquatics

- Developing a Plan to Manage Lake Vegetation, by Sandy Engel, Stanley Nichols, and Tom McNabb
- Medicinal Uses of Aquatic Plants Common to Florida, by Sue Newman
- Haller’s Historical Highlights
- Much, Much More...
Florida’s Water Management: A Humid History

By Mike Bodle, Aquatic Biologist
South Florida Water Management District
West Palm Beach, Florida 33416

Modern Florida is a place which has undergone a lot of remodeling, and I don’t mean simply my Aunt Sophie’s Boca condo, although she’s still unhappy with the wallpaper. Southern Florida, especially, has seen vast projects constructed across its face to achieve water drainage and land reclamation.

With average annual rainfall of 55 inches the natural Florida was a very watery place. Because of the state’s unique southern hydrogeology the shallow, miles-wide Everglades arose. Very flat land contours and porous, near-surface resources allowed nearly complete retention time was very long.

South Florida’s aboriginal Indians inhabited the area continuously for ten to twenty thousand years. Peninsular inhabitants were the Calusas in the southwest, including Lake Okeechobee, and Tequestas on the Keys and southeast coast. The peninsular Indian cultures were markedly different from those in north Florida and the American Southwest. Sub-tropical coastal resources allowed nearly complete sustenance from hunting and gathering methods without extensive migration or agriculture. Only in the Pacific Northwest of North America was a comparable food resource available.

Due to the natural abundance, little environmental modification was performed or necessary for the peninsular people to flourish. Evidence of some canals and agriculture does remain, however. At their peaks, the Calusas may have numbered 20,000 and the Tequestas 5,000 people. That they flourished in spite of the on-slaught of the region’s incredible hordes of mosquitoes and biting flies remains a marvel to me.

Spain ruled Florida for 300 years, establishing coastal settlements and forts. In 1821, the U.S. acquired the new territory of Florida for $5 million. Statehood followed in 1845. The federal Swamp Lands Act of 1850 conferred all ownership of swamp and overflow lands to the states. The young state of Florida was plagued by financial woes. To generate capital, vast areas were given, or sold at bargain prices, to those pledging to drain land, build railroads or otherwise contribute to making more land arable and accessible. Yet the State’s debt continued to mount as its real estate was handed over to private hands. The land grants and cutting sales to developers met with a lot of criticism especially when commitments to drain land, build railroads or otherwise contribute to making more land arable and accessible. Yet the State’s debt continued to mount as its real estate was handed over to private hands. The land grants and cutting sales to developers met with a lot of criticism especially when commitments to drain land, build railroads or otherwise contribute to making more land arable and accessible.

The first effective drainage operation was initiated in 1881 by Hamilton Disston of the Philadelphia tool manufacturing family. Disston purchased 4,000,000 acres at twenty-five cents an acre and brought dredges to Kissimmee. Here lakes (Kissimmee, Hatchineha, Tohopekaliga and others) forming the headwaters of the Kissimmee River, and ultimately Lake Okeechobee and the Everglades, were connected by canals and the Kissimmee River was deepened and somewhat straightened. Also, the waterfall of the Caloosahatchee River was blasted out and three lakes

(Hicpochee, Bonnet, and Lettuce) southwest of Lake Okeechobee connected. These lakes had been the Caloosahatchee’s headwaters yet they ultimately were directly connected to Lake Okeechobee.

In addition to increased water flow, this drainage system allowed steamboat traffic between Kissimmee and Okeechobee and on from there to the Gulf of Mexico. Commerce and immigration possibilities were enhanced. Disston received title to 1,652,711 acres or half of the land he claimed to have drained. Later surveys held that the project permanently drained no more than 50,000 acres yet a lot was learned during the work.

Besides showing that the drained lands could be farmed, Disston’s projects illustrated the extreme difficulties and expense such undertakings entailed. Disston continued to develop his land holdings and encouraged agricultural research and railroad construction. However, he died in 1894, after which his family sold all his Florida holdings at a fraction of their potential value. From his undertakings, though, it was realized that regional, public-funded projects would be required to accomplish major drainage projects.

Initial state drainage legislation came in 1905 with the creation of the Board of Drainage Commissioners who were empowered to construct a drainage system. Governor Napoleon Bonaparte Broward proposed that a 200 foot-wide canal be cut from Lake Okeechobee east to the Saint Lucie River at a cost of $250,000. Financing was to come from taxes levied by the Drainage Board upon the 4,300,000 acres lying

Cont. on p. 16
Clean up...with a clear conscience.

Pennwalt's aquatic herbicides: The responsible choice for aquatic weed control.

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- **Hydrothol 191** Granular Aquatic Algaicde and Herbicide
within its newly-created Everglades Drainage District. The taxation rate was a nickel per acre. Their first project actually begun, however, was in 1906 as the New River Canal between Fort Lauderdale and Lake Okeechobee was dug through state-owned lands. Broward faced stiff opposition in continuing the project, yet its activity spurred new land sales and decreased opposition to the taxation. He underestimated the cost and difficulty of the work, though. By 1909, only fifteen miles of the New River Canal had been constructed at a cost of $377,642. At this point, Broward’s successor, Gov. Gilchrist began looking for private contractors to take on the canal projects.

Despite the stuttering drainage efforts, people were coming to Florida. Land sales companies made claims (often false) as to the vast drained areas available for productive farming. The public uproar surrounding false sales claims instigated federal Congressional hearings in 1912 which led to markedly decreased sales and drainage funding. Florida issued drainage bonds to reinforce confidence in land sales but WWI intervened and little progress was made in the ‘20s. The Palm Beach Canal was completed between Lake Okeechobee and West Palm Beach in 1917. In 1924, a William J. Conners invested in 16,000 acres in what was to become the Everglades Agricultural Area and was given authority to construct a toll road along the new Palm Beach Canal.

During the same period, Flagler’s original railroad company, the Florida East Coast, constructed lines to the emerging towns around the lake. The boat traffic which had predominated in supplying the area was displaced. In 1926, the Florida land boom collapsed entirely and credit of the Everglades Drainage District was exhausted. Yet the area population had risen to 48,000 and the occurrence of droughts, floods and deadly hurricanes in the ‘20s prompted $20,000,000 in new bond issues to complete the drainage project. The Depression intervened, however, and the debt-load of the Drainage Commission was so great that all employees were released and efforts to re-pay creditors began in 1932.

Drainage project construction fell to the Army Corps of Engineers which built a levee system, as part of the new Okeechobee Drainage District project, around much of Lake Okeechobee between 1930 and 1937. Many other projects weren’t resumed until the ‘40s when the need to proceed was shown by alarming muck soil subsidence in the Everglades basin, saltwater-intrusion along the coast, and concern for the newly-created (1947) Everglades National Park. Also, in 1947, almost twice normal rainfall occurred in south Florida flooding as many as 5,000,000 acres of 18 counties six inches to ten feet deep for a month. Much of the existing drainage infrastructure was obviously not working.

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- Alligatorweed
- Cattail
- Giant Cutgrass
- Guinea Grass
- Johnson Grass
- Maidencane
- Paragrass
- Phragmites
- Reed Canary Grass
- Spratterdock
- Tallowtree
- Torpedo Grass
- Willow

You can use Rodeo in flowing or standing water in most aquatic sites, including ditches, canals, lakes, rivers, streams and ponds.

Get to the root of your toughest aquatic weed problems—without disturbing the environment—with Rodeo.

Rodeo cannot be applied within a half mile upstream of domestic water points, in estuaries, or rice levees when floodwater is present.

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Cont. from p. 16

drew up plans and submitted them to Congress in 1948. The state created the Central and Southern Florida Flood Control District in 1949 to maintain many of the Corps constructions. Numerous projects continued well into the 1970s. The southern water conservation areas were created within a levee and canal system, the Lake Okeechobee dike was continued and heightened, the Kissimmee River was channelized and the canals between the Osceola County lakes Disston had originally connected were modified in the interest of retaining water in them year-round. Historically, many of these lakes had drained almost completely during the winter dry seasons.

In the upper St. John's River Basin, west of Vero Beach, drainage work had been planned, but not begun during times of low land prices. Plans were scaled down in the late '60s when canal construction to aid navigation and drainage was begun. A series of weirs between Melbourne and Sanford allow several lakes (Washington, Hell'n'Blazes, Sawgrass) to function as reservoirs in the river system.

In 1960, the Southwest Florida Water Management District, or "SWIFTMUD," was created. As a result of the Water Resources Act of 1972, Suwanee River, Northwest Florida and St. John's River Water Management Districts were created and Central and Southern Flood Control District was renamed South Florida WMD. These Districts, along with the previously mentioned SWFWMD, partitioned the state into five regional water management districts.

The northern water management districts were, and continue to be, managers of more natural systems in which there are fewer man-made constructions. Of course, to begin with, natural drainage was greater in many of these areas. Many parts of north Florida are even blessed with hills; rare unknowns in south Florida, (by way of explanation to Dade County residents, these constitute land which rises and falls, in the Florida panhandle to the nose-bleeding altitude of 345 feet).

While central and north Florida's wetlands comprise major land areas (including North America's reputed largest wetland area: the Green Swamp), arable lands also were available without extensive drainage. Projects in the St. John's River District, for example, have included land acquisition for agricultural water retention, not drainage.

All the Districts continue to try to be all things to all their residents. Agriculture needs water to irrigate with when conditions are dry, but water removal when too much arrives. Urban dwellers need high quality water for recreational and domestic purposes. In order to survive, wildlife need areas to remain without excessive human manipulation or intrusion. All water-use demands are continuing to increase with the population. Local, state and federal agencies, elected officials and the people must continue to make integrative decisions in order to achieve an aquatic equilibrium with equal dampness to all.

Bibliography


Help Wanted

The people who write for this magazine are the same people who read it. If you read Aquatics magazine and have never contributed, then shame on you! Aquatics magazine needs your support. We accept a wide range of materials; including, but not limited to, all aspects of weed control, aquascaping, new or better pumping systems, pure science, human interest stories, etc. If it has anything to do with the field of aquatic plant management, then put it in print. Don't be shy, share your knowledge with your fellow professionals. SUBMIT...SUBMIT...SUBMIT
Successful Biocontrol of Water Hyacinth: A Documented Example

By
Kim H. Haag
Department of Entomology
University of Florida - IFAS
Gainesville, FL 32611

and
Ted D. Center
USDA ARS
3205 College Avenue
Ft. Lauderdale, FL 33314

Introduction

Reports on a decline in water hyacinth infestations have become more frequent in recent years. Yet there always remains the problem of documentation (Center 1982). It is rare to have a situation in which one person has been in an area long enough to notice a gradual weed decline. Even if this is so, data are seldom collected until the process is nearly complete and baseline data for comparison are by that time unavailable. Moreover, if declines are rapid at sites that are only infrequently observed, the changes may go unnoticed altogether. Economic realities are such that research funding is scarcely ever made available for monitoring of released biocontrol agents in the field. Yet from the standpoint of researchers and aquatic plant managers alike, data are essential in evaluating change and determining the primary causative factors.

In January 1986, we began a two-year study of the population dynamics and life history patterns of water hyacinth weevils at several field sites in north and south Florida. Our goal was to find relationships among climatic conditions, water quality, plant nutritional quality and weevil abundance and ecology. We tried to select field sites at which the water hyacinth were not damaged in any way, so that we could exclude impacts from herbicidal or mechanical weed control on the insect-host plant system. We also wanted water hyacinth sites that we were sure would persist for the full two years so that we could collect a complete data set.

One of the sites we chose was an abandoned phosphate pit in north central Florida. This pond was approximately 22 feet (7m) deep with a surface area of approximately 10 acres (4 ha). The pond water was nutrient-rich, and remained so throughout the study, with nitrogen concentrations as high as 2.1 ppm and phosphorous concentrations often up to 0.8 ppm. In November 1985 this pond was completely covered with a dense stand of large water hyacinth plants. The plants were large and robust so we felt certain we could have a viable field site for the duration of the study. Adult water hyacinth weevils were present at the site, averaging 1 weevil per plant.

Methods

We began collecting data on a monthly basis at this site in February 1986. Water samples were collected monthly and analyzed for nutrients (N and P) and other compounds. Information was collected on air temperature, water temperature, sunlight, wind speed and relative humidity, using a continuously-recording remote weather station. We collected replicated quantitative water hyacinth samples to determine plant density, size, biomass, and tissue quality (chemical composition), as well as weevil density and distribution of life history stages (larvae, pupae, adults). We also took qualitative insect samples to determine when weevils produced eggs and when they possessed the flight muscles that allow them to periodically disperse in the field.

Results and Discussion

The data are presented in Table 1, and show the decline in the water hyacinth population at Miner’s Lodge Pond during a 2-year period. Early in 1986 the pond was completely covered with frost damaged water hyacinth, with only a very small area of open water (5%). Plants began sending out new leaves in March as they recovered from winter damage (height 3rd leaf 25 cm). The biomass of live plant tissue averaged 408 g DW/m². Shoot density of these tall (36 cm), robust plants doubled over the next 3 months and biomass increased 2.5 times (1030 g/m²) as early summer plant growth occurred. Weevil populations declined slightly prior to and during this period of rapid plant growth. Water hyacinth biomass fell through the late summer as plant growth slowed in the higher summer temperatures. Leaf height was greatest at this time (41 cm), and weevil density increased to
127 m². Biomass of living tissue was still high in the fall (987 g/m²), whereas shoot density and leaf height both fell slightly. By this time water hyacinth covered about 76% of the pond surface, and Hydrocotyle increased to cover about 20% of the pond. Weevil density did not change significantly (122 adults/m²).

By February of 1987, Hydrocotyle was very abundant at Miner's Lodge Pond, effectively competing with water hyacinth for space. Weevil populations held steady and then reached a peak in March of 240 adults/m² as the overwintering population produced a new generation of adults. Feeding damage to leaves was very heavy at this time, with as much as 80% of most leaf surfaces damaged by weevil feeding scars. Living tissue biomass averaged 516 g DW/m² at this time and leaf height was only 17 cm. Fifty to 60% of the weevils in this period had developed flight muscles enabling them to disperse to other areas of water hyacinth infestation. This may account for the decline in weevil density during the next three months, which averaged only 89 adults/m². Weevils have been shown to disperse at this time of year in north Florida under similar conditions of high population density and declining plant quality (Haag 1986a,b).

The coverage by Hydrocotyle continued to increase and by the end of June water hyacinth covered only 30% of the pond. Much of the water hyacinth population was growing beneath a canopy of Hydrocotyle. These plants were small and short and total water hyacinth biomass averaged only 336 g/m², which is only 33% of the biomass present during the same period one year before. Through the end of the summer biomass increased slightly but plant density stayed low (66 ramets/m²). Water hyacinth covered only about 15% of the pond, and Hydrocotyle dropped out during the summer so there was an increasing amount of open water. Weevil density continued to decline (68 adults/m²) as available habitat diminished. From October to November, plant density increased as the smaller (leaf ht. 23 cm), stunted plants produced daughters. Biomass remained low (435 g/m²), approximately half of the value for the preceding year. By December, shoot density was very high (180 ramets/m²) but total pond coverage by water hyacinth was less than 5%. Plants were very short (10 cm) and biomass was only 272 g/m². Weevil density reached a low level of 42 adults/m². The pond was virtually all open water.

The decline in water hyacinth population at Miner's Lodge Pond was due to a high density of weevils and the concomitant heavy feeding damage that we were able to document. The weevil population responded to the excellent nutritional quality of the plants at this site (leaf tissue concentrations of N and P averaged 3.9% and 0.7%, respectively over the period of February to December, 1986) by overwintering in large numbers and producing a large spring generation. The plant mat was stable and

---

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Table 1. Changes in the water hyacinth plant population at Miner's Lodge Pond 1986-1987.

<table>
<thead>
<tr>
<th></th>
<th>Shoot Density (#/m²)</th>
<th>Plant Biomass (g DW/m²)</th>
<th>Ht. 3rd leaf (cm)</th>
<th>% surface coverage by water hyacinth</th>
<th># adult weevils per m²</th>
<th># adult weevils per Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb.-Mar.</td>
<td>72.5</td>
<td>408.0</td>
<td>24.8</td>
<td>95</td>
<td>101.5</td>
<td>249</td>
</tr>
<tr>
<td>Apr.-June</td>
<td>144.9</td>
<td>1,030.0</td>
<td>36.2</td>
<td>90</td>
<td>75.2</td>
<td>73</td>
</tr>
<tr>
<td>July-Sep.</td>
<td>69.2</td>
<td>739.0</td>
<td>41.5</td>
<td>90</td>
<td>127.1</td>
<td>172</td>
</tr>
<tr>
<td>Oct.-Dec.</td>
<td>80.9</td>
<td>987.4</td>
<td>33.9</td>
<td>75</td>
<td>122.3</td>
<td>124</td>
</tr>
<tr>
<td>1987</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan.-Mar.</td>
<td>91.5</td>
<td>515.5</td>
<td>16.8</td>
<td>60</td>
<td>207.7</td>
<td>403</td>
</tr>
<tr>
<td>Apr.-June</td>
<td>97.3</td>
<td>336.0</td>
<td>23.1</td>
<td>30</td>
<td>88.5</td>
<td>263</td>
</tr>
<tr>
<td>July-Sep.</td>
<td>66.2</td>
<td>435.1</td>
<td>30.6</td>
<td>15</td>
<td>68.4</td>
<td>157</td>
</tr>
<tr>
<td>Oct.-Nov.</td>
<td>98.7</td>
<td>475.4</td>
<td>23.4</td>
<td>10</td>
<td>54.3</td>
<td>114</td>
</tr>
<tr>
<td>Dec.</td>
<td>180.0</td>
<td>272.0</td>
<td>9.8</td>
<td>&lt;5</td>
<td>42.0</td>
<td>154</td>
</tr>
</tbody>
</table>

a A shoot consisted of any individual structure possessing ≥3 complete leaves and roots. N=3 per month.
b Biomass consisted of all live leaves, crown and roots of all shoots in the m² area. Material was over-dried for 47 hr. at 80°C. N=3 per month.
c The 3rd leaf is the leaf on each shoot 2 positions removed from the center of the shoot. See Center 1981. N=30 per month.
d Pod surface area coverage was estimated visually from the same vantage point each month.
e All adult weevils on 10 plants were removed and counted. This value was converted to density as follows: weevils/10 plants × # plants/m² = weevils/m². N=3 per month.

...continuous, allowing easy access to unlimited food resources by weevil larvae and adults. In addition, as water hyacinth growth slowed due to increased insect feeding damage, *Hydrocotyle* began competing successfully for space. The canopy of *Hydrocotyle* at the pond shaded the water hyacinth plants extensively and this additional stress further retarded water hyacinth growth in the winter and spring of 1987. Weevil populations eventually fell by December of 1987, but the concurrent and even greater decline in the plant population kept the “herbivore load” at high levels (see Table 1 — weevils/kg), thus maintaining pressure on the plants to the end.

When this study began we observed several other ponds in the immediate vicinity of Miner’s Lodge Pond completely covered with water hyacinth as well. By December of 1987 all of these ponds were also devoid of water hyacinth suggesting a scenario similar to that documented at Miner’s Lodge Pond. This is

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further evidence that if a water hyacinth infestation contains water hyacinth weevils and is allowed to remain free of manipulations which might impinge on the insect population, the insects may successfully control the plant (Center and Durden 1981).

Acknowledgments

The authors wish to thank Wiley Durden, Judy Gillmore, Margaret Glenn, Joe Hinkle, Ann Jones, Jackie Jordan, Terry Lott, Donna Niehaus and Helena Puche for their help in the field and lab. Dale Habeck provided additional facilities and support. This study was funded in part by the U.S. Army Engineers (USAE), Office of the Chief of Engineers, U.S. Army, Washington D.C. through the Aquatic Plant Control Research Program at the U.S. Army Waterway Experiment Station, and by the U.S. Department of Agriculture, ARS Cooperative Agreement No. 58-7830-5-570 and The Center for Aquatic Weeds, Institute of Food and Agricultural Sciences.

References


HALLER'S HISTORICAL HIGHLIGHTS

Where Did it Go?

Time passes quickly they say. Recent surveys show us that the majority of people active in aquatic weed control today have been in the profession less than 10 years. Thus, let's go back to 1960 and visualize if you can, rivers, streams, lake shores and canals totally covered with an aggressive, exotic, aquatic weed. You say, “well, I see that all the time”! But, not like it was in 1960, believe me. The major plant causing the problem in 1960 was introduced into the United States, probably in the late 1800s, possibly through the dumping of ballast from sailing ships. It was an emergent/ floating plant having hollow stems as big as your thumb. The lush green vegetation often grew to 3 feet high and as an old timer said, “it's like running your boat into a sea of binder twine.” The thick, intertwined mats of vegetation could support the weight of a man and provided excellent habitat for swamp rabbits. Floating mats completely clogged major tributaries of the St. Johns River, the Withlacoochee and many others. Santee-Cupper backwaters in South Carolina and shallow bayous of Louisiana provided favorable habitat to many thousands of acres of this plant. It was considered more of a problem than water hyacinth, primarily because few herbicides effectively controlled it. Certainly, esters of 2,4-D, silvex, 2,4,5-T and other materials of the day slowed its growth, but this plant was public enemy number one back in 1960.

Alligatorweed was growing rampant throughout the southeast from Texas to North Carolina when the U.S. Army Corps of Engineers asked for assistance and provided funds to the U.S. Department of Agriculture's Entomology Research Division of the Agricultural Research Service. Research literature of the 60s and 70s clearly documents the methodical search for the native range of alligatorweed in South America. Alligatorweed was found along most of the eastern coast of South America, but never growing to the extent that it was causing problems as in the southeastern U.S. Many insects were found to be feeding on alligatorweed in South America, but the alligatorweed flea beetle seemed to cause the most damage to this plant. After extensive food preference and reproductive studies it was determined that the alligatorweed flea beetle fed and reproduced exclusively on alligatorweed. It was also documented that the alligatorweed flea beetle was not present in the United States. Thus, in April, 1965, 260 adult alligatorweed flea beetles were introduced into the Ortega River alligatorweed mats and everyone involved in the project was sitting on their hands to see what would happen next.

By the following year literally thousands of alligatorweed flea beetles had decimated the alligatorweed in the Ortega River, and scientists collected these insects for movement to other areas of the southeast. Within 2 years, the alligatorweed flea beetle was in contact with all the major alligatorweed population in Florida, and the rest is history. Alligatorweed still is controlled in some areas in Florida today, primarily in ornamental ponds where people can't wait for the flea beetle to do its work, and in agricultural areas of south Florida where populations of the insect don't build up to high enough populations to be effective. Also, alligatorweed flea beetles can't tolerate cold weather along the northern range of alligatorweed growth and it is not effective against terrestrial alligatorweed. But by and large, alligatorweed problems are non-existent in Florida compared to 1960. Next time you see one of the yellow-black striped adults, show some respect as it's great, great, etc. grandparents were likely one of the initial 260 history making alligatorweed flea beetles introduced into the Ortega River.

Bill Haller

Alligatorweed flea beetle (Agaskles). Photo by Greg Jubinsky.
**Water Hyacinth Biocontrol: A Case History**

By

Mike Bodle

SFWMD Aquatic Biologist, West Palm Beach, Florida

NOTE: “The following observational report is based on one inspection and plant collection at the site described; conclusions are drawn from this qualitative inspection.”

On June 10, 1988 I met with a ranch owner in western St. Lucie County who had observed apparent biological control of the water hyacinth on his property. The 20,000 acre ranch has an extensive system of drainage canals that are permanently wet. The system is open to a ditch along a state road on the south and has a controlled outlet to a SFWMD canal on the eastern property line. Along with water, water hyacinth enters the property at the inlet. Floating aquatic plants observed in the canals were alligatorweed, salvinia and water hyacinth.

During the tour of the ranch, all of the hyacinth on the property, even at the inlet, were stressed to some degree. Leaves were reduced in size and unnaturally tightly curled. Petioles were slender as opposed to spongiform. Very few plants had inflorescences and those that did had unusually short spathes with few flowers. While nutrient deficiency could cause similar symptoms (wimpy plants and aerial plant parts reduction) it didn’t seem to be a factor. Low nutrients usually lead to an abnormally high root-to-shoot ratio yet there was no significant increase in the root mass size. Alligatorweed showed feeding scars of alligatorweed flea beetle, had few leaves and “clumps” of the plant were not extensive or lush. Shoreline plants included healthy pickerelweed, cattail, grasses and primrose willow. The ranch supports a healthy and varied wildlife population. Water was visibly flowing and shallow (one meter or less) in most of the ranch canal system, which has run dry only a few times during the owner’s lifetime.

The ranch owner said many of the canals had consistently had total water hyacinth coverage for many years. Aquatic herbicide applications were performed routinely until about five years ago. Since that time pesticide use on the property has been avoided to as great an extent as possible in keeping with the owner’s commitment to the wildlife on the ranch. Much of the ranch is devoted to low-intensity cattle production with extensive natural wooded areas kept intact, a minority is committed to citrus and rock mining. Several years after cessation of aquatic herbicide application water hyacinth started looking unhealthy in parts of the ranch. Damaged plants were moved around the ranch and the damage was seen to spread also. Eventually, without further effort on the owner’s part, canals opened up completely. Today, near the inlet to the ranch canals, water hyacinth coverage is complete as plants continue to enter the system. However, the further one proceeds from the inlet the greater is the damage evident on the plants.

Feeding scars of adult *Neochetina* spp. weevils were seen on leaf surfaces of plants throughout the ranch. Fungal infection as evidenced by dark streaking and massive discoloration on older leaves was seen. Many plants had more heavily-damaged leaves drooping to and below the waterline than erect, green leaves. Dead material weighted the most damaged plants to the point of pulling the crowns underwater. Within the ranch few water hyacinth were found except for mats at culvert crossings and other points of constriction. The majority of the ranch was free of water hyacinth.

On June 13, I took water hyacinth collected on the ranch to Dr. Ted Center, USDA Aquatic Plant Management Lab, Fort Lauderdale Agricultural Research Center. Many *Neochetina bruchi* and *N. eichhorniae* adults and larvae were extracted. Tunnels typical of larval feeding were omnipresent in the bud areas of the plants. The larval damage stops new leaf and daughter plant development in the plant core, severely retarding growth. Suppression of the plants at the ranch was obviously a result of the activity of the weevils, probably along with other factors such as fungal infection.

While no monitored weevil release has occurred in western St. Lucie County, the weevils have been found to be capable of flight. Also, many releases were made which were not specifically recorded or monitored. Interestingly, following initial Florida release of the weevils in August of 1972, some of Dr. Center’s first observations of hyacinth control by weevils were found in areas where herbicidal control was not performed due to inaccessibility or neglect. In such areas weevil populations apparently expanded to effective levels more readily than in areas of intensive chemical aquatic plant control.

Since all plants observed were relatively small, persistent plant feeding was ongoing. As their growth is suppressed, plants become even more vulnerable to weevil feeding and other pressures. Factors which would not be fatal to normal plants become so stressed ones. It has been shown in controlled settings that...
The 28th annual meeting of The Aquatic Plant Management Society, which convened last July in New Orleans, was both informative as well as exciting. Papers ranged from aquatic ecology to plant management and operations to pure science. The night life included the cajun style “Fais do do”, historic tours and, of course, Bourbon Street.

Every year the APMS annual meeting provides aquatic plant managers and scientists with current technologies and information as well as an interesting meeting site. As a member of FAPMS or any other of the regional chapters of the APMS, I encourage you to join the APMS and attend the annual meeting. Your membership includes the *Journal of Aquatic Plant Management*, which is published twice yearly. And also the APMS newsletters, published 3 times yearly. To join, send $35.00 to:

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ED DAVIS RETIRES

After ten years with the St. John’s River Water Management District, Ed Davis has decided to retire his hand gun. Ed entered the Aquatics Division in 1981 when the District took over the responsibilities for weed control in the Oklawaha Basin. The majority of Ed’s time will be spent at his home in the Ocala National Forest fishing, hunting and farming. When asked if he had any regrets, he replied, “I never did get to tell off ‘Leaping’ Lena Smith.”

NEW FACES — NEW JOBS — NEW POSITIONS —

Julie O’Connel is the latest addition to the DNR’s Bureau of Aquatic Plant Management in West Palm Beach. Her previous employment found her working for the Harbor Branch Oceanographic Institution at Big Pine Key field station in Monroe County. Julie received her B.S. degree in the biological sciences from Illinois State University.

Dan Thayer has recently moved to West Palm Beach to fill the Director of Aquatic Plant Management position at the South Florida Water Management District.

Dan’s father, Paul Thayer, recently retired to Gainesville where he works part-time at the Center for Aquatic Plants teaching Herbicide Technology and conducting research. Prior to moving to Gainesville, Paul was a research scientist with Elanco Products out of Dallas, Texas.

The DNR’s Bureau of Aquatic Plant Management recently went through an internal reorganization. As a result, Greg Juhinsky has moved from Grants Adm. to Research Adm., Larry Nall from Research Adm. to Permitting Adm., and Jeff Schardt from Permitting Adm. to Grants Adm.

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Oh yeah, one more thing. If you’re a musician, or just think you are (like me), be sure to bring your instrument. We plan to get an impromptu band together for some pickin’ and grinnin’. See you there.

CATTLALS

At the last Florida Aquatic Plant Advisory Council meeting there was some lengthy discussion over the DNR’s permitting procedures for emergent vegetation management. As a result, staff from the DNR will complete a literature search to determine documented emergent vegetation problems and benefits. Prior to the next council meeting, copies of the literature search will be sent to all council members for their comments. Eventually, information gathered from the DNR literature search and comments from council members will be used to set guidelines for permitting aquatic plant control.

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NO CAN SPRAY

In the last legislative session, a moritorium was placed on chemical spraying to control floating aquatic weeds in the St. Marks River till January 1993. The DNR has been directed to study the impacts of spraying (not spraying in reality) on water quality, fish and wildlife.

Case History
Continued from page 24

the weevils are capable of hyacinth control without other stress factors. However, the interaction of various factors such as water quality, nutrient availability, native pests such as mites, fungi and disease can play a contributory role.

Biocontrol can work, but slowly. As seen at the ranch once effective populations are established and suppressing plant growth, biocontrol can be self-perpetuating. However, operational constraints of maintaining the integrity of water delivery canals and flood control structures in south Florida preclude sole reliance on biocontrol for weed control. It simply isn’t possible to neglect weeds long enough for effective weevil populations to develop. It took several years, apparently, for the weevils to control the hyacinth on the ranch I visited. Many sites exist (such as water hyacinth-infested ditches along Florida’s turnpike) where Neochetina is found year after year and chemical aquatic plant control is not practiced yet water hyacinth persists.

Clearly some optimal, and as yet undefined, combination of conditions is needed for water hyacinth control by water hyacinth weevils.

Chemical control measures can impede biocontrol but results are more immediate. In public waters, few or no weeds can be tolerated. Operationally speaking, sections of weeds cannot be left untreated as potential insect nursery areas since weed control is quickly lost. Obviously, the ability to integrate both programs effectively is lacking. If such integration can be developed effective and less expensive control could follow.
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