Lake Apopka And Aquatic Weeds

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The problems associated with Lake Apopka are many and complicated but basically the lake is completely nutri-
fied and in an accelerated rate of eutrophy. It is a lake
that has been neglected by man and allowed to age or go
down hill rapidly.

There are many reasons why this lake is non-productive
at the present time. It has been determined by the Gover-
nor's Lake Apopka Technical Committee in their Final
Report (September 1968), that there are three major
sources of artificial nutrients entering the lake. These
are: pumped discharges from a large truck farming interest
on the north shore; citrus processing and sewage treatment
plant effluents on the south shore. There are minor natural
sources, being the springs in the Gourd-Neck area, ground
water leaching and overland drainage around the entire
lake.

A plan has been developed whereby these artificial
sources of nutrients will be either isolated, diverted or
treated prior to being released into Lake Apopka.

This still leaves a second problem, a lake that has
loose unconsolidated material on the bottom, and the
waters above having a tremendous algal growth with very
little rooted aquatic plant life throughout the lake. This
loose unconsolidated material has caused a condition where
game fish cannot spawn, and small organisms needed in the
food chain cannot survive. Consequently, there is a tre-
memdous population (±95) of gizzard and thread fin shad,
gar fish and a small game fish population (±5%).

Many research projects have been enacted on the lake
to ascertain the effects caused by this lack of aquatic weed
growth. The lake must have a firm substrate which will
support benthic organisms and provide a suitable habitat
so game fish can spawn. In the summer of 1967, fish reefs
were constructed of wood, concrete block, limestone, sand
and hyacinths. Most of these cribs or pens were 12' x 70'
long. All proved to be successful in raising a standing crop
of fish food organisms.

The hyacinth pen was unsuccessful because wave action
caus ed the plants to grate against the wire sides of the pen
causing them to break apart. The limestone and sand reefs
were the most practical to build and maintain. The lime-
stone reef supported adequate spawning habitat for fish.
The sand reef provided a suitable substrate for fish.
The sand reefs could also provide suitable substrate for
submerged aquatic plants to root.

Mud drying experiments were conducted by the Orange
County Pollution Department to ascertain if there were
seeds of both annual (land) and aquatic plants lying
dormant in this loose mud and silt of Lake Apopka, and
to determine whether or not this material (silt, muck,
peat, detritus) would consolidate when exposed to the
atmosphere.

In August 1967, bottom samples of Lake Apopka were
obtained to initiate this experiment. The top 6-12 inches
of the unconsolidated material was removed from the lake
bottom by means of a two (2) inch clear plastic sampler.
Samples were taken at water depths of 1, 3, 4, and 6 ft.
depths (the lake was at an elevation of 66.5 ft. above mean
sea level). Sample locations were on the north shore at
the two story pump house, west at Smith's Island, Gourd-
Neck area and on the East at Crown Point. Sealed wooden
boxes 2' x 2' x 9' high were obtained to hold the samples.
The samples were placed in containers (to a height of
seven (7) inches) and covered with window glass. They
were allowed to dry for eight weeks.

After this eight week period plants grew in most all
of the one (1) and three (3) foot samples. Most of
these plants were marsh plants (found in areas that are
normally both wet and dry depending on the time of the
year). "There were not many upland plants and there-
fore it is doubtful that they seeded from surrounding areas". (1)

From a cursory review of Table I Lake Apopka Silt
Drying Experiments it can be observed many marsh plants
grew in the one (1) and three (3) foot depths while few
if any grew in the four (4) and six (6) foot depths.
Numerous plants did grow at the six (6) foot depth in
samples taken from Crown Point. This might be explained
by the fact that this area is one of the most biologically
productive areas remaining in the lake. This biological
production is probably due to the sandy bottom material
of Crown Point.

It can be concluded from the 1967 mud drying experi-
ments that marsh plants would grow if the lake was drawn
down three (3) feet to the sixty three and one-half
(63.5 ft.) elevation, above mean sea level.

On October 15, 1967 the boxes were flooded with clear
well water to ascertain what type of aquatic plants would
grow after the extended (8 weeks) drying period. The
boxes were kept flooded continuously until June, 1968
when they were allowed to dry out for two (2) weeks to
simulate natural fluctuation of the lake. They were re-
flooded July 1, 1968 and kept full of clear water until
October 1968. Essentially the same plants continued to
grow (See Table 1).

In August of 1968, duplicate samples were obtained at
each of the sixteen (16) stations. The containers used to
hold the samples were the bottom twelve (12) inch section

45
<table>
<thead>
<tr>
<th>Location</th>
<th>Water Depth (feet)</th>
<th>Bottom Material</th>
<th>Amount Consolidated (inches)</th>
<th>Plant Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown Point</td>
<td>1</td>
<td>sand and shell</td>
<td>3</td>
<td>Not enough sample</td>
</tr>
<tr>
<td>Crown Point</td>
<td>2</td>
<td>sand and shell</td>
<td>5.5</td>
<td>3 grasses</td>
</tr>
<tr>
<td>Crown Point</td>
<td>4</td>
<td>sand and shell</td>
<td>3.5</td>
<td>4 grasses, Sagittaria</td>
</tr>
<tr>
<td>Crown Point</td>
<td>6</td>
<td>sand and shell</td>
<td>3.5</td>
<td>2 small arrowhead</td>
</tr>
<tr>
<td>Crown Point</td>
<td>6 and some muck</td>
<td></td>
<td>4</td>
<td>Typha</td>
</tr>
<tr>
<td>Crown Point</td>
<td>6</td>
<td>sand and shell</td>
<td>6</td>
<td>1 small arrowhead</td>
</tr>
<tr>
<td>Smith Island</td>
<td>1</td>
<td>muck</td>
<td>4.5</td>
<td>2 small pigweed</td>
</tr>
<tr>
<td>Smith Island</td>
<td>3</td>
<td>muck</td>
<td>5</td>
<td>2 large pigweed</td>
</tr>
<tr>
<td>Smith Island</td>
<td>4</td>
<td>muck and shell</td>
<td>4</td>
<td>1 water hyacinth</td>
</tr>
<tr>
<td>Smith Island</td>
<td>6</td>
<td>shell (great shrinkage)</td>
<td>4.5</td>
<td>1 pickerel weed or arrow arum Pontederia or Peltandra</td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>1</td>
<td>muck</td>
<td>6.5</td>
<td>1 large sedge</td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>3</td>
<td>muck</td>
<td>6.5</td>
<td>3 large pigweed</td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>4</td>
<td>muck</td>
<td>6</td>
<td>1 grass</td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>6</td>
<td>muck</td>
<td>6</td>
<td>1 rush or bulrush</td>
</tr>
<tr>
<td>Two Story</td>
<td>1</td>
<td>muck</td>
<td>4</td>
<td>1 rush or bulrush</td>
</tr>
<tr>
<td>Pump House</td>
<td></td>
<td>muck</td>
<td>4</td>
<td>Juncus or Scirpus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peat and shell</td>
<td>3.5</td>
<td>1 rush or bulrush</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peat</td>
<td>2.5</td>
<td>3 pigweed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peat</td>
<td>1.5</td>
<td>2 sedge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peat and shell</td>
<td>3.5</td>
<td>nothing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peat</td>
<td>2.5</td>
<td>nothing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peat</td>
<td>1.5</td>
<td>nothing</td>
</tr>
</tbody>
</table>

of fifty-five (55) gallon drums. These drums were cleaned, scraped and coated with asphalt paint both inside and outside for protection. Once again the top six (6) to twelve (12) inches of the silt was obtained from the four (4) different locations. Each sample was approximately nine (9) inches deep and they were taken back to the Orange County Pollution Department laboratory in Orlando where they were then covered and allowed to dry for eight weeks. The plants in each container were then counted and identified. (See Table II).

After this, they were flooded, one set with Lake Apopka water, and the other set with clear water. Table II is only the data on the drums flooded with Lake Apopka water. Essentially the same results were obtained in the samples flooded with clear water. Also, samples from each of the sixteen (16) stations were taken back to the base camp laboratory where they were dried on the shore edge using the middle twelve (12) inch section of the fifty-five (55) gallon drums. A portion of the shore line was prepared with three (3) inches of coarse sand to support the samples. The containers (open on both ends) were submerged approximately six (6) inches into the lake edge on the prepared sand. As the lake level fluctuated it was hoped that this would simulate natural drying conditions. Unfortunately the lake rose a foot (approximately 67.5 mean sea level) during October, 1968 and was held at this level throughout the fall and winter keeping the containers inundated.

The complexity of the problem is indicated in the "State Board of Health Report, 1962 - 64 Physical, Chemical and Biological Report on Lake Apopka".

"Failure of the submerged aquatic vegetation to recover following the hurricane as a result of a reduced transparency of the water caused by the first algal bloom of record (DeQuine, 1950) is not, within itself, a complete explanation. The dependence of these plants upon the substrate was demonstrated experimentally by Bond (1918).

Vallisneria (Vallisneria spiralis) was found to be dependent upon the soil for sufficient supplies of nitrogen, potassium and phosphates. While the uprooted plants were capable of synthesizing starch, they were unable to maintain a starch proteide balance and died as a result of this imbalance.

The extent to which the litter of uprooted plants may have affected the regrowth of the remaining plants or the germination of seeds is also unknown. Viable seeds have been found to be present in the bottom muds. Since no tendency toward recovery was observed during the fall of 1962 and the spring of 1963 when the water was clear, it is obvious that conditions during the seventeen years subsequent to the hurricane have not been favorable or that other environmental conditions must be satisfied as a prerequisite". (2)

Comparing Tables I and II it would appear that drying would facilitate emergent shoreline vegetation growth. Lilypads grew in the samples from Smith Isle and Gourd Neck. The only submerged aquatics noted was Chara and Sagittaria. Chara does not seem to be significant here, and the Sagitteria may turn out to be emergent rather than submerged. Clugston (4) reported that Lake Apopka supported Eel grass, Southern naiad and variable pond weeds as well as all aquatics. Unfortunately, these did not grow during the 1967-68 experiment. This does not mean that they will not grow if the lake is drawn down and this loose unconsolidated silt allowed to dry out and other pollution sources are corrected.

With regards to mud consolidation, while all of the samples showed shrinkage during the drying period, samples with large amounts of plant fiber and one muck sample, seemed to suspend when they were reflooded (at the six (6) foot water depth). For most of the samples, after shrinkage and oxidation, they remained consolidated and did not resuspend.

From Table II, it is interesting to note that none of the mud samples consolidated to a high degree that were taken at the 6.5 foot water depth. (60.5 ft above mean sea level). This would indicate that the lake level has never receded below a 59.0 to 61.0 ft. mean sea level for any extended period of time.

The conclusion of this experiment indicates that artificial substrate material of sand and limestone can be placed in Lake Apopka on top of the loose unconsolidated mud and will support suitable benthic organisms and probable game fish spawning. Further, from the drying experiments it was surmised from the 1967-68 experiments that when the bottom muds are dried out (to a water level of 59 to 61.0 ft above mean sea level) a balance of aquatic weeds and shore line (emergent) vegetation will grow. Further, the silt will oxidize and will not resuspend.
upon flooding. If a sufficient annual and aquatic plant growth prevails this would help to consolidate the bottom materials. From these experiments it can be concluded that if Lake Apopka is drawn down to a maximum of 59 to 61.0 feet above mean sea level for six to eight (6-8) weeks, during the dry season, a suitable aquatic weed growth should result. From all indications it might take more than one draw down to accomplish the desired results.

TABLE 2. LAKE APOPKA SALT DRYING—1968

<table>
<thead>
<tr>
<th>Location</th>
<th>Water Depth (feet)</th>
<th>Bottom Material</th>
<th>Consolidated (inches)</th>
<th>Condition After Flooding Lake Apopka H2O</th>
<th>Plant Identification</th>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown Point</td>
<td>1.5</td>
<td>Sand &amp; Shell</td>
<td>1.25</td>
<td>Consolidated</td>
<td>Dog Fenel</td>
<td>Polysiphonia Sp.</td>
<td>Capillillan</td>
</tr>
<tr>
<td>Crown Point</td>
<td>3.5</td>
<td>Sand &amp; Shell</td>
<td>1.0</td>
<td>Consolidated</td>
<td>Fox Tail grasses</td>
<td>Seteria Sp.</td>
<td></td>
</tr>
<tr>
<td>Crown Point</td>
<td>4.5</td>
<td>Sand &amp; Shell</td>
<td>1.5</td>
<td>Consolidated</td>
<td>Careless Weed</td>
<td>Acnida Cuspidata</td>
<td>Chara</td>
</tr>
<tr>
<td>Crown Point</td>
<td>6.5</td>
<td>Sand &amp; Shell &amp; Some Muck</td>
<td>2.5</td>
<td>Consolidated</td>
<td>No uplands</td>
<td>Sagittaria</td>
<td></td>
</tr>
<tr>
<td>Smith Island</td>
<td>1.5</td>
<td>Muck</td>
<td>3.5</td>
<td>Consolidated</td>
<td>Arrowhead (?)</td>
<td>Pontederia Sp.</td>
<td>Acnida Cuspidata</td>
</tr>
<tr>
<td>Smith Island</td>
<td>3.5</td>
<td>Muck</td>
<td>3.0</td>
<td>Consolidated</td>
<td>Pickrel Weed</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>Smith Island</td>
<td>4.5</td>
<td>Muck &amp; Shell</td>
<td>3.0</td>
<td>Consolidated</td>
<td>Careless Weed</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>Smith Island</td>
<td>6.5</td>
<td>Muck</td>
<td>2.25</td>
<td>Unconsolidated</td>
<td>Water Lily</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>1.5</td>
<td>Muck &amp; plant fibers</td>
<td>4</td>
<td>Unconsolidated</td>
<td>Water Lily</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>3.5</td>
<td>Muck &amp; plant fibers</td>
<td>3</td>
<td>Unconsolidated</td>
<td>Water Lily</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>4.5</td>
<td>Muck &amp; plant fibers</td>
<td>3.5</td>
<td>Unconsolidated</td>
<td>Water Lily</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>Gourd Neck</td>
<td>6.5</td>
<td>Muck &amp; plant fibers</td>
<td>0</td>
<td>Unconsolidated</td>
<td>Water Lily</td>
<td>Nymphaea Sp.</td>
<td></td>
</tr>
<tr>
<td>2 Story Pump House</td>
<td>1.5</td>
<td>Muck &amp; Peat</td>
<td>0</td>
<td>Consolidated</td>
<td>Pickrel Weed</td>
<td>Nymphaea Sp.</td>
<td>Acnida Cuspidata</td>
</tr>
<tr>
<td>2 Story Pump House</td>
<td>3.5</td>
<td>Peat &amp; Shell</td>
<td>0</td>
<td>Consolidated</td>
<td>Sedge</td>
<td>Chara</td>
<td></td>
</tr>
<tr>
<td>2 Story Pump House</td>
<td>4.5</td>
<td>Peat</td>
<td>0</td>
<td>Consolidated</td>
<td>Sedge</td>
<td>Chara</td>
<td></td>
</tr>
<tr>
<td>2 Story Pump House</td>
<td>6.5</td>
<td>Peat</td>
<td>2</td>
<td>Consolidated</td>
<td>Sedge</td>
<td>Chara</td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES

3. Mr. G. Kenneth Schudder, Jr., U.S.D.A. Identified the annual plants.
4. Mr. James P. Clugston—Lake Apopka—“A Changing Lake and Its Vegetation.” Florida Game and Fresh Water Fish Commission.