gill and largemouth bass, good food and cover; Cattails — supports insects; Bladderwort — good food and cover; Eel grass — good shade and shelter, supports insects, and is valuable fish food.

H. S. Swingle and E. V. Smith (1943) reported that they planted Chara in Lake Auburn and allowed cattails to grow around the edge. Lake Auburn is located 5 miles from Auburn, Alabama, and was the subject of a 10 year study to determine the effects of fish management practices. The study was reported in two periods and Swingle states that during the second period, no pond weeds were allowed to grow in the pond and all cattails were removed from the edge because experiments had shown that the growth of plankton, instead of weeds, would result in greater fish production and better fishing at the start of the second period. Swingle decided to flood a luxurious growth of jungle-rice which had grown on the pond bottom while the dam was being repaired. These decaying weeds furnished an abundance of food in the pond from August to December, 1938. Their use for this purpose was found to be a mistake since the lignified stems were resistant to decomposition and wherever present interfered greatly with fishing during the next two years.

As you can see from the literature that I have cited above, there are two sides to the problem of aquatic vegetation in fishing waters.

I would like to point out that in the case of pond management (water areas under 5 acres) most authors agree that the presence of algae as a source of fish food is desirable. The Florida Game and Fresh Water Fish Commission recommends land owner to add fertilizer to ponds to increase algae and plankton growth for two reasons.

1. To provide a source of food for young fish.
2. To help prevent sunlight from reaching the pond bottom in order to stop the growth of the higher aquatic plants.

The question of the higher aquatic plants is more complex. Large concentrations of water hyacinth and water lettuce can interfere with lake and river navigation. On the other hand the root systems of both hyacinth and water lettuce are filled with aquatic insects on which largemouth bass and sunfish feed. In closing I would like to point out the fact that very little work has been done on the relationship of aquatic vegetation to fish life in the State of Florida.

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The Value Of Water Hyacinth In The Propogation Of Fish

By Captain Noah J. Tilghman

A life long resident of Putnam County, reared on the St. Johns River and Palatka, I feel qualified to explain the value of water hyacinth and its importance with nature in the development of our natural resources "FISHING".

For the love of boating and sports fishing, I started making this my career about 1912, with the purchase of a 43 ft. Cruiser, and several fishing boats. We would entertain out-of-state visitors black bass fishing, for periods of three days to a week. The interest and pleasure of our clients justified the building of Noah's Ark in 1930, which has been a successful operation.

Florida's first water hyacinth was placed in the St. Johns River by a winter visitor, Mrs. W. F. Fuller at San Mateo, five miles south of Palatka. This beautiful flower attracted much attention, and has a rightful place in this land of flowers. We have entertained many parties that would make reservations so as to be here when hyacinth are blooming. To catch a big bass along this green shore line of blooming hyacinth, results in return reservations.

Stationary hyacinth along a shore line where the water is about two to four feet deep is a haven for all kinds of bug life, especially along a wooded area where spiders and frogs inhabit for their food like midges, candleflies. In hyacinth roots are found hardback shrimp, crawfish, and other water bugs, the kind of food required for small fish of all kinds. From the time a fish is hatched from an egg it starts seeking cover, or be devoured by larger fish. There is no better cover than hyacinth roots and between the leaves.

Hyacinth roots extend about 12 to 15 inches in the water, making it possible for fish to feed under and between the roots. It is an old custom for fishermen to make a hole in a hyacinth bank, drop a hook and bait just below the hyacinth roots and you are most certain to catch your fish.

Hyacinth are a floating plant, feed entirely on substance in the water, therefore, this growing plant aids water purification and life, needed for fish propogation. Dead or rotten hyacinth on the water surface or the river bottom are a menace for Nature's act of producing life and beauty for man, fish, or beast.

Growing hyacinth along a shore line prevent bank erosion, by quieting the waves, and water around the tree roots, from washing sand and soil, that does in time fall the trees. Fish definitely require shade and avoid high temperature of water during summer months. Hyacinth provide shade and cools the water from a direct sun-ray, reducing the water temperature.

We now know from experience green growing water hyacinth are an asset to the propogation of fish in the St. Johns River. Fishing records and harvesting of commercial fish produced the greatest catches during the time when water hyacinth were most plentiful.

Hyacinth spread around the roots of orange trees have proven beneficial to the growth of the trees and growth of the fruit. The problem of the farmer is to harvest hyacinth from the water. When hyacinth are made available in a package, so they can be handled profitably, farmers will learn their value used as a mulch in Florida's sandy soil.

Drifting acreage of hyacinth in navigable streams are a menace to boat navigation, which is necessary to control. Hyacinth acreage can easily be removed by the use of a power harvesting machine placed on the bow of a boat. The harvester designed with an elevated conveyor moving hyacinth into the boat hull. A hay-baler conveniently placed in the boat, where hyacinth can easily be dumped, will pack and bundle them in packages the size that can easily be handled. A boat loaded with bales of hyacinth moved to the river bank, where they are unloaded, provides the farmer with a good mulch around tree roots that will hold moisture and fertilizer in sandy soil.

The use of 2,4-D has no good results, and should be used only in extreme necessity for clearing water-ways and boat navigation. It not only kills hyacinth but other plant life, growing flowers, and farm produce. It should be the objective of every Floridian to want to keep Florida green and productive for nature's beauty, and the joy of living in a live and productive outdoors.

Herbicidal Operations In Relation To Water Supplies

Florida State Board of Health Bureau of Sanitary Engineering Division of Water Supply

S. N. Finney, Jr.

The use of weed killers, herbicides and related chemicals on

or around surface waters may result in contamination of water supplies for various municipalities. Some of those cities in Florida which could be affected by weed control operations on nearby watersheds would be Tampa, Arcadia, West Palm Beach, Bradenton, and Melbourne, to mention but a few.

One of the effects of such chemicals, perhaps modified into other substances by treatment processes, for instance alum coagulation, may be the production of very unpleasant tastes and odors. These may be intensified by treatment with chlorine, which may chlorinate the molecule. The case with phenol in amounts greater than 0.001 mg/1 is well known among the water works profession; chlorine intensifies the odor of phenol in water very strongly, and it reacts similarly with many organic compounds.

To show the diversity of chemical types among the various herbicides, the following list, by no means exhaustive, is offered for your consideration: "CMU" is 3-para chloro phenol dimethyl urea, a phenol derivative of urea, chlorinated.

"2,4D" is 2,4 dichloro phenoxy acetic acid, a phenol derivative of acetic acid, chlorinated.

"dichlone" is 2,3 dichloronaphthoquinone, a chlorinated naphthoquinone, derived from napthalene.

copper sulfate ("bluestone") is an inorganic compound, used primarily as an algicide.

sodium arsenite (no common name) is also an inorganic compound, but used for submerged weeds (some are algae).

"PMA" is phenyl mercuric acetate, a phenol derivative containing complexed mercury (no ions).

aminotriazole is an alicyclic nitrogenous organic compound (no chlorine).

potassium cyanate is another inorganic compound, not closely related to cyanide in spite of similar name.

"Ferbam" is ferric dimethyl dithio carbamate, a thiourea derivative, usually an algicide.

The effects of the various herbicidal chemicals on the human physiology are largely unknown. Although in the dosages employed for weed control they may not be "poisonous" or result in the death of those drinking the water; they may on the other hand possibly interfere with enzyme action of one kind or another, or affect the central nervous system adversely, or perhaps produce other unpredictable and undesirable effects. Just feeding handfuls of any of the pesticides to laboratory animals and demonstrating a high L.D./50, does not prove them safe for man at low levels of intake.

Some house plants, notably hibiscus, altheas, hollyhocks and in general, the malvaceae, are sensitive to truly minute quantities of 2,4D. When a plane in Texas several years ago sprayed a field with this material and cotton was destroyed many miles away, it was calculated that no plant could have received more than microgram amounts of the weed killer, yet the entire crop was lost. It is possible for whole towns to be defoliated by the herbicides carried in the water supply, if care is not exercised to keep them out of that supply.

The detection and quantitative estimation of these exotic substances by the carbon chloroform extractables procedures is cumbersome, time-consuming and subject to errors and interferences. It would add a considerable burden to the operational load already imposed on those employed in treating surface water. This test consists of passing large measured volumes of pre-filtered or pre-strained water through beds of activated carbon, a typical volume being 1000 gallons, and, after drying, the extraction of the carbon material with chloroform, evaporation of the chloroform and the direct weighing of the chloroform — extracted residue. A suitable correction factor gives parts per million or parts per billion, depending on the quantity of material present.

There is a rough analogy here with bacteriological testing in that this indicates to a greater or less degree contamination by all exotic organic material. But carbon has a much greater affinity for some organic pollutants than for others. Chloroform, for instance, is not taken up during the extraction because its one carbon atom is modified in its effects by the presence of three big, inorganic chlorine atoms (plus one hydrogen). Carbon dioxide, with one carbon atom and two oxygen atoms, is considered inorganic by most chemists, it has so little in common with most other carbon compounds. So you see, the carbon chloroform extractables test, which is at present our most reliable procedure, is at best limited in its precision and accuracy.

Removal by treatment: Alum coagulation, because of the affinity of the aluminum hydroxide floc for organic materials, doubtless would remove a percentage but not all of suspended as well as dissolved organic herbicides. The arsenic-containing ones might not be stopped at all, but likely would pass through into the effluent. Nearly all arsenic compounds are soluble when we consider the parts per million range. The detective stories, as well as actual case histories, are full of chronic arsenic poisoning by accumulation of sublethal doses of this cumulative poison.

Activated carbon is credited with removal, more or less complete, of organic matter dissolved in water and responsible for natural tastes and odors. This holds good for most hydroxylated organic derivatives, even though some are highly complex. However, as noted above, when chlorine and some other elements enter the molecule, carbon has less affinity for the substance. We, therefore, should not depend on activated carbon to remove the typical herbicide, which contains, as a rule, chlorine and perhaps nitrogen and phosphorus or sulphur as well.

Breakpoint chlorination. While many organic substances can be "burned out' by breakpoint chlorination — and I'll spare you the details of the process because of limited time — not by any means all of them can be removed in this manner. Some which contain nitrogen (i.e. the triazines) will form highly stable complexes with active chlorine, and cannot be "burned out" at any reasonable dosage. So we cannot look to breakpoint chlorination with any degree of certainty for removal of herbicides.

In short, the herbicides in general may be considered as undesirable additives for potable water. The processes available in the best operated water treatment plants for surface water cannot be depended on to remove all kinds or all amounts of these chemicals. Let us, therefore, take pains to prevent their reaching potable water sources, and keep weed control sprays, as well as other pesticides, off our watersheds insofar as possible, understanding all the while that small local applications may be found necessary in isolated instances.

Dacamine: Oleoyl 1,3 Propylene Diamine Salts Of 2,4-D and 2,4,5-T

(An Oil-Soluble, Water-Emulsifiable Amine Salt of 2,4-D and 2,4,5-T)

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Water-soluble amine salts of 2,4-D and 2,4,5-T have been used for many years in brush control work because of their non-volatile nature. They have been recognized as being less effective than the oil-soluble, water-emulsifiable ester formulations. The erratic effectiveness of these amines has been partly attributed to the cutin and cutin waxes on the leaf surface, which are relatively impervious to penetration by the water-soluble amine sprays.

With the above facts in mind, it becomes obvious that the "ideal" product would combine both the advantages of esters and amines. In order to test the practicality of this hypothesis, several oil-soluble, water-emulsifiable amines were produced, screened, and field tested.

Initial laboratory studies were set up to test a series of long chain oil-soluble amines. Most of these amines were of a viscous nature, some very viscous. Preliminary screening results pointed to the use of the Duomeens. Since the physical handling of these materials would be of great significance, the oleoyl trimethylene diamine (Armour's trademark name is Duomeen-O) was selected. Another reason for the use of a diamine is that it contains two reactive sites and, therefore, one part of diamine will react and combine with 2 parts of 2,4-D acid.

At the present time the above-mentioned salts of 2,4-D and 2,4,5-T are being formulated as 2 pound concentrates; that is, 2 pounds acid equivalent per gallon of 2,4-D; 2,4,5-T; and 1 pound acid equivalent per gallon each of 2,4-D and 2,4,5-T (2 pounds total). There was no chemical reason for the production of the 2 pound concentrate since chemically they could be made up to contain approximately 4 pounds acid equivalent per gallon. However, due to the viscosity of this 4 pound material, especially at low temperatures (about 10 degrees Farenheit,) it was felt the handling of this material would be