their principal tributaries in Louisana and are now placing many of them on an occasional maintenance basis. However, since the water hyacinth is a growing crop and spreads from seeds as well as vegetative shoots, constant work must be undertaken to hold the gains so far achieved.

The State of Louisiana, through its Wild Life and Fisheries Commission, became interested in water hyacinth destruction in the early 1940s. Its prime interest was to improve those waterways and inland lakes used by the sportsmen. This work was carried on independently although there was informal contact between the operating crews of the State and Engineers. In 1947, the State built a small elevating conveyor similar to those used by the Engineers and employed this machine to good advantage. However, the conveyor was eventually abandoned for the same reason that those used by the Engineers were taken out of service.

In 1948, the U. S. Army Engineers working in conjunction with the U. S. Department of Agriculture, the Department of the Interior, and the Public Health Service, submitted a report on existing conditions and made recommendations for future operations. As a result, Congress authorized a 5-year expanded aquatic weed control project in 1958 which enabled the State and U. S. Army Engineers to undertake a joint operation on a cost sharing basis. This joint venture has permitted an extensive, coordinated campaign against the water hyacinth throughout the entire State of Louisiana. Utilizing the larger and heavier equipment of the Engineers to open up avenues of approach and the lighter equipment of State for destroying the vegetation in the smaller tributaries, much progress has been made and at this time (1961) all major waterways and their principal feeder streams as well as many of the inland lakes in north Louisiana are now comparatively free of the pest growth.

The water hyacinth problem reached a peak in the late 1930s as a result of the widespread distribution of the plants during the great flood of 1927 and the completion of the Intracoastal Waterway in the early 30s, which served as a connecting link between infested areas and those hitherto free from the vegetation. Numerous new canals to serve oil well, etc., added to the problem and increased the mileage of streams requiring urgent attention. It was not uncommon during the early 1940s to learn that war traffic was being hindered in some places by the jams of water hyacinths.

However, as new equipment was developed to meet the emergency and new techniques were utilized for the destruction of the water hyacinth, progress was made towards the control of the pest growth in the waterways important to the war effort.

Using a well balanced mechanical and chemical attack on the water hyacinth based on a sound plan of operations has produced results which have completely changed the entire aspect of the overall picture. In the years since 1950, the combined efforts of all those engaged in aquatic vegetation control in Louisiana have succeeded in reducing the areas of infestation in the many usable streams to a point where the water hyacinth is no longer considered to be the serious menace that it was only a few short years ago.

The results of sixty years work in destroying the water hyacinth has resulted in opening some 3,000 miles of waterways and numerous inland lakes to those who use the waterways of Louisiana for sport or livelihood. The water hyacinth has been driven back to the dense swamps and to private grounds where access is impracticable at this time. All of the cleaned waterways are now on a maintenance schedule and the gains achieved in the past few years are held by these operations. Constant observation must be maintained on this pest growth for a few years. Neglect might well wipe out the excellent degree of control which is now evidenced.

The water hyacinth is a dangerous threat as long as some still grow in isolated waters, but it can be destroyed.

William E. Wunderlich
Chief, Aquatic Growth Control Section
New Orleans, Louisiana, October 25, 1961

Hyacinth-Obstruction To Navigation

JULY 1962

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Who? The Corps of Engineers.
Where? Florida.
What? Water Hyacinth.
Why? Obstruction to Navigation.
When? 1884 to Present.

Accounts vary as to the country of origin of this troublesome plant and many are the stories concerning the introduction of hyacinth into this country. A report dated 1898 stated that it is a native of tropical South America and was "introduced into this country many years ago." The first authentic account of its presence in the United States was at the New Orleans Cotton Exposition in 1884. The plant is eye-catching, beautiful and tempting. Some nameless Floridan found it so attractive that he procured some of the plants to place in a lawn fountain at his home on the banks of the St. Johns River somewhere close to Palatka, Florida. Of course, the plant multiplied rapidly and the excess was thrown into the nearby river. By 1896 the plant had spread at an alarming rate and was seen throughout most of the St. Johns River Basin. By 1900, hyacinth had taken over the river at Palatka to such extent that it became a curse to navigation in that steamboats and other craft were unable to reach docks or pass through navigation openings of bridges. Since then it has spread in Florida from as far north as the Suwannee River to as far south as Florida's famous Everglades.

In favorable environment where the plants are seldom killed by frost, hyacinth attain a height of 50 inches and a density of 200,000 plants per acre. In more northerly areas where the growth is checked by low winter temperatures, the plants quite naturally are smaller and reach a density of 450,000 or more per acre.

All hyacinth flower produce seeds, but under normal conditions only about 5 per cent of the seeds germinate. These seed capsules are three-celled and each bears from 3 to 250 tiny seeds. Therefore, a stand of medium-sized plants can produce as high as 45 million seeds per acre. However, the principle method of reproduction is by stolons which grow laterly below the water surface from the rhizomes at the center of the plant. When these attain a length of some 6 inches, a new plant forms, which in turn, sends out stolons to form other new plants. In this manner, plants can double in number within 10 days. Under ideal conditions, 10 plants can cover an entire acre in 10 months.

The Corps of Engineers became concerned about hyacinth obstructing the navigable waters of the south as early as 1897. Below is a quote from the Annual Report of the Chief of Engineers for 1900:

"Removing the water hyacinth from Florida Waters.—Under the provisions of the sundry civil act approved June 4, 1897, a Board of Engineer Officers was appointed to investigate the extent of the obstruction of the navigable streams of Florida, Louisiana, and other South Atlantic and Gulf States, by the aquatic plant known as the water hyacinth, and to perform such experimental work as might be deemed necessary to determine a feasible plan or method of checking or removing such obstructions.

"The report of this Board, dated November 30, 1898, is printed in House Doc. No. 91, Fifty-fifth Congress, third session, and on page 1615 of the Annual Report of the Chief of Engineers for 1899. In Florida the Board found that the main channel of the Upper St. Johns River was affected by the plant, while many of the smaller channels were completely blocked. The Board recommended the construction of a steamer fitted with crushing machinery, and the use of log booms as adjuncts to the operation of the boat.

"The river and harbor act approved March 3, 1899, appropriated $25,000 for the construction of a boat, $1,000 for log booms, and $10,000 for operating expenses. Under this provision it is proposed to design a suitable boat and have same built by contract. Some work has been done on plans, but the matter has been deferred pending results of a test of the boat procured for the Louisiana district.

"During the winter of 1899-1900 the tops of the plants in the St. Johns River were destroyed by a frost which has retarded their interference with navigation. Recent reports indicate that the plant is becoming troublesome in the Withlacoochee River on the Gulf coast."

Hyacinths are also obstructive to aircraft. During World War II large scale seaplane operations were conducted in the St. Johns River at the Jacksonville Naval Air Station. It was found that hyacinth even in small concentration were a serious

menace to seaplane operations. At the request of the Navy a boom or trap was constructed across the river about 10 miles below Palatka to stop all drifting hyacinths.

The most elementary method of removing hyacinth is to drag or throw them onto a bank by hand with rakes or forks, there to dry out and die.

For many years, the common method of removing obstructive jams from navigation channels was to break them up by hand and by boats so that they would float downstream and ultimately reach salt water.

Another successful method has been the "Conveyer." This is a barge-mounted machine in which the hyacinth are pulled or pushed onto an endless belt conveyor which lifts them from the water and deposits them on the bank. Barge-mounted equipment with a boom and forked grapple has also been used to deposit plants on shore. Crusher boats lift the plants out of the water on an endless belt conveyor from which they are passed between heavy, power-driven rollers which crush the hyacinth into a pulp. The plants are then returned to the water to decompose and settle to the bottom. This method results in an almost complete kill of the plants that pass through it, but can only be used effectively in water deep enough to float the barge and where the hyacinth are massed over a considerable area so that they can be fed to the machine continuously and in large amounts.

The most effective mechanical destroyer used has been the sawboat. Whirling saws cut the hyacinth leaves and rizomes, leaving behind a floating mass of shredded material which dies and sinks to the river bed. This usually takes about 2 weeks.

The principal limitation of the sawboat is that it cannot operate in water much less than 18 inches deep. So this, of course, leaves a belt or fringe of undestroyed hyacinth in the shallow water adjacent to the banks of the waterways.

Close study of these methods reveal they all have one thing in common; that is, they are too slow to keep up with the rapid growth of the hyacinth in a large area of infestation.

An effective killer for many years on some of the waterways was spraying the plants with Sodium Arsenite. This solution gave a swift and complete kill. Though quite satisfactory results are achieved with this chemical it is most dangerous to personnel handling it. Then too there was danger to other vegetation and cattle. So much so that the State of Florida imposed the restriction that "no chemical process injurious to cattle which may feed upon the water hyacinth shall be used." From that time on Sodium Arsenite was abandoned in the interest of safety.

The weed killing properties of 2,4-D were first realized in 1941 and the first field trials were made in 1944. In 1946, representatives of the United States Department of Agriculture in cooperation with the District Engineer, Jacksonville, and the Everglades Experiment Station of the University of Florida, conducted tests of 2,4-D in Florida to prove that it is harmless to fish, cattle and wildlife.

Further tests and extensive field operations have shown that the basic rate of application should be approximately 2 pounds of acid equivalent per acre of hyacinth. This may be applied in various concentrations depending on weather conditions and the size of the hyacinth being sprayed. It has been found that when using chemicals having 4 pounds of acid per gallon a good kill can be obtained with a mixture of 2 to 4 pints of chemical to 50 gallons of water.

Small inboard motorboats were developed for use in spraying navigation channels; they are economical and effective and are still being used in appropriate locations.

In March 1960 operations were started on the Expanded Project for Aquatic Plant Control in cooperation with the State of Florida Game and Fresh Water Fish Commission.

It was realized that the inboard motorboats would not operate in the extremely shallow waters that now had to be treated. A study of many types of equipment was made and the airboat was chosen because it best met the overall requirements. It was found during operations that an airboat could cover the same areas as an inboard or outboard boat in about half the time and do a better job. Airboats are also able to work in exteremely shallow waters, going over logs, through heavy growths of hyacinth and working in hyacinth jams in a fraction of the time required for sawboats, inboards and outboards. In many instances airboats work in places no other type of equipment can operate. Overall, the airboat is proving to be the most economical and effective piece of floating equipment used in destroying hyacinth.

Where large masses of hyacinth are concentrated in open areas the most economical method of initial destruction is by aircraft spraying. This type of spraying has been utilized in all areas where it has been practical.

The most efficient spray pump being used by the Corps is the high pressure John Bean Royallette 10 GPM Pump. This is operated at 300 psi with a John Bean quick-acting trigger valve spray gun with adjustable barrel using a number 10 tip.

In areas now being treated under the APC Program by the Corps of Engineers and the Game and Fresh Water Fish Commission, the majority of the hyacinth remaining are in less than 18 inches of water. In the short time this program has been in effect we feel that real progress has been made and great benefits have been achieved.

On the Withlacoochee River one can see fish beds in areas where fish could not live before because of heavy infestation of hyacinth. Huge floating rafts of hyacinth drifting from place to place which did untold damage to fish beds and fish populations in lakes and streams, no longer exist, thanks to this program.

Water Hyacinth Control With Amitrol-T

John E. Gallagher

This meeting will discuss the history, the economic importance, and the control of Water Hyacinth. The discussion on control will deal with the mechanics of spray operations, as well as mechanical methods of control. As the meeting progresses, it will be obvious that chemical control and 2,4-D are synonymous. Newer chemicals have not been field tested since about 1948.

If the Water Hyacinth problem is an increasing one, and it should be considered so if current methods have not been able to prevent its expansion, new methods and chemicals should be tested at the research level. Once proven practical, whether for economic reasons or because of increased biological activity, these methods should be field tested to prove their worth. After three years of controlled experimental work including some field operational test, it seems that Amitrol-T can offer both economic and biological advantages.

It was my pleasure to work with Dr. Seaman of the USDA Aquatic Weed Research Laboratory. What I will say here is in essence a report on the work conducted by Dr. Seaman over the past three years. I will use periodic reports made by him to show the initiation and development of Amitrol-T for the control of Water Hyacinth.

The work started in 1959, there had been little systematic research work done on Water Hyacinth since 1948 when 2,4-D proved effective.

Because of the many improvements in the formulation of 2,4-D, a project was set up to compare the new with the standards to see if these formulations improvements could be translated into increased weed kill. Amitrol-T was added to the list because it had proven to be more effective on other aquatic species and also seemed to translocate well in stoloniferous plants.

In summarizing the 1959 work Seaman had this to say:

Four different formulations of 2,4-D, and formulations of emid, fenac, and amitrol (+NH_4SCN) were evaluated at several application rates for control of water hyacinth in a 3-replicate experiment. The amitrol formulation was more effective than any other material at equivalent rates, and yielded nearly complete control at 2 lb/A. Practical control was obtained by 4 lb/A applications of the butoxyethanol ester, emulsifiable acid, and diethanolamine salt of 2,4-D, and the sodium salt of fenac, but emid and the water-in-oil emulsion of 2,4-D were practically ineffective at less than 6 lb/A rates.

The slow-acting but remarkable control of water hyacinth by the amitrol formulation was especially interesting, because this herbicide might be used in areas where 2,4-D compounds are hazardous to crops and ornamentals. The less-mature weeds of one replicate series were more difficult to kill by all treatments than were the more mature weeds of the other two series, but it was thought that effects of all treatments might be improved by reducing the application volume which would serve to increase the effective concentration contacting the plants.

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