

other obnoxious aquatic plants are present. Restricted waterways and obstructions to piers and beaches have rendered many such properties unusable.

The joint report the Chief of Engineers furnished the Eighty-Fifth Congress in 1958 was published as House Document No. 37 of that session and it contained an evaluation of the problem as it existed in 1948. The Congress, in reviewing the magnitude of the problem, instructed the Corps of Engineers to proceed with a comprehensive program for the control and progressive eradication of water hyacinths, alligatorweed, and other obnoxious aquatic plant growths in the combined interest of navigation, flood control, drainage, agriculture, fish and wildlife conservation, public health, recreation and related purposes. Congress also recognizing the value of scientific research included in the authorizing act a requirement for continuing research and development of the most effective and economic control measures. This project, known as the Expanded Project for Aquatic Plant Control, was separate from the previous Act for Removal of Water Hyacinth Obstructions to Navigation.

This expanded project has been underway for several years. Progressive control operations have been conducted in North Carolina, the Santee-Cooper area in South Carolina, the Lake Blackshear area in Georgia, and in most of Florida and Louisiana, with the greatest part of the work being accomplished in Florida and in Louisiana, where the problems are more acute. In the States of North Carolina and South Carolina, the most obnoxious aquatic plant is alligatorweed. Water hyacinths have not been reported in these states. Work in these states has been somewhat limited in scope for lack of a satisfactory herbicide.

Research conducted under the project has been primarily directed against alligatorweed. The research work is being done by means of a cooperative research program with three other federal agencies concerned in the program. These are the U. S. Fish and Wildlife Service, the U. S. Public Health Service, and the Agricultural Research Service. These agencies are also represented on the Research Advisory Committee for this project. This committee is composed of one representative from each of three Engineer Divisions concerned and one representative from each of the research agencies. This committee is unique in government agency cooperation. Being small in number, it can and does function as a working group to review existing and proposed cooperative research programs of each of the agencies and contract research work with qualified universities to perform research in the field of aquatic plant control. It also furnishes professional evaluations of the research performed with suggestions for continuation to the Corps for guiding its administration of the research program.

The 1948 report stated:

"In the present state of knowledge, no practical means of combatting the alligatorweed is known to this committee." This statement is as true today as it was when it was written in 1948. However, we do know infinitely more now about alligatorweed. We have several interesting and promising leads which are under investigation. Large scale field tests using Silvex on alligatorweed are underway in North Carolina and Florida. The use of a 2,4-D and diglycolic acid mixture is being investigated in large scale field tests in Louisiana. Other promising herbicides are being investigated in greenhouses, growth pools and in smaller field tests. Biological investigations for the control of alligatorweed have been underway in the U. S. and South America for about four years. These studies by the Agricultural Research Service

were made as part of the research program administered by the Corps and have resulted in the introduction into the United States of the most promising insect found to feed on alligatorweed. This insect, a flea beetle of the genus *Agasicles*, is host specific to alligatorweed.

The expanded project is programmed for two more years of operational work. It is expected that Congress will again recognize the many benefits derived from this program for the control and progressive eradication of water hyacinth, alligatorweed and other obnoxious aquatic plants. At a time when every effort is being made to conserve and utilize our natural resources for their highest and best use, the losses incurred as a result of having obnoxious aquatic plants on our waterways, streams and tributaries are of great importance and become more so when we consider that water resources are not depleted or used up but can be used over and over again by the public.

In conclusion it appears that the Expanded Project for Aquatic Plant Control is in keeping with the objectives of this Society contained in Article II of the Certificate of Incorporation which reads:

"The general nature of the objects of this Society shall be to assist in promoting control of water hyacinths and other noxious aquatic weeds, to provide for the scientific advancement of members of the Society, to encourage scientific research, to promote university scholarships, and to extend and develop public interest in the movement."

Water Hyacinth Control In Louisiana

by

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There is an old saying, "A thing of beauty is a joy forever," which is simply untrue in the case of the water hyacinth. Because it is a beautiful and unusual plant, it was brought to the Exposition in New Orleans in 1884. Many people asked for samples of the water hyacinth to transplant into the ponds and streams on their country places to beautify the scenery. Others had visions of increasing the cattle fodder in the area and carried plants home for this purpose.

This was the start of the hyacinth problem in the State of Louisiana. Visitors to the Exposition took samples of the plant home to other states. Florida inherited the problem from this source when a well-meaning citizen presented numerous plants to the authorities for beautification of the St. Johns River according to legend.

Within ten years after its introduction into Louisiana, it had become a menace in the streams of St. Tammany Parish, the Plaquemine Waterway and in the Mermentau River. It continued to spread until the navigation in these areas was seriously threatened and the Congress was finally asked to do something to provide relief. In 1900, the Corps of Engineers was assigned the mission of clearing the navigable waters of Louisiana in the interest of navigation and the battle was on. It has continued without interruption to the present date.

The menace has continued to spread into other areas largely through the action of man. Dozens of tourists gather the blooming plants each year to take home to other states.

These plants eventually find their way into the local waters and spread rapidly under favorable growing conditions. Fishermen spread the seed and small plants when they launch boats in the various fishing spots throughout the country. Many have the mistaken idea that the water hyacinth provides for better fishing. This has been disproved time and again in the waterways of Louisiana. Many areas have refused to consider the water hyacinth as a menace and have taken steps to protect the plants in their waterways. This, of course, provokes another old saying of "There are none so blind as those who would not see."

The time has now arrived when all should recognize the water hyacinth for what it really is and make every possible effort to control its spread and to destroy it where such is possible.

When the mission was first assigned to the Corps of Engineers, it was estimated that some \$50,000.00 would be needed for the year's work. This was reduced to a mere fraction of the original and the limitations on the work were in force. Through the years since that time, funds have been the limiting factor in the control efforts of the Engineers. It has been only in the past few years that sufficient money has been provided for an intensive drive in the control of this pest aquatic plant. The results in Louisiana have been very satisfactory and the problem of the water hyacinth has been pushed back into the smaller streams, the swamp areas and the hard-to-reach areas of infestation.

As a start in 1900, the Engineers used a large mechanical unit for the removal of the water hyacinth. It was the crusher type and was slow and cumbersome. In 1902, a new wonder chemical was introduced and put into immediate use. Later, it was analyzed to determine just what it was and found to be sodium-arsenite. This was recognized as a deadly chemical, but its effects on the water hyacinth were such as to make those in charge at the time dare to take the gamble in ordering its continued use.

For the next 35 years, the Engineer personnel engaged in destroying the water hyacinth and the citizens of Louisiana who lived along the banks of the streams treated lived dangerously. An organized Safety Drive had not yet developed, but every precaution was taken to prevent an accident which might be caused by this highly toxic material. Rubber gloves, rubber aprons, respirators, goggles, spray shields, etc. were some of the things adopted to prevent injury to the operators. However, familiarity breeds contempt and it was not long before most of these safety devices were forgotten.

Special notices were published in the local papers when a stream was to be sprayed, announcements were made over the radio when this type of communication became available, notices were placed in the post office and letters were sent to all livestock owners in the area warning them to pen up the cattle and take all precautions against the poison. Finally, the spray boat arrived in the area with huge signs on each side stating "This Boat Spraying Poison" and the fire-siren aboard was sounded at intervals of one minute as a warning that the boat was approaching. Despite all of these precautions, there were casualties each year and numerous claims had to be answered when the "best cow in the herd" was killed by the arsenic.

Eventually came the day when some of the arsenic spray found its way into the food being served to the crew. Many were made desperately ill and the captain of the spray-boat died. Although the spraying of arsenic continued after this accident, it was recognized as too hazardous to use longer

and a Board of Officers recommended the use of machinery for the control of the water hyacinth.

In 1937, the crusher boat KENNY was launched and put into operation. This boat, more than any other one unit, was responsible for the successful opening of hundreds of miles of waterways in Louisiana. It was able to cut its way into dense mats of the hyacinth and also to destroy the many islands of floatant which were blocking the waterways. Other smaller machines were developed as time passed and each served its purpose in an entirely satisfactory manner. There were the conveyors which picked the material from the streams and placed it on the banks of the waterways to die from lack of moisture. It was not unusual to see a levee of hyacinths 15 feet high and stretching for hundreds of yards along the streams in which work was being done. However, this fact and also the fact that some of the vegetation took root and spread from the banks of the streams into the adjacent cultivated areas soon made the deposit of the refuse on the stream bank unpopular with the farm owners. The growth of willows along the streams also hampered the work of this type of machine and it was discarded in favor of the saw-boat which destroyed the vegetation in place.

These saw-boats were highly developed for use in the streams of Louisiana and varied in many details from those used elsewhere. They did a very good job of opening a waterway quickly and could take cuts of up to 40 feet in one passage through an infested area. They are still used in providing passage ways for the chemical spray-boats which now carry the largest burden of clearing the waterways of unwanted vegetation. All of these mechanical devices had one fault in common. They were unable to operate in the shallow water along the bank, nor could they penetrate those areas that were infested with snags and underwater obstructions. This left a fringe of untreated vegetation along the banks of the streams which quickly regrew. The job was unending and the effort to maintain any particular stream in use throughout the year was tremendous. The work was made more difficult during the years of World War II when limitations placed upon the Engineers made it necessary to operate at reduced schedules. Since the main Intercoastal Canal was used to such a great extent, all efforts were directed towards keeping this stretch free from water hyacinth jams and the smaller streams were ignored. Thus, the problem took on greater proportions in Louisiana and gave birth in later years to the story that the Corps of Engineers worked only in the Intracoastal Waterway.

Another problem that injected itself into the picture was the interpretation of the original bill authorizing the work in the Navigable streams of Louisiana in the interest of navigation. There was always some confusion in the minds of a few as to what constituted a navigable stream. The courts have ruled that a stream is "navigable in law" when it is "navigable in fact." The dictionaries tell us that navigable means the ability to carry a vessel for acts of commerce or war. Hence, the use of streams by the citizens for gathering moss or for trapping and fishing make that stream navigable even though the vessel may be a pirogue or a small skiff. There was also the problem of securing authority to go into certain areas since there was no navigation reported from the streams. The reason there was no reported navigation was the fact that even those who desired to use the waterways could not do so because of the hyacinth jams. When this bottleneck was finally broken, the work began to progress and we were able to extend operations into areas hitherto

untreated and from which reinfestation of the main waterways was continuous.

All of this led to the realization that something had to be done to liberalize the thinking and to secure authority to destroy the water hyacinth wherever it was found. In Louisiana, we were fortunate in having a Representative in Congress who knew and understood the conditions of the streams and the limitations that were imposed on those trying to clear the waterways of the unwanted vegetation. Through the efforts of the Louisiana delegation to the Congress, the present bill authorizing the Expanded Aquatic Plant Control Project (P.L. 85-500) came into being. This permitted an all-out drive on the various pest growths and allowed the work to be expanded to all of the public waters in Louisiana. The overall results in Louisiana have been very gratifying.

At the end of World War II, only the main waterways in Louisiana which had been important to the war effort were open to normal navigation. It was apparent that the task before the Engineers was a gigantic one and that some more effective means for destroying the vegetation must be found. Studies were initiated to determine what materials were available which could be used to destroy the vegetation in the areas which could not be reached by the mechanical devices then in use. Persons in the Department of Agriculture who had visited Louisiana and were interested in the problem sent a material known only by a code number to be tried on the water hyacinth. Later, it became known that this material was "2,4-D". It produced good results although the time required to kill and sink the hyacinth was much longer than when the sodium-arsenite had been used. A mutual friend introduced Engineer personnel to some of the research people at the University Of Southwestern Louisiana and it was discovered that they had been doing experimental work with 2,4-D in a lake at Lafayette, Louisiana, while similar tests had been carried out near New Orleans by the Engineers with the same material. Neither knew that the other was engaged in the work. There has been close cooperation between the University personnel and the Engineers ever since.

As a result of Congressional action in the mid-40's, an intensive study was undertaken into the amount of damage done by the water hyacinth and other aquatic vegetation to navigation, agriculture, fish and wildlife and public health. Investigations continued into ways and means of controlling the unwanted vegetation. "2,4-D" became available on a commercial basis about this time and, at last, we were able to use a chemical that would control the water hyacinth and be safe to cattle and persons.

Plans were formulated for a concerted operation in the areas of infestation using a combined mechanical-chemical attack on the plants. The machines were used to cut access ways into the areas of infestation through which the chemical spray-boats could follow. The latter piece of equipment covered large areas in a comparatively short time and, best of all, could reach the fringe areas along the banks of the streams to destroy the plants and seedlings left by the mechanical units. A way had been found at last to clear the entire surface of a stream and full advantage was taken of this fact. The operation was in full swing by 1950 and has continued ever increasing efficiency in the years since then. The use of machinery has been decreased as stream conditions improved until, at the present time, only about 3% of the vegetation is destroyed by mechanical means. The greater portion of the destruction work is done by 2,4-D alone and in combination with other materials.

The change in technique and the full growth of the Safety Campaign made new studies imperative if we were to avoid accidents. The potentials of the newly found 2,4-D were carefully evaluated before any large scale operations were undertaken. Although it was reported to be harmless to the individuals handling the spray job, no chances were taken and every precaution was taken to protect the operator just as though it had been a deadly poison. Protective clothing was worn by the operators and a standard requirement is the frequent washing of hands and face during the working day. Fresh water is carried on the spray-units for this very purpose and its use is mandatory. At the close of the day, the operators are required to take a shower bath and to wash out their clothes. Freshly washed clothes are used each day to prevent the possibility of concentration of the materials accumulating in the fabric and causing skin irritation. When mixing the materials at the supply base, face masks are used to prevent damage to eyes and skin from splash and rubber gloves are the order of the day even though the material is reportedly harmless. In describing the work to others in the state, we have avoided the term "spraying poison" and refer to it as "application of chemicals". This has a decided psychological effect on the persons living adjacent to the streams being worked and especially to those who suffered damage during the old arsenic days.

Despite all of the precautions taken, some damage was done early in the operations when the potentials of 2,4-D were not fully understood. Since that time, we have learned to be very careful about the valuable crops in the area of operations, the direction and velocity of the winds at the time of spraying, the potential use of the water for irrigation down-stream from the point of applications and numerous other items entering into the safe use of the materials. Even though the majority of the people in Louisiana know of all of the safety precautions that we take, there are still those who are apprehensive due to the unfavorable publicity given to the use of herbicides and pesticides in the press of the country and over the TV and radio in recent times. This has made the necessity for safety precautions even more important than before and steps are taken to keep the operating personnel fully aware of the normal hazards of application.

The Corp of Engineers has developed its own spray guns in Louisiana for use in this work after exhaustive study of the various similar units on the commercial market. The guns are simple and inexpensive. They are made of 3-foot sections of aluminum pipe attached to a quick-operating valve and with a reducer on the other end to take a copper tube fitting. The pipe is 1/2-inch diameter and the tip is made from what is commonly called a half-union for 1/8-inch pipe to 1/4-inch copper tube. This gun gives a good coverage over a distance of about 75 feet. The spray reaches the plants in droplets and excessive drift is avoided. Standard spray pumps are used. These are the piston type with a capacity of 10 gallons per minute and capable of operating at 400 PSI pressure. Excellent kills have been obtained on hyacinths with this combination of gun and pump. The 40% amine salt of 2,4-D is used and applied as a 1/2% solution (by weight) at a working pressure of about 350 PSI. About 100 gallons of water per acre is used to make a 4-pound per acre application. The high pressures penetrate the vegetation and give good coverage to the small plants which would be protected by the umbrella effects of the larger plants if the solution was simply rained in from above. The guns are mounted on swivels so that the recoil is absorbed and good aim can be maintained

throughout the spray-day without overtaxing the stamina of the spray operator.

The spray pattern is important. It is accomplished by moving the gun in such a manner from side to side to provide a cone in the horizontal plane. On one-half of the movement, the gun is moved in a straight line to strike the plants below the leaves and to penetrate through the stems to reach small plants. The return swing of the gun is more rapid and is at an elevation that will permit the material to fall on top of the upper leaves of the taller plants. Thus, the pattern takes on the appearance of a cone with the lower sweep slightly flat and the upper portion curved.

The application is most effective when confined to the area in the one-half section of the forward quadrant measured in the direction of travel. It is of the utmost importance that a portion of the bank be treated at the time of spraying in order to retard infestation from any seedlings that may be located in that area. This has paid great dividends in the control work in Louisiana. The plants should be sprayed at as great a distance as possible ahead of the boat and efforts to hit individual plants or to spray at right angles to the direction of travel should be avoided. A forward speed of from 1 to 2 miles per hour is considered to give excellent results in a normal stand of hyacinths. More rapid progress causes a greater percentage of misses. Every effort should be made to cover all of the distance between the spray unit and the bank and, where there are numerous coves, it is important that the course of the boat be determined by the contour of the bankline. Straight through passes are often not effective. All vegetation in an area should be covered before the unit leaves for another location. This limits reinfestation to a minimum.

The amount of non-effective time caused by the necessity of mixing a batch of chemical has been eliminated in Louisiana by the adoption of a simple inline mixing device developed by the Engineers. Made of simple pipe fittings, the device permits the pump to draw water from overboard and mix it with the concentrated chemical as it passes through the suction line and the pump. The discharge is a uniform mixture at the desired strength. A self-cleaning strainer developed by the Engineers permits continuous operations. Several who have seen the devices in operation on Engineer units in Louisiana have been furnished with details of the construction upon request and are now using the equipment in their own operations.

The cost of clearing a particular stream will depend on the conditions encountered and the methods which have to be used to produce the desired results. It will vary from \$15.00 per acre to \$60.00 per acre with the same unit in operation and will change with the ease of operations. Quite often, those engaged in this kind of work worry too much about the unit cost and how it will look on the ledger sheets. They are prone to await the time when the operations become "economically justifiable" and, while this produces a condition which leads to a lower unit cost, it ignores the fact that it has resulted in more units. It has been found in Louisiana that the best results are obtained by constant observations of conditions in the stream and immediate action towards destruction taken when it becomes apparent that the vegetation is on the increase. While the unit cost of such operations may be higher than it would otherwise, the overall cost of maintaining the stream in good conditions is lower than it would be if operations were to wait. The use

of the unit-cost system in determining when a stream should be cleaned can lead to an increase in the overall cost of work in the state and complaints from the normal users of the stream that the authorities are not giving the service expected. Too close adherence to the unit cost system can be tricky and misleading.

While all of the operations in Louisiana have been producing satisfactory results in an ever increasing area, the Engineers are continuing to engage in research to discover even better ways of accomplishing their mission. New machines and new materials are being constantly evaluated to make the work more efficient. Good results are being obtained as time passes and new techniques are being developed to handle vegetation other than the water hyacinth which has found its way into the streams of the state in recent years.

As a result of the operations since 1950 and, more particularly since the initiation of the Expanded Aquatic Plant Control Project, all of the main waterways in the state have been substantially cleared of the unwanted surface plants and the work is now being pushed in the secondary streams and feeder areas. The Engineers are being assisted in this work by the State of Louisiana which has had a hyacinth destruction project of its own for many years. The two programs are now coordinated to the ultimate maximum benefit of the users of the waterways.

The end results thus far have shown great benefits to navigation and have materially improved the flood control and drainage operations in the state. This, in turn, has resulted in many acres of marginal land being returned to agricultural uses throughout the state. Living conditions important to fish and wildlife have been improved and large areas have been opened to those persons interested in recreation activities. Improved conditions in the waterways, especially near the larger towns along the many bayous, have resulted in benefits to the public health in the area.

With all of these improvements being noted as a result of the work in Louisiana since 1950, the Engineers are planning on intensifying their activities during the next few years within the limits of funds made available. It now appears that, with the exception of some certain locations, eradication of the water hyacinth is impracticable and would require funds beyond any reasonable amount for the work. A more realistic view is now taken. Complete control of the unwanted vegetation is now recommended for the waterways of Louisiana. This envisions keeping the usable portions of the various public waters open for all normal use and the confinement of the vegetation to the swamp areas where it can do little damage.

There have been many changes in the hyacinth control operations in the past several years and many more are expected in the future. These operations have changed from the frantic, do-or-die efforts to keep the main waterways open during the war period and insure the uninterrupted use of some 300 miles of steam to an orderly, routine maintenance operation in some 3,000 miles of waterway at the present time.

However, all of those engaged in this important work realize only too well that any let up in the present activities would result in a very short time to the return of the nightmarish conditions of yesteryear. Every effort will be made to prevent this deplorable condition from ever developing again in the waterways of Louisiana.