INFORMATION EXCHANGE HALTED - INTERNATIONAL SPONSOR SOUGHT

This is the final issue of AQUAPHYTE and the end of Aquatic Plant Information and Retrieval Services for some 2,000 international subscribers unless a sponsor is located to fund the international portion of the Aquatic Weed Program. This issue is being mailed to users in 65 countries to let them know that the program can no longer offer its services outside the United States.

After 8 years, the contract with the United States Agency for International Development (USAID) expired in May 1985. Negotiations with AID continued through October 1985, at which time the agency decided it no longer could financially support the services. Thus, for several months we have had no international funding to support services for overseas subscribers to the Aquatic Plant Information Service.

Of the regular users of these services, one third are in the state of Florida, one third are elsewhere in the United States, and one third are foreign users. Funding continues to provide for domestic services in the U.S.; however, we can no longer bear the $30,000 annual cost of providing services to foreign scientists, water resources managers, teachers and government personnel in 65 countries.

The University of Florida’s Aquatic Plant Information and Retrieval System has been invaluable to numerous overseas scientists where libraries cannot afford to subscribe to the many journals which contain research results on aquatic plants. It is the world’s largest holding of books, reports and research articles on the subject of aquatic plant biology, ecology, utilization and management. More than 23,000 references are cataloged in a computerized database according to subject areas and keywords. Articles often are provided on a complimentary basis.

The library service was begun in 1976 as a worldwide concern and research on aquatic plants began to increase dramatically. International use of the system has increased annually since the service was begun. Currently, nearly 500 foreign users receive regular computer updates (new citations) in the subject areas of their interest. In addition, approximately 1,400 copies of articles, reports and so on have been provided annually to foreign users of the service. The newsletter AQUAPHYTE was begun in 1983 and has been sent free-of-charge to 4,000 subscribers throughout the world as the only regularly published newsletter regarding aquatic plant meetings, new books, conferences and research news. Approximately 2,000 newsletters are sent to foreign subscribers.

We have enjoyed providing assistance to our foreign friends and will continue to do so if and when we can locate a sponsor to provide funds to offset the high costs of producing and mailing information overseas.

Domestic U.S. service will continue through support from the Center for Aquatic Weeds, the Florida Department of Natural Resources and the Aquatic Plant Control Research Program of the U.S. Army Corps of Engineers Waterways Experiment Station.

For a detailed proposal or more information, contact the Aquatic Weed Program, 2183 McCarty Hall, University of Florida, Gainesville, Florida 32611. (904) 392-1799.

ECONOMIC LOSS RESULTS FROM HYDRAILLA INFESTATION

Recently, researchers at the University of Florida Center for Aquatic Weeds and the Department of Fisheries and Aquaculture have completed several years of research on the impact of hydrella on the fishing and the local economy of an infested lake in northern Florida.

Orange Lake is a 13,350 acre lake with a national reputation for its largemouth bass, bluegill, redbear (shellcracker) and crappie (speckled perch) fishing. Historically, the lake once had a wide fringe of plants such as water hyacinth, maldencane, coontail, southern naiad and bladderwort. However, the public usually enjoyed 6,700 acres of vegetation-free open water.

In 1974, one acre of hydrella (Hydrellia vittata) was first recorded in the lake. Within three years, only 282 acres of Orange Lake remained free of vegetation in the productive lake, the balance being covered with dense mats of hydrella. Irrigated fishermen were unable to move their boats through the mats or to fish through the intertwining tangle of stems and leaves.

As a result, fishermen gave up their efforts on the lake and went elsewhere. Research shows that in 1977, 90% fewer fishermen used Orange Lake than in 1974, resulting in a significant loss to the local economy. In 1974, fishing expenditures on Orange Lake were calculated to be $1.02 million. By 1977 fishing expenditures had fallen to $112 thousand.

Fishermen reported that they ceased fishing Orange Lake because hydrella had decimated the fish populations. In fact, fishermen who devised new fish catching techniques and continued to fish the lake actually caught fish at an equal or slightly greater rate than they did when there was no hydrella problem. The studies determined that the numbers of harvestable bass and crappie were not negatively affected by the abundance of hydrella. (On the other hand, numbers of harvestable bluegill and redbear steadily declined as hydrella levels increased.) In the peak hydrella year of 1977, the largemouth bass hourly catch rate was higher than previous years, and in 1982, black crappie fishing success was much greater than in previous years. The studies also showed that the total fish harvest and fishermen success rates were the same during 1974 and 1982, even though hydrella covered less than 1% in 1974 and 67% in 1982.

Limited aquatic weed control in recent years has kept hydrella coverage on Orange Lake to less than 70%. Lake access areas and fishing trails through the hydrella are periodically treated. The studies show that aquatic weed control and the willingness of fishermen to learn new fishing techniques has enabled fishing expenditures to rebound; in 1982 they were nearly $2 million. If aquatic plant control ceases, hydrella will quickly return to or exceed the 1977 levels if 91% of the lake was covered.

(Continued on page 7)
THE ARMY CORPS OF ENGINEERS AND AQUATIC PLANTS
(The following is from a Public Information Fact Sheet produced by the Jacksonville District U.S. Army Corps of Engineers)

Aquatic plant control operations by the Corps of Engineers in Florida began in the 1890's soon after the water hyacinth was introduced into the state near Palatka. In 1897, upon petition of the concerned citizens of Palatka seeking relief from the navigation problems caused by the water hyacinth, the Corps undertook an investigation of the plant on the river. This investigation resulted in the initial authorization for the maintenance project by the River and Harbor Act of 3 March 1899. An expanded pilot project was authorized by Public Law 85-505 passed by the 85th Congress on 3 July 1958. This project was later amended on 27 October 1965 by Public Law 89-298 to a continuing "program" approach.

OPERATIONS
Today, aquatic plant control operations by the Corps of Engineers in Florida are performed under two separate authorizations. One, the Removal of Aquatic Growth Project (RAGP), is the original operation and maintenance project for the protection of navigation on federal project waters and the other, the Aquatic Plant Control Program (APCP), is a cooperative program of the control of water hyacinth and other obnoxious aquatic plants in all navigable waters.

The RAGP is 100 percent federally funded. The Aquatic Plant Control Program is a cost-sharing program of 70 percent federal and 30 percent state of Florida funds, except that research and planning costs are 100 percent

(Continued on page 7)
CONGRESSIONAL HEARING ON AQUACULTURE

Part of Washington, D.C. moved south to Gainesville, Florida recently when a congressional hearing was convened to hear testimony about the promises and problems of warm water aquaculture. U.S. Congressman Don Fuqua chaired the hearing of the Committee on Science and Technology of the U.S. House of Representatives, which took place at the University of Florida on April 28, 1986.

Congressman Fuqua said the hearing was held because several problems which face the U.S. and other countries can be alleviated by a strong commitment to aquaculture. He particularly noted that the U.S. trade deficit is increasing, Americans are eating more seafood, and fish yields from natural resources are declining. Therefore, he said, aquaculture offers unique opportunities to supply new sources of food. During the Congressional hearing, two panels of aquaculture specialists discussed the needs and opportunities of aquaculture and the national and state policies which deter or augment commercial aquaculture.

In 1980 the U.S. Congress passed the National Aquaculture Act. It later placed responsibility for aquaculture research and production with the U.S. Department of Agriculture. In 1984 at the University of Florida Institute of Food and Agricultural Sciences, the Department of Fisheries and Aquaculture was established. Its chairman is Dr. Jerome V. Shireman.

Congressman Fuqua said that Congress has authorized the construction of four regional aquaculture centers in the United States. Because of Florida’s existing aquaculture industry and its potential for expansion, he believes one of the research centers should be built at the University of Florida. At a press conference, Fuqua said that such a center would “complement the U.F. Department of Fisheries and Aquaculture, the U.F. Center for Aquatic Weeds and the U.S. National Fisheries Laboratory” in Gainesville.

Welcoming the hearing to campus, U.F. President Marshall Criser said that the University of Florida is ready to assume a greater role in aquaculture research and extension. He was seconded by Vice-President of Agricultural Affairs Dr. Kenneth Tefertiller who said “Florida has the right technology and is the right place for aquaculture.” The Secretary of the Florida Department of Agriculture, Doyle Connor, testified that aquaculture “should be an integral part of agriculture in Florida” and that his department already has set up a laboratory to diagnose diseases in aquacultural facilities.

Transcripts of the testimony given at the April 28 hearing can be found in the U.S. Congressional Record.

NEW FISHERIES AND AQUACULTURE DEPARTMENT

Florida’s abundant water resources and subtropical climate have given rise to flourishing and valuable fisheries and aquaculture industries. In 1984, the Department of Fisheries and Aquaculture was established to meet the research and educational needs of these industries. Dr. Jerome V. Shireman was selected to be chairman of the new department which is part of the School of Forest Resources and Conservation (SFRPC) in the Institute of Food and Agricultural Sciences (IFAS) at the University of Florida in Gainesville.

There are three areas of primary emphasis in the department. The freshwater fish and limnology program studies physical, chemical and biological factors which influence fish production in Florida waters. Particular emphasis is placed on sportfish production and the influence of aquatic weeds and eutrophication on fresh waters.

The marine and coastal fisheries component studies the needs of breeding stocks and reef communities as well as finfish and crustacean fisheries.

The aquaculture program studies the conditions necessary for maximum commercial production of freshwater, estuarine and marine organisms in the aquarium fish and food production industries.

The new department works closely with the IFAS Center for Aquatic Weeds and the National Fisheries Research Laboratory. It also works with the Florida Sea Grant College and the U.S. Cooperative Fish and Wildlife Unit as well as several other federal and state agencies.

The address is: Dr. Jerome V. Shireman, Chairman, Department of Fisheries and Aquaculture, IFAS, University of Florida, 7922 N.W. 71st Street, Gainesville, Florida 32607 USA; (904) 376-0732.

SALVINIA IN SRI LANKA

What “a fleet of 50 large-size mechanical weed harvesters” cannot do may be done by millions of tiny weevils if all goes well in Sri Lanka.

In March 1985, Salvinia molesta covered 40 hectares of the Maduru Oya Reservoir in Sri Lanka. Only two months later, the pest plant covered 3,157 hectares—an estimated 316,000 tons of plant material—an 80-fold increase. Half the reservoir was covered and the plant threatened to spread to downstream paddylands and other parts of the massive Mahaweli Development Project. Salvinia also has established in Polgolla Barrage and NDK Dam. Authorities believe that mechanical control methods would be inadequate and so have decided to import a tiny weevil, Cylindrous, known elsewhere to be an effective biological control agent of the noxious floating fern.

According to reports of the Mahaweli Authority’s Headworks Administration Operations and Maintenance Division (HAOM), mechanical and chemical methods were tested against the fast-growing plant without appreciable effects. “Even a fleet of 50 large-size mechanical weed harvesters would probably not have been able to control the spread,” said one report. As for chemical control, the HAOM tested 10 ammonium hydroxide solution which caused the plants to “die off in irregular patches.” Shading the plants with black plastic was determined to be impractical on such a large scale. In the meantime, permits were obtained to import Cylindrous, and Dr. Peter Room of Australia agreed to deliver a batch of the insects for quarantine, breeding and testing in Sri Lanka.

Cylindrous has been introduced into Australia to control salvinia in large reservoirs. In each case, severe infestations of salvinia were brought under control within months. It is hoped

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SONAR REGISTERED

Sonar (fluridone) is the most recent aquatic herbicide to pass the U.S. Environmental Protection Agency's (EPA) newer, more stringent, pesticide registration requirements. The product, effective against hydrilla and other aquatic weeds, received full registration by the EPA in March 1986. Fluridone-treated water has no use restrictions; swimming, fishing and drinking are permissible immediately after herbicide application.

Since 1983, the EPA has required more extensive studies of new pesticides before allowing them to be registered and marketed. The studies include mammalian acute toxicity, subchronic, chronic and carcinogenicity, effects on reproduction and possible mutations and genetic damage, and environmental fate. Sonar was discovered in 1975 by Eli Lilly and Company and for ten years has been researched in the laboratory and in the field.

Fluridone is a slow-acting herbicide which works by inhibiting the plant's ability to synthesize carotenoids (yellow pigments). Carotenoids protect the plant's green pigment, chlorophyll, from photolysis (breakdown by sunlight). Without carotenoids, chlorophyll is destroyed and the plant cannot photosynthesize. Terminal buds of the plant begin to turn white and the plant dies in 30-90 days, which tends to minimize the possibility of dissolved oxygen depletion and fish kills.

The primary process for fluridone degradation in water is through photolysis. The half-life of fluridone ranges from five to 60 days with an average of 20 days, depending on environmental factors. The potable water tolerance established by the EPA is 0.15 mg/L.

Many submersed, emergent, floating and ditch-bank plants are susceptible to the herbicide. Weed control periods of more than one year from one application have been reported.

Sonar is available in three formulations: aqueous suspension (AS), granules (SP), and slow-release pellets (SRP). The liquid and granule formulations are for use in areas with restricted water flow. The pellet formulation is for use in areas where water flow cannot be restricted, such as in canals with slow-moving water.

For more information, contact Elanco Products Company, Lilly Corporate Center, Indianapolis, Indiana 46285. (317) 261-5589.
U.F. AQUATIC WEED SHORT COURSE

Government and private aquatic plant management personnel met for the bi-annual University of Florida Aquatic Weed Short Course in June 1986. The course was sponsored by the Center for Aquatic Weeds, the Florida Cooperative Extension Service, and the Department of Agronomy of the Institute of Food and Agricultural Sciences. Nearly 150 applicators, technicians and managers attended the four-day course in Gainesville.

The 1986 Aquatic Weed Short Course was an intensive series of lectures, discussions and demonstrations about aquatic ecosystem management. Researchers, university professors, and government regulators explained the problems and current solutions of aquatic plant management in relation to limnology, especially as plant management relates to eutrophication and fisheries. The latest research findings regarding biological control of plants using pathogens, insects and fish also were discussed. And because chemical controls of plants remains the most widely used method, heavy emphasis was placed on them. Herbicide safety, toxicology, permitting, application, calibration and herbicide effects on non-target biota were explained.

HERBICIDE DRIFT

Herbicide drift control is one of the most important problems of chemical control technology. Drifting herbicides sometimes migrate to non-target areas, resulting in damaged crops and ornamentals and justifiably raising the ire of affected farmers, nurserymen and homeowners. Among the presentations of the Aquatic Weed Short Course was one by Dr. Richard H. Wilson, field scientist for the Velocil Chemical Corporation, who explained the characteristics of herbicide drift and ways to control it.

The amount of herbicide drift produced is directly related to droplet size. Droplets of less than 100 microns in size are most likely to remain airborne and to drift. And droplets of 20 microns or less may reach the air infinitely. (For comparison, a typewriter period is 800 microns in diameter.)

Herbicide drift is influenced by the equipment and application techniques used, weather conditions, and herbicide formulation. Equipment and application account for 68-90% of the drift produced. Though some nozzles are designed to produce larger droplets (and to reduce drift), all nozzles still produce some droplets of less than 100 microns. For example, 3% of the droplets produced by the flat-fan type nozzle are “drift size” droplets. If 0.5% of a herbicide drifts onto crop plants, significant damage can result.

Another device, the “microfoil boom”, is used for aerial application of pesticides from helicopters. The microfoil boom is one of the best application devices because it produces droplets of uniform size, 800 microns in diameter. Droplets of this size are most likely to fall where they are aimed. Another factor to consider in drift reduction is pressure. Higher pressure usually produces smaller droplets, increasing drift. In one study using a flat fan nozzle, increasing the pressure from 20 psi to 40 psi more than doubled the volume of 100-micron or smaller particles. And, of course, spray height also affects drift: the higher herbicide is sprayed, the more likely that winds will capture the drift and carry it off target.

Weather also affects the amount of drift lost from the target area. Wind speed and direction, relative humidity and air temperature, and “inversions” all affect herbicide placement. The most important of these factors obviously is wind speed and direction. On days when strong winds are blowing toward sensitive non-target areas, it would be wise not to apply herbicides. When this truism is ignored, drift damage can occur. Low relative humidity and high temperature will cause the water present in herbicide mixtures to evaporate more readily as drops fall, thus reducing the size of the droplets and increasing drift. Application in 80% humidity will produce less drift than application in 20% humidity. Another weather phenomenon can affect drift. Air inversions (cooler air above holds down rising warmer air) can significantly increase the distance that herbicide drift can travel. This is because the rising cloud of drift (invisible though it may be) is not able to disperse, and so can travel intact until a falling air mass forces the cloud to the ground. Herbicide drift clouds can travel many miles in an inversion before the concentrated cloud falls on someone’s tomato crop downwind.

Some herbicide formulations are less likely to produce drift than others. Polymer materials are added to some herbicides to force bigger size droplets. Inverting herbicides (herbicide droplets are surrounded by oil) creates a mayonnaise consistency which cannot drift in the air.

The volatility of a herbicide also determines how much of it will go into the air, and possibly drift off site. (Volatility is the degree to which the herbicide "sublimates" (evaporates).) Volatility is referred to as "secondary drift"; it occurs after the application has been made. Wilson says that volatility is enhanced by temperature and suggests that, when possible, herbicide applications be made in the evening, when the temperature is going down. In aquatic work, this is usually not practical, but at times may be an alternative.

Wilson has authored a 14-page paper on the control and prevention of pesticide drift. He can be contacted at his office: Dr. Richard H. Wilson, Field Scientist, Velocil Chemical Corporation, 5820 N.W. 57th Way, Gainesville, Florida 32601.

USDA/SEA/AR COOPERATIVE AGREEMENT WITH CENTER FOR AQUATIC WEEDS

For eight years, the School of Education Administration of the U.S. Department of Agriculture has cooperated with the University of Florida Center for Aquatic Weeds by sponsoring "multifaceted research on integrated management systems for aquatic plants in various water systems."

The Cooperative Agreement specifies that the Center will conduct research to determine the most effective integrated systems using biological, chemical and mechanical methods to control undesirable species and to enhance the establishment or re-establishment of desirable species.

Recently completed research includes:
- The evaluation of spawning techniques for efficient production of sterile triptoloid grass carp which can be used for aquatic weed control in agricultural canals.
- The evaluation of the presence and biology of aquatic nematodes associated with aquatic plants.
- The evaluation of the impact of herbicides used for waterhyacinth control on bulrush communities.

Continuing research under the Cooperative Agreement includes:
- The evaluation of the ability to manage a given quantity of type of aquatic vegetation with the triploid grass carp. The evaluation of the potential of herbicides as fishes for filamentous algae control and efficacy on several hard-to-control species.
- The investigation of the potential control of a filamentous algae, Lyngbya with indigenous blue-green algal viruses in order to develop a non-herbicidal control method.
- Plant competition studies and re-establishment of native plant species. The evaluation of the potential of spikerushes and other native plants to reduce the growth of hydrida.
- The evaluation of the impact, toxicity and methods of integrating chemical waterhyacinth control with the use of the biological control, Neochetina.
- The evaluation of the economic impact of aquatic weed infestations on a Florida lake ecosystem and the determination of the potential cost/benefit ratio for the control of hydrida in a fish management area.
- The evaluation of the physiology and biology of nuisance plants in order to determine the mode of action of aquatic herbicides and methods for increasing herbicidal efficacy.
- The evaluation of herbicides, herbicide combinations, growth regulators, surfactants, timing of application and other parameters to improve herbicidal weed control. The evaluation of the effect of aquatic herbicides and growth regulators on aquatic fauna.
- The evaluation of the physiology of nuisance filamentous algae.

For information, contact:
Director, Center for Aquatic Weeds
Institute of Food and Agricultural Sciences
University of Florida
7922 N.W. 1st Street
Gainesville, Florida 32606 USA
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AQUATIC WEEDS IN PORTUGAL
by I. Moreira and T. Ferreira, Departamento Botânico, Instituto Superior Agronomia, P-1399 Lisboa Codex, PORTUGAL.

A fair number of aquatic macrophytes have been reported as weeds in Portuguese freshwater ecosystems. Emergents like Phragmites australis, Typha domingensis, and T. latifolia frequently obstruct drainage channels and damage irrigation schemes. Dense growths of floating and submersed plants such as Potamogeton pectinatus, P. crispus, Ceratophyllum demersum, Zannichellia palustris, Lemna spp. and Azolla caroliniana, prevent circulation patterns, increase evapotranspiration and disturb aquatic trophic chains. However, in Portugal the most important aquatic weeds are undoubtedly the waterhyacinth (Eichhornia crassipes) and parrotfeather (Myriophyllum aquaticum), commonly associated with naturally or culturally eutrophic waters.

Waterhyacinth was first noticed in 1939 in Tagus basin. By 1976, a huge infestation covered the entire surface of Belver reservoir, in mid-Tagus river, and subsequently spread downstream. Parrotfeather has a somewhat more northern distribution and also was first reported in the late thirties in the Vouga and Mondego river basins. Both plants now occur in several main river lowlands (2), especially in small tributaries and irrigation channels.

The Tagus and Serra de Aire rivers, near Lisbon, enclose a fertile alluvial plain, the so-called Lextaria Grande de Vila Franca de Xira. The plain is crossed by a wide net of channels used simultaneously for irrigation and drainage. A fifth of the 570 km of channels, wider than 2 meters, is heavily covered by waterhyacinth or parrotfeather. Since 1977, several experimental studies have been carried out to assess the best strategy for weed control. The studies were led by the Botany Department of the Agronomy Institute of Lisbon, with some equipment help from a Luso-German cooperative program.

Ecological studies of the channels during 1982-83 included the studies of pH, Eh, temperature and DO profiles, transparency and conductivity, and also nutrient and heavy metal loads in the water, sediments and plant roots and shoots (3). Chemical monitoring continued up to late spring 1984 (11). The phenological cycle of major aquatic weeds also was studied in detail (3).

Mechanical harvesting till now has been the only extensive control measure used in the plain to control aquatic weeds, despite considerable financial costs. However, plant fragments produced by mechanical operations easily reinfect the areas.

Some experiences indicate waterhyacinths might be controlled by increasing water depths and flow rates, followed by controlled discharges to the main river and estuary, using nets to prevent reinfeation. Other methods, such as shading, are not likely to result in control because of sky brightness and long photoperiods. Several channels already have natural shade, from Populus spp, but no obvious growth limitation occurs.

Some herbicides have been tried in small plots since the mid-seventies against Typha spp., Phragmites australis and E. crassipes. The fairly good results have raised farmers' interest, especially in the case of common reed (6,7,8,13). The herbicides proved to be effective for control of small waterhyacinth infestations after mechanical harvesting. For toxicological reasons, glyphosate was chosen for demonstration applications on km of channels to control waterhyacinth plants which remained after mechanical removal (5). A special spraying device was developed and installed on a boat. The device draws water from the channel, mixes the water with herbicide to the required dilution and applies the herbicide at various rates (4). A research program is necessary to reach a compromise between herbicide cost, efficiency and dosage before extensive spraying is initiated. There also must be assurance that herbicides will cause no water quality deterioration nor harm to the aquatic life in the channels such as plankton, macroinvertebrates and fish.

Some bionssays are being carried out to assess the growth of tomatoes, rice and melons irrigated with channel water after glyphosate treatment. First results indicate the herbicide is not harmful to the crops (12).

The mirror carp (Cyprinus carpio) was found to prevent the spreading of parrotfeather. The fish disturbs the bottom mud, increases turbidity and damages plant beds; the best results seem to occur at 400 kg/ha fish density (1). The programmed introduction of grass carp (Ctenopharyngodon idella) to control parrotfeather has not yet been permitted by the authorities. Biological control of waterhyacinths using insects also is under consideration.

References

Experiment in a Portuguese canal using mirror carp (Cyprinus carpio) to control parrotfeather (Myriophyllum aquaticum).
SALVINIA INFESTATIONS IN PAPUA NEW GUINEA

Problems caused by aquatic weeds are usually defined in terms of navigation, recreation, irrigation, and flood control and so on. Social consequences of aquatic weed infestation are rarely described. Recently, a very interesting account of "catastrophic" social consequences brought about by a Salvinia molesta infestation was published. The book was brought to our attention by D.S. Mitchell of CSIRO-Australia. The account is in SEPIK RIVER SOCIETIES-A HISTORICAL ETHNOGRAPHY OF THE CHAMBER AND THEIR NEIGHBORS by Deborah B. Gewertz (Yale University Press, New Haven, Connecticut, 1983.) For part of her studies, Ms. Gewertz had intended to study the sex roles of the Chamber people of Papua New Guinea, but after realizing the significance of the weed infestation, she changed her plans in order to "analyze the social processes associated with the introduction of Salvinia as objectively as possible."

The account is about the Chamber people, hunter-gatherer's living in the shores of the Sepik River which, in the early 1970's, became choked with dense mats of the floating fern. Chapter 10 of her book is titled Salvinia molesta: The Destruction of an Ecosystem.

Gewertz recounts how the plant slowly spread to cover 79 kilometers of the river and 90% of Chamber Lake, affecting nearly 35,000 people who grow no crops, subsisting entirely by fishing and trading for sago palm.

The author examines the effects of the infestation on the economy of the people, and analyzes why and how villagers have placed blame on the problem. According to Gewertz, the plants entirely covered village fishing grounds, making it impossible to use fish nets. The women, traditionally responsible for catching fish for their families, return from the lake without enough food to feed their families. Sago, another staple of the economy, grows primarily in groves on the opposite side of the lake and river. Canoeing in the ferns is nearly impossible, and villagers have been trapped among the weeds in the middle of the water. The Chamber economy has been drastically altered by the presence of Salvinia. No longer do the Chamber have enough fish to exchange for sago. Because food supplies were greatly reduced, almost 50 percent of the population left their lake-side village for refuge in the town of Wewak. The remaining people face starvation.

The social stresses extend far beyond the obvious level of not having enough to eat. Because "nothing in Chamber experience has prepared them for Salvinia molesta," villagers have assigned various causes for the plague of "the no-good grass." Gewertz quotes a villager as saying that the weeds came "because the people had disobeyed God's commandments and God sent this weed into the area to make people suffer and be punished." Members of other nearby tribes blame the infestation on the "weakness of Chamber ancestors."

The Chamber women are blamed by the men who believe the food shortage is because the women do not maintain clear-cut allegiances and give food to the wrong people, or simply because the women do not work hard enough.

Gewertz also describes how the villagers engage in "weed warfare": planting the weed in fishing grounds and gardens of family and village enemies.

WATER PLANT SOCIETY OF JAPAN

The Water Plant Society of Japan was founded in 1980 for promotion of scientific research, exchange of information and propagation of the knowledge of water plants. The society has about 240 members including professional researchers, amateur botanists and general fanciers of plants. The society's interests include the study of taxonomy, ecology and physiology of water plants, weed control, utilization of water plants as class materials in schools, environmental conservation and cultivation for ornamental purposes.

The society publishes the Bulletin (in Japanese) and the Water Plant Society's Newsletters (in English). The reports of studies, reviews of current topics, essays and lists of publications on water plants which appear in Japan.

Annual membership fees are 2,500 yen. For more information, write to Dr. Yasuo Kadono, Secretary, Water Plant Society, Department of Biology, College of Liberal Arts, Kobe University, Nada, Kobe 657, JAPAN.

ECONOMIC LOSS...

Research cited here was conducted by D.E. Colle, J.V. Shireman and D.E. Canfield of the Department of Fisheries and Aquaculture and by W.T. Haller and J.C. Joyce of the Center for Aquatic Weeds.

ARMY CORPS...

The Corps of Engineers Waterways Experiment Station (WES), Vicksburg, Mississippi, is conducting research under the Aquatic Plant Control Program to develop improved methods of mechanical, chemical and biological control. Each of these methods possesses its own advantages and disadvantages; however, by using each method effectively, the overall control program will be more cost effective and environmentally compatible.

For more information, contact: Natural Resources Management Section, Construction Operations Division, U.S. Army Corps of Engineers, P.O. Box 4970, Jacksonville, Florida, 32233, USA. (904) 791-1215, or Waterways Experiment Station, Corps of Engineers, P.O. Box 631, Vicksburg, Mississippi, 39180-0631, USA.

(Continued from page 1)

SAVING... that these successes will be repeated in the water development project in Sri Lanka. Agencies which have provided Sri Lanka assistance against this new problem include: The Commonwealth Science Council, London; The Commonwealth Institute of Biological Control, India; The CSIRO Long Pocket Laboratories, Australia; The International Development Research Centre, Canada; and the Aquatic Weed Program, University of Florida, Gainesville.

The following list of Cyrtobagous research was retrieved from the Aquatic Weed Program's aquatic plant database.


AQUATIC MACROPHYTES IN RIO GRANDE DO SUL STATE, BRAZIL

by Gilberto Pedrali, Setor de Ecosistemas, Fundacao Centro Tecnologico de Minas Gerais (CETEC); Av. Jose Candido da Silveira, 2000; CEP 31.170—Belo Horizonte—MG; BRAZIL.

The State of Rio Grande do Sul has the largest lacustrine complex in Brazil. There are many lakes and lagoons, rivers and creeks, many of which are linked together and/or linked with the Atlantic Ocean.

Since 1976, a team of researchers has been collecting and identifying aquatic macrophytes throughout the State. Team members are from the Universidade Federal de Pelotas (UFPEL) and Universidade Federal do Rio Grande do Sul (UFRGS). They receive the support of Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (CNPq), Fundacao de Amparo a Pesquisa do Estado do Rio Grande do Sul (FAPERGS) and Comissao Interministerial de Recursos do Mar (CIRM).

After identification, the collected species are classified according to 7 principal biologic varieties: amphibians, rooted floating, free floating, rooted submergents, free submergents, emergents and epiphytes.

Team members have identified 126 species belonging to 53 families and 95 genera in the region between the municipal districts of Chui and Rio Grande, near the Taim Ecological Station of the Secretaria Especial do Meio Ambiente (SEMA). 85 species of 41 families and 66 genera were identified between the municipal districts of Sao Jose do Norte and Viamao. 70 species of 43 families and 66 genera were found in the region between Tramandai and Torres.

The final results of these floristic studies will be published in a manual of "Aquatic Macrophytes", that will contain identification keys, illustrations, ecological observations and maps of the geographic distribution of the species.

The partial and final lists (including all the State of Rio Grande do Sul) can be acquired at the above address.

AQUATIC WEEDS AND COLOMBIAN HYDROELECTRIC PROJECTS

Colombia is a country well suited for the development of hydroelectric power plants. Colombia also is well suited for the development of major aquatic weed infestations which can cover reservoirs and interfere with dams, their water intakes and discharge gates.

In Cordoba State, two major power plants, URR A I and URR A II, are being built at the confluence of several rivers where two reservoirs with a total area of more than 600 square kilometers are being created. The power plants together will have a capacity to produce 5,000 gigawatts of energy per year.

To minimize the effects of aquatic weeds on the project, researchers of the Corporacion Electrica de la Costa Atlanticica (CORELCA) are devising a management plan to control aquatic weeds before they create major hazards.

Initial steps include studying the effects of aquatic weeds on similar projects in other countries. They also are identifying species, studying their ecology, growth and population dynamics, and locating their sources throughout the river systems. Finally, they are collecting information on the methods of prevention and control of species expected to proliferate in the reservoirs.

Of the 32 species of aquatic plants common to the rivers of the area, three species have been identified as weeds of major concern. They are the waterhyacinth (Eichhornia crassipes), water lettuce (Pistia stratiotes) and salvinia (Salvinia auriculata).

For more information on the project and their aquatic plant studies, contact: Sr. Eustorgio Caro Sierra, Director, Regional Hydroelectric Project of URR A, CORELCA, Edificio Centro Ejecutivo II Carrera 55, No. 72-109 Piso 9 Apartamento Aereo No. 2741, Barranquilla, COLOMBIA.

NOTICE

See INFORMATION EXCHANGE Halted... on page one.

MEETINGS

SEVENTH INTERNATIONAL SYMPOSIUM ON AQUATIC WEEDS, September 15-19, 1986, Loughborough, ENGLAND. The symposium is sponsored by the European Weed Research Society (EWR S) and the Association of Applied Biologists (AAB). The symposium theme is: The Biology and Control of Aquatic Weeds. For information, contact: Dr. Max Wade, Department of Human Sciences (Ecology Group), Loughborough University of Technology, Loughborough, Leicestershire LE11 3TU, ENGLAND.

INTERNATIONAL CONFERENCE ON BIOMANIPULATION OF NATURAL AND ARTIFICIAL WATER BODIES, Summer, 1987. Lake Kinneret, ISRAEL. The conference is organized by the Israel Oceanographic and Limnological Research Co. For information, contact: Dr. Moshe Gophen, Chairman, Organizing Committee, The Yigal Alon Kinneret Limnological Laboratory, P.O.B. 345, Tiberias, ISRAEL 14-102.

Biomanipulation, the management of aquatic communities by controlling natural populations of organisms to produce desired conditions, is a field of growing interest. Although research to date shows varying degrees of success, evidence suggests that it is sometimes possible to greatly improve water quality, productivity (fishery), and overall community structure by enhancing or reducing populations of relatively few target species. The Conference will bring together researchers from different areas of limnology, fisheries, and aquatic resource management for an exchange of information and ideas to stimulate interest in biomanipulation of lakes, rivers and reservoirs. The scope of the conference will include the control and management of water quality, plankton, benthos, and macrophyte and fish populations.

FLORIDA AQUATIC PLANT MANAGEMENT SOCIETY ANNUAL MEETING, October 13-16, 1986. Plant City, Florida. Contact: Mr. David Tarver, President, FAPMS, 2416 McWest Street, Tallahassee, Florida 32303. (904) 562-1870.

Personnel from the Center for Aquatic Weeds recently cooperated in a residue study with the Dow Chemical Company and the Army Corps Waterways Experiment Station. The study took place on Lake Seminole, a 37,000 acre reservoir on the borders of Florida, Georgia and Alabama. Part of the study was to determine the uptake and effects of the herbicide Garlon (triclopyr) on crayfish and freshwater clams. Here, Dr. Joe Joyce delivers crayfish cages to the study area. Dr. Howard Westerdahl was the principal investigator for the study. Westerdahl is the section chief, Aquatic Processes and Effects, Environmental Laboratory, Waterways Experiment Station, Vicksburg, Mississippi.
REMOTE SENSING OF FLORIDA

Remote sensing with satellites is a state-of-the-art tool which is being used to survey and catalog everything on the planet’s surface. With satellite images, agronomists diagnose food crop health and compute acreages, geologists discover and map geologic faults and meteorite craters, foresters survey and identify diseased forests and hydrologists observe delta formation and measure temperature zones in the oceans. Since the early 1970s, satellite images have been used to map wetlands, determine water quality of lakes, determine surface areas of water bodies, and so on. Recently, researchers have employed satellite technology for yet another task.

Now, aquatic plant managers are studying the potential of satellite images to help survey aquatic vegetation in lakes and rivers. Remote sensing could provide an easier and cheaper method to anticipate and prevent spread and infestations of nuisance species. Thus, environmental and economic impacts of these infestations could be reduced.

Photograph-like images of earth taken by satellites show much more detail than the eye can see. These images are digital (dot-by-dot) recreations of computer measurements of wave-lengths reflected from the earth’s surface. Images can be “enhanced” by computers by specifying wave-lengths corresponding to whatever the viewer wishes to see. For example, an image of hydilla infestation in a lake can be produced by telling the computer to produce an image using only the red reflectance wave-length of hydilla. This ability coupled with satellite imagery’s very high resolution has made satellite photographs a tool for earth-bound researchers. As accurate as these images are now, technical developments promise even higher resolutions in the future. Perfecting techniques now will make it much easier to use the next generation of satellite images.

The Florida Department of Natural Resources has a program to study the use of satellite imagery for aquatic plant management. DNRF Larry Nall has produced enhanced color-coded images which differentiate several species of aquatic plants in Florida lakes. Floating, emergent and submerged plants are represented by specified bits of colors in these images.

Nall began his work in remote sensing to improve the accuracy and reduce the time required to conduct the department’s aquatic plant surveys of Florida. The 1983 survey covered 1,401,511 acres of water and took 8½ months to complete. These surveys require many hours of work but are an important part of DNR’s job of managing Florida’s water resources.

Another goal of Nall is to reduce the cost of surveying. Aerial photography used in surveys is expensive because of aircraft rental, flight crew wages and specialized photographic materials. Digital processing of the photographs also is quite expensive, requiring computer equipment and technical assistance. Satellite imagery is comparatively inexpensive. The satellite provides complete and frequently repeated images of most areas worldwide through a largely automated process. Data from satellite images require only a mini-computer for processing.

LANDSAT IMAGES

One Landsat scene is approximately 115 miles square. Twelve images cover the entire state of Florida.

Landsat cameras are of three types: the Vidicon, the Multispectral Scanner (accurate to 0.6 acres) and the Thematic Mapper (accurate to 0.2 acres). Future cameras will have even higher resolutions.

Specific wave-lengths can be assigned true colors, false colors or black and white, making the images very useful for rapid identification of different plant populations.

Nall has determined that the current minimum acceptable size for accurate sensing of aquatic plants from Landsat is about 500 acres. With today’s satellite technology, Landsat probably is acceptable only for larger lakes—over 100 acres—and for large populations of plants. This limitation should be overcome as more sophisticated satellites with higher resolution cameras become available to the public.

Unprocessed photographs show almost no vegetation in lakes. “Enhancing” brings out wave-lengths which correspond to specific reflectance of species.

Acreages can be determined by a computer plotter-counter. Precise fixed-point transacts initially will have to be conducted to correlate the signature (wave-length) with plant species. Ground-truthing (verifying plant species on the ground) should take place on the day of the LANDSAT flyover.

Advantages of surveying large systems such as Lake Okeechobee are obvious. Biologists will only have to visit certain areas to confirm the identity of plants, and the computer can then quantify those areas which correspond to that plant’s wave-length.

SOME RESULTS

Nall found that many classes of marginal and floating plants were detected using Landsat data. Landsat data generally corresponded well with known aquatic plant communities. Several classes of submerged plants also were detected and good penetration of moderately clear water was demonstrated.

Using the multispectral scanner camera data, Nall found the cost for coverage of the entire state is about $7,800. The cost of using thematic mapper data is substantially higher: about $38,400. Therefore, a survey of one million acres of water using multispectral scanner data would cost about $0.0078 per acre; thematic mapper data would cost about $0.0384 per acre.

Nall believes Landsat data can be used economically and conveniently to survey emergent and submerged plants. Nall’s future work will be to collect data to produce a detailed processing procedures manual so that satellite imagery can be used routinely.

For this work, Nall used DNR’s Landsat analysis facility at the St. Petersburg Marine Laboratory ( Gould computer, Comsat Image Processing System and ELAS software from NASA) and magnetic tapes of Florida images obtained from Landsat satellites. Nall’s address is: Mr. Larry Nall, Florida Department of Natural Resources, Bureau of Aquatic Plant Management, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303. Landsat photographs and magnetic tapes can be obtained from the U.S. Geological Survey, Earth Resources Observation Station (EROS) in South Dakota.
A FARMER'S PRIMER ON GROWING RICE by B.S. Vergara. 1979. International Rice Research Institute (IRRI), Communication and Publications Department, P.O. Box 933, Manila, PHILIPPINES. 221 pages.

Published in 25 languages, this book clearly and simply explains the "why" and "how" of good rice-growing practices. It is (being translated into 20 other languages.)

The primer is based on the IRRI studies and experiences from developing countries to explain through black and white illustrations how to incubate seeds, how to determine proper depth for transplanting and so on. IRRI believes the book is the most translated agricultural book in existence.


This is a collection of three papers presented at an ASTM symposium in Ft. Lauderdale, Florida in January 1983. Most of the papers are about methods for sampling and quantifying macrophyte vegetation in the field, but others have to do with mapping and the use of remote sensing and aerial photography to monitor aquatic plants.

CULTURE METHODOLOGY FOR EXPERIMENTAL INVESTIGATIONS INVOLVING ROOTED SUBMERSED AQUATIC PLANTS, by R.M. Smart and J.W. Barko. 1984. Army Corps of Engineers, Waterways Experiment Station, P.O. Box 2816, Vicksburg, Mississippi 39180-0631, USA. Miscellaneous Paper A-84-6. 20 pages.

This information is intended to help in culturing submersed plants for experimental laboratory research.


This 3-volume work is "the only general reference work on the freshwater biota of the neotropics" and was produced through the collaboration of 150 taxonomists supported by institutions in Brazil, Mexico, the United States and Venezuela. Each volume contains an updated systematic and ecological classification of all plant and animal groups found in the inland waters of the region. The book is a valuable resource for biologists, hydrologists, and anyone interested in the biota of freshwater environments.

"MAINTENANCE CONTROL"

"Maintainance control" of aquatic plants is an official policy of the State of Florida, and state regulatory agencies have been mandated to implement maintenance control methods in their aquatic plant management operations. The objective of maintenance control is not the eradication of problem plants. Because of high economic and environmental costs of very intensive chemical and/or mechanical operations, complete eradication is considered practically impossible.

Florida State Statute, Chapter 372.925, defines maintenance control as "a method of managing exotic aquatic plants in which control techniques are utilized in a coordinated manner on a continuous basis in order to maintain a plant population at the lowest feasible level."

There is a great deal of debate as to what the "lowest feasible" levels of problem plants should be. However, it is generally agreed that the levels vary according to the plant species, location and management objectives of given water bodies.

Dr. Joe Joyce of the U.F. Center for Aquatic Weeds recently published results relevant to maintenance control practices. His research shows that maintenance control methods result in the use of less herbicides, the deposition of less organic matter (from dead leaves and plants) in the lake bottom, less overall environmental impact by weeds, and reduced management costs. See the bar graph below.

The shaded bars of the graph show pounds of herbicide used to control waterhavacins on a one-acre pond per year at different vegetation levels. One of the purposes of maintenance control is to reduce the amount of herbicide used in water bodies. The graph shows that maintenance control requires the use of less herbicide, in this case 60% less per year. (The number over each bar indicates the number of site visits per year.)

The un-shaded bars of the graph shows the annual organic sedimentation resulting from chemical control of waterhavacins in a one-acre pond. Another purpose of maintenance control is to reduce the amount of sediments produced by the plants. The graph shows that maintenance control results in much less sediment deposition per year. These sediments reduce water depth, reduce oxygen levels, and cover fish spawning areas.

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**AQUATIC HERBICIDE RESIDUE LITERATURE REVIEW**


This report identifies research on the fate of aquatic herbicides in water, especially research relevant to Florida's freshwater ecosystems. The report includes research on 2,4-D, fluoridone, endothal, diquat, copper, and glyphosate.


The author presents a taxonomic analysis of 71 plants inhabiting the five main rivers in Korea. Included is new information on Isoetes and Trapa species.

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**ABC NEWS AND AQUATIC PLANTS**

Millions of television viewers learned something about using aquatic plants for wastewater purification last year in an ABC News segment. In a regular newscast, ABC interviewed Dr. B.C. Wolverton (NASA, Bay St. Louis, Mississippi, USA) about the ability of water hyacinth (Eichhornia crassipes) to remove heavy metals and other pollutants from industrial wastewater. Also shown to viewers was the new San Diego (California, USA) wastewater facility which uses acres of water hyacinths ponds for domestic wastewater treatment. San Diego is the eight most populous city in the United States and the aquaculture part of the system is expected to treat 40% of the city's wastewater.

The research of Wolverton, R.C. McDonald, K.R. Reddy and other researchers since the early 1970s has shown that water hyacinths and other aquatic plants can remove pollutants from water systems. Several cities in Florida, Texas and California have used these systems, but San Diego's appears to be the largest anywhere. ABC reported that such systems cost about half what other types of wastewater treatment systems cost. Asked why other cities have not opted to use aquatic plant and wetland treatment systems, Wolverton replied that the systems are "just too simple".

The Aquatic Weed Program's database contains several hundred research articles and books about the abilities of many aquatic plants to accumulate water pollutants.
COMPETITION BETWEEN HYGROPHILA AND HYDRILLA
Hygrophila continues to be a major nuisance in irrigation and flood-control canals and other flowing waters. However, competition studies at the University of Florida Center for Aquatic Weeds have shown that another exotic plant (Hygrophila polysperma) may be able to outcompete hydriella in especially fast-flowing waters. This could be more bad news for water managers in places where hygrophila has been introduced. For example, hygrophila has been introduced into South Florida irrigation and flood-control canals, and in some of the canals, hygrophila has successfully competed with hydriella.

In the competition studies, researchers demonstrated that hygrophila produced a 3 to 5-fold increase in biomass in flowing water with turnover times of 1 to 5 hours. In contrast, hydriella biomass increased 2-fold in water with turnover times of 2 and 3 hours. The researchers noted that treatment of canals with herbicides for the control of hydriella “would favor the expansion of hygrophila which is more resistant to herbicides labelled for hydriella control.”

The research was conducted by Gerda van Dijk and Dan Thayer, under the direction of Dr. William Haller. Van Dijk was a visiting student from The Netherlands.

PEEM
Three international organizations have created and support a panel of experts to help countries control diseases such as schistosomiasis and malaria. The Panel of Experts on Environmental Management for Vector Control (PEEM) operates under the auspices of the World Health Organization (WHO), the Food and Agriculture Organization (FAO) and the United Nations Environment Program (UNEP).

The panel of about 30 experts was created five years ago. Its main goals are to increase awareness of the need to solve vector-borne disease problems by means of environmental management, to encourage the incorporation of health safeguards into environmental management, and to study the effects of management methods on vectors of diseases. Because most of the target diseases are spread by water-borne vectors; most of PEEM’s work has to do with the development and management of irrigation projects, rice production and flood control systems.

Among PEEM’s new projects is the study of the effects of azolla use on the mosquito vectors present in rice fields. Azolla is an aquatic plant which is used as a “biofertilizer” in rice fields. Information is needed on whether or not using azolla increases the risk of disease spread by providing breeding places for Anopheles and Culex mosquitoes.

The PEEM Newsletter is published four times a year, in English and French. Other PEEM publications include: 1) The global scale of health problems of water resources development. 2) Health problems in small scale water resources development projects. 3) Guidelines for forecasting vector-borne disease implications resulting from the development of water resources projects. PEEM can be contacted through Dr. Robert Bos, PEEM Secretariat, World Health Organization, 1211 Geneva 27, SWITZERLAND.

HYDRELLIA ON HYDRILLA
A minute aquatic fly (Hydrellia pakistanae) from Pakistan and India has become a primary candidate for study of the biological control of the menace aquatic weed hydriella (Hydrella verticillata). “Extensively damaged” mats of hydriella recently were observed in Pakistan and India by U.S. researchers Dr. Gary Buckingham and Mr. Christine Bennett and, earlier, by Dr. Joseph Balcunas. Larval stages of the fly mine hydriella leaves and stems, heavily damaging the plants. Buckingham and Bennett have collected the flies for quarantine studies in the Division of Plant Industry quarantine facility in Gainesville, Florida. If their studies are successful and permission for release is received from various agencies, small-scale outdoor tests against hydriella could be attempted by early 1987.

Hydrellia on hydriella was first discovered in the 1970s by researchers of the Commonwealth Institute of Biological Control Rawalpindi (Pakistan) Station, working under a United States research grant (PL-480). The fly was “rediscovered” by Balcunas in southern India in his 1981 and ‘82 round-the-world trips to identify insects which attack hydriella. In 1985, Buckingham and Bennett went to Pakistan and India to collect samples of Hydrellia, as well as to conduct other field work. According to a CIBC-Pakistan report, a single Hydrellia larva can damage an average of 12 leaves before reaching maturity. The entire life cycle from egg to adult is 18-31 days and the fly lays a maximum of about 30 eggs in its lifetime. No studies about its biological control potential have been published.

Buckingham and Bennett have begun their work by raising populations of the flies in quarantined tanks of hydriella. In various experiments, they hope to verify the fly’s host-specificity to hydriella in Florida. They also are studying the fly’s short life-cycle and will devise culture techniques.

Buckingham has worked on biological control methods for more than 15 years. He is a United States Department of Agriculture research entomologist (ARS). Bennett is an entomologist with the University of Florida (IFAS) Department of Entomology and Nematology. They are stationed at the USDA Biological Control Laboratory in Gainesville. Their address is: Biological Control Laboratory, P.O. Box 1269, Gainesville, Florida 32602.