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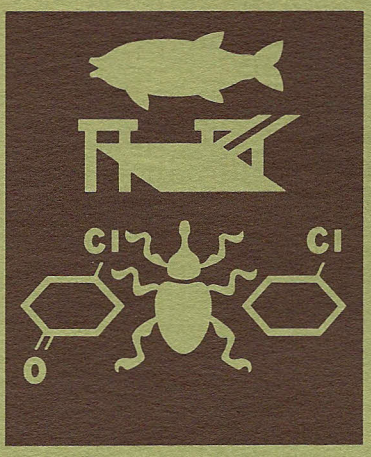

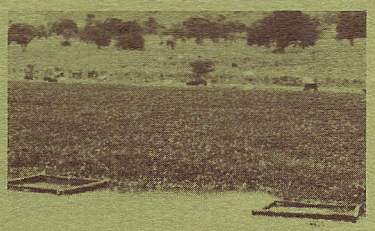

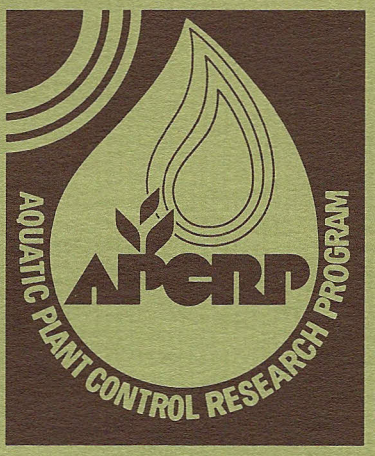

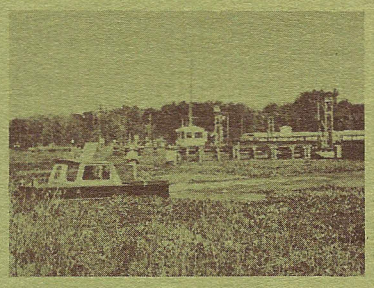

AQUATIC PLANT CONTROL RESEARCH PROGRAM

Information Exchange Bulletin

AQUATIC PLANT CONTROL RESEARCH PROGRAM

This is the first issue of an information exchange bulletin to be published periodically by the Waterways Experiment Station (WES) for the purpose of disseminating timely information on the status of technology development under the Corps of Engineers' nationwide Aquatic Plant Control Research Program (APCRP). This issue provides background information on the APCRP, including authority and objectives, and identifies those persons at WES directly concerned with the conduct of the APCRP.

INTRODUCTION AND BACKGROUND

The Corps of Engineers is responsible for control of weed infestations of major economic significance (in addition to those that have potential to reach problem proportions) in navigable waters, tributaries, streams, connecting channels, and allied waters. This responsibility is carried out under the Aquatic Plant Control Program (APCP) of the Office, Chief of Engineers (OCE), Civil Works Directorate, Construction-Operations Division, Recreation-Resources Management Branch. Field operations for control of aquatic plants are conducted through Corps District offices. WES has been designated as the Corps' lead laboratory for aquatic plant control research and conducts the APCRP through the Aquatic Plant Research Branch of the Environmental Systems Division, Mobility and Environmental Systems Laboratory. The authority for the APCP is set forth in Section 302, Public Law 89298 (79 Stat. 1092), Rivers and Harbors Act of 1965. The program is carried out under Engineer Regulation 1130-2-412, dated 28 May 1976.

The operations portion of the program is the actual "hands-on" use of various tools and techniques for aquatic plant control such as chemical spraying programs and use of biological and mechanical control techniques. The research program has responsibility for developing and transferring the technology needed by the field operations units to control and manage aquatic plant infestations in an environmentally compatible manner at the least possible cost.

In early 1975, OCE assigned the management of the APCRP to WES with instructions to redirect the program so that it would be more responsive to the operational requirements of the Districts. As a result, emphasis is presently on the transfer of technology from the researchers to their operations counterparts at an accelerated pace. The program emphasizes identification and development not only of new control agents, but also of necessary methods and techniques for their proper use on a continuing

operational scale. By the beginning of 1976, the objectives of ongoing and new research had been focused more clearly on operational problems found nationwide.

APCRP MANAGEMENT

Given the number and diversity of problem weed species, environments where these problem weeds occur, uses of land adjacent to weed control operations, and political aspects of the various Federal, State, and local weed control programs, it is obvious that no single control technique will be adequate. Yet, because management of aquatic plants must be relatively inexpensive, the comprehensive solution sought requires the use of systems analysis techniques that permit study of the effectiveness of various control agents used singly and in combinations. For these reasons, the APCRP has been divided into six major program elements. These elements identify the technology development necessary for the primary methods of control pursuant to the management of problem aquatic plants on an operational level. Each element, though separate, has the common objective of technology transfer to the user through short- and long-term research. The program elements are as follows:

I. Biological Control Technology
II. Chemical Control Technology
III. Mechanical Control Technology
IV. Integrated Control Technology
V. Problem Identification and Assessment
VI. Management Technology

WES has established as an additional objective of each program element, the publication of manuals that will:

- Allow Corps operational field units to better assess and classify the type of aquatic plant problems they face.
- Provide a technique for rationally selecting the type and method of control that can be applied for each problem class.
- Give guidance as to the degree of control that can be expected from each control technique applied to a given problem class.

Preparation of these manuals will require the ability to predict the effectiveness of various control agents applied under a variety of conditions. Also, for compliance with existing laws, such preparation requires the ability to predict any subsequent environmental effects resulting from weed control operations as well as some means of mitigating them. The APCRP is, through all program elements, developing this predictive capability.

PROGRAM ELEMENTS

Biological Control Technology

WES research being conducted for development of biological control methods includes laboratory tests and both large- and small-scale field tests of various species of insects, plant pathogens, and fish. This element will be accelerated, with increased emphasis on the search, evaluation, and subsequent release of additional biological control agents. Two important studies presently being conducted are discussed below.

Field Test of the White Amur. A large-scale operations management test for introducing the white amur (*Ctenopharyngodon idella* Val.; see Figure 1) into a field environment has been initiated at Lake Conway near Orlando, Fla., to study the feasibility and effectiveness of this fish for con-

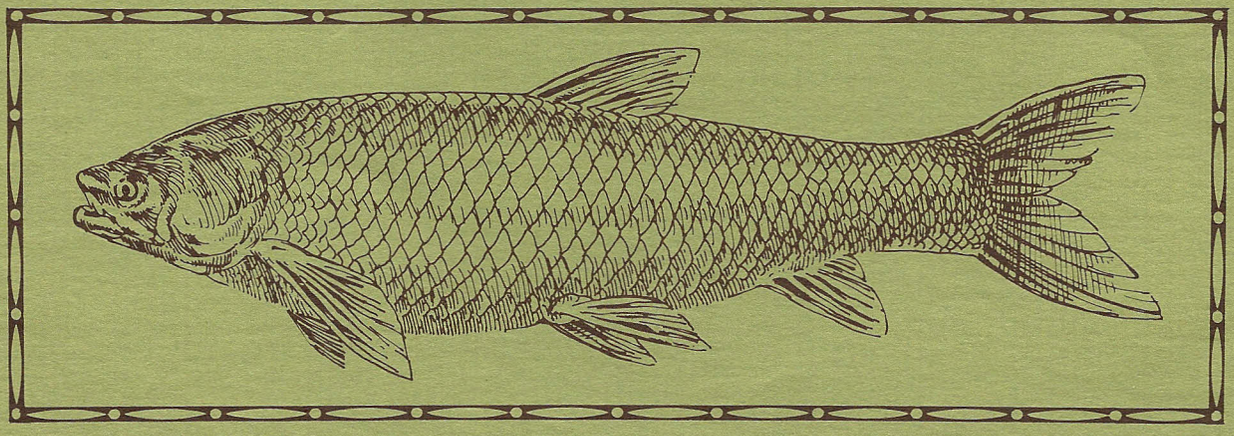

Figure 1. The white amur or grass carp

trol of hydrilla. One year of study of aquatic plants, fish, water quality, benthos, phytoplankton and zooplankton, and periphyton will be completed in August 1977. The monosex white amur will be stocked in early September 1977. Project personnel will continue to collect data for 3 years after stocking to determine the effects of the white amur on the ecosystem.

Insects and Pathogens. Research using insects and pathogens is being conducted in cooperation with the U. S. Department of Agriculture Biological Control Laboratory and the University of Florida Plant Pathology Department, respectively, both at Gainesville, Fla. Research on pathogens has shown that *Acremonium zonatum* and *Cercospora rodmanii* have considerable potential as biocontrols of waterhyacinth (Figure 2). These two species combined with two insect species (*Neochetina eichhorniae* and *Arzama densa*) have been tested by WES for control of waterhyacinth in Lake Concordia, La. (Figure 3). The results of these tests indicate that the effect of combining an insect and a pathogen is synergistic. An operational test of the *Neochetina eichhorniae* (Figure 4) in combination with the pathogen *Cercospora rodmanii* will be initiated in FY 77-78 in New Orleans District problem areas. As a result of insect research, alligatorweed has been successfully controlled in most areas of the Southern United States with the flea beetle (*Agasicles hygrophila*).

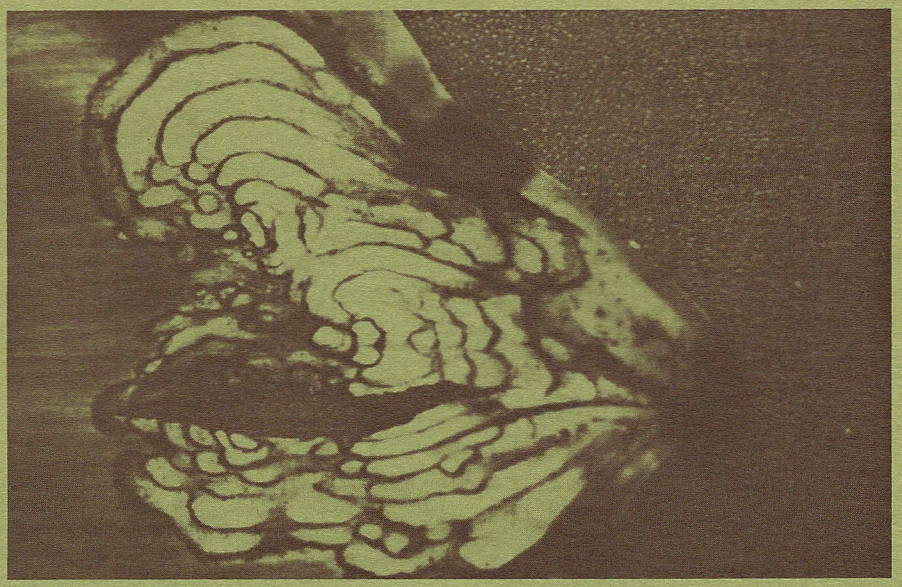

Figure 2. Zonate leaf spot fungus on a waterhyacinth leaf

Figure 4. The waterhyacinth weevil

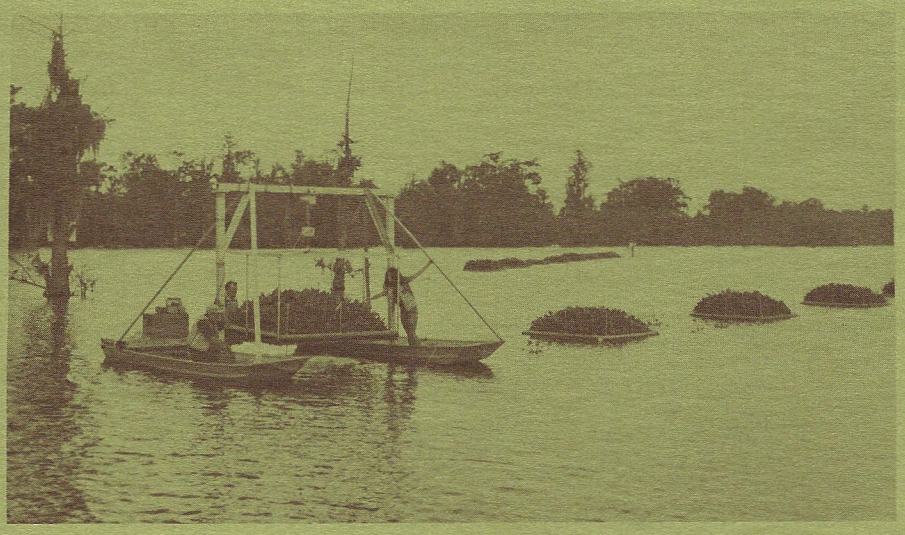

Figure 3. Plot layout and weighing apparatus used at Lake Concordia, La., for studying the effects of integrated control of waterhyacinth with insects and plant pathogens

Current research on insects is in various stages of progress and includes work on the following:

- For waterhyacinth control—waterhyacinth weevil (two species of *Neochetina*) and stem boring moth (*Sameodes sp.*).
- For Eurasian watermilfoil control—moth (*Paraponyx sp.*).
- For hydrilla control—midge (family Chironomidae-species currently unidentified).

Various portions of this research are being conducted in the United States, Europe, and Africa.

Chemical Control Technology

Research in the area of chemical control involves technology development required to place chemical tools in the hands of Corps operations personnel for the management of aquatic plants. Testing and evaluation of chemical compounds per se and associated techniques and equipment used to apply the chemicals are of major concern. Specific interest is currently being centered on the development of controlled-release herbicide formulations of presently available chemicals which have proven to be valuable for aquatic plant control operations. It has been demonstrated that substances containing effective herbicides, when released slowly into the aquatic environment, effect control over a longer period of time than when massive doses are applied by conventional methods. Controlled-release formulations of 2,4-D, Fenac, and copper have been prepared and evaluated in the laboratory. Small-scale pool tests are presently under way. Studies of the fate of herbicides in the aquatic environment are also under way to satisfy registration requirements of certain herbicides that appear promising for immediate use as control agents.

Mechanical Control Technology

In the past, research for development of mechanical methods for controlling aquatic plants has been abandoned in favor of apparently less costly methods, before any significant advances could be realized. In addition, the research has been sporadic. The insistence of the public sector on immediate problem relief without environmental side effects has generated a requirement for an intensive evaluation and development program in mechanical control. The objective of this program element is to develop and evaluate mechanical control systems, for identified problem areas, for operational use. Current research is centered around the evaluation of low-energy control systems for two major problem areas in Florida, collection of the necessary data to adequately describe the problem areas in order to identify problem-specific performance criteria, and eliciting response from industry for the design, construction, and evaluation of mechanical control systems (Figure 5).

Integrated Control Technology

The biological control research discussed earlier has shown that the effect of using some agents in combination on a given problem plant is greater than the sum of the individual effects of these same agents; i.e., the control effect is synergistic. Agents to be studied in the future in integrated applications include selected combinations of environmental manipulation and mechanical, biological, and chemical agents. Various combinations of chemical and biological agents are currently being studied in south Florida.

Problem Identification and Assessment

The objective of the research conducted in this program element is to develop rapid techniques for locating, identifying, and mapping the character and distribution of aquatic plant problems.

The water-covered surfaces in the United States comprise slightly over 2 percent of the total surface area. This vast water-covered area of over 42,763,950 hectares (427,640 km^2) is the potential habitat (depending on the suitability of growing conditions in a specific locality) for up to 50 noxious aquatic plants.

Presently, the most prevalent problem species occurring in high-use areas are: waterhyacinth *Eichhornia crassipes* (Mart.) Solms, hydrilla (*Hydrilla verticillata* Royle), Eurasian watermilfoil (*Myriophyllum spicatum* L.), Brazilian elodea (*Egeria densa* Planch.), pondweed (*Potomogeton spp.*), and naiad (*Najas spp.*). In addition to these six, other species present continuing problems: alligatorweed *Alternanthera philoxeroides* (Mart.) Griesb., waterchestnut (*Trapa natans* L.), and coontail (*Ceratophyllum demersum* L.). The six most prevalent species are emphasized in the research program.

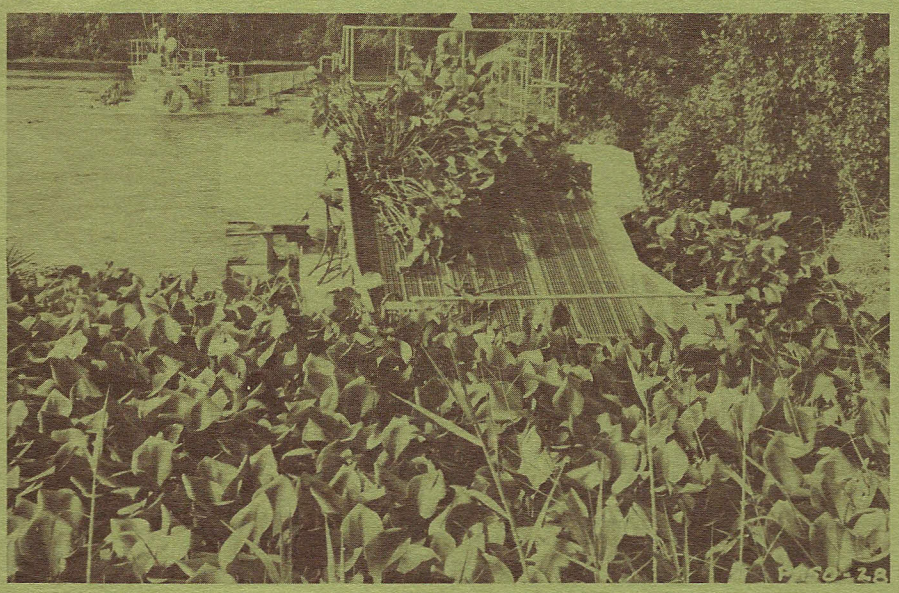

Figure 5. Mechanical harvesting of waterhyacinths in the St. Johns River near Astor, Fla.

Remote sensing studies are being conducted to establish the optimum film-filter combinations and other mission parameters that must be used if a target species is to be identified. Also, work has been initiated on development of a system that will permit classification of various aquatic plant infestations such that an adequate control method can be more readily tailored to a specific problem.

Management Technology

Past research efforts have not addressed the problem of identifying for operational management a framework for applying available control methods to their problem that will ensure a level of success commensurate with the technology potential. The objective of this program element is to provide operational management with a method for integrating present control technology into a management framework. WES has developed a concept for the development of such management plans and is developing prototypes for evaluation at the operational level in five operational problem areas.

Future research will be devoted to the problem of operational management of aquatic plants through:

- Development of a system simulation of the aquatic ecosystem that is realistic in terms of predicting system response to the use of control agents.
- Development of an operations simulation model that permits performance prediction of selected hardware system-control agent application technique combinations.
- Generation of long-term operational management plans for control of aquatic plants through integration of the results of all research in a logical, sequenced manner.

In addition, research will be directed toward the objective of providing operational management with a guide for the preparation, initiation, and implementation of a rationally based aquatic plant management plan. This guide will provide the user with the steps necessary to:

- Identify and assess his problem.
- Determine available methods and techniques applicable to his problem situation.
- Develop a framework from which to formulate a long-term management plan for control of problem plants and subsequent maintenance at a desirable level.
- Identify follow-up procedures necessary to obtain the data and information required for determining the degree of success and cost of the resulting management plan.

TRANSFER OF TECHNOLOGY

Transfer of technology is presently being emphasized in the APCRP. Three means are being used to enhance the flow of information from the researchers to private, State, and Federal agencies and to the Corps Districts; namely, a public information program to keep the public sector informed of research efforts, technical reports of research findings distributed throughout the scientific community, and large-scale operations management tests.

This last item is a recent innovation of the program and is conducted cooperatively by both laboratory basic research personnel and field operations personnel, with the purpose of adapting basic laboratory and experimental research results to the field by integrating them into the operations program. Such a test differs from a pure research experiment both in scale and in minimum experimental controls that are imposed on the variables that may affect the outcome of the experiment. Although conducted at a scale and in a manner representative of a full-scale field operations activity, it differs from a pure operational project in that the results are carefully monitored over a period of time.

WES will continue to direct future research under the APCRP toward objectives that are clearly related to operational needs. In addition, the research elements will be couched in terms of specific plans to place operational capabilities in the Districts' control programs in a defined time frame. Obviously, the operational control programs will also undergo change in order to incorporate this problem-solving attitude.

The solutions resulting from these efforts must be designed for application to aquatic plant problems at levels defined by the public users of our waterways. The burden of success lies with well-managed, long-sighted control programs with true problem-solving tools provided by research. Future issues of this Information Exchange Bulletin will periodically present the results of the research being conducted to achieve this objective.

PERSONNEL OF THE APCRP

It may be helpful in this first issue of the Information Bulletin to introduce those WES personnel who are involved with the APCRP:

Mr. J. L. Decell, Environmental Engineer, Chief, Aquatic Plant Research Branch

Mr. W. N. Rushing, Research Botanist, Coordinator and Technical Administrator

Dr. D. R. Sanders, Plant Physiologist, Technical Staff

Mr. E. E. Addor, Research Botanist, Technical Staff

Mr. P. A. Smith, Physicist, Technical Staff

Mr. M. M. Culpepper, Civil Engineer, Technical Staff

Mr. R. F. Theriot, General Biologist, Technical Staff

SP5 Ahmed Khan, Chemical Engineer, Technical Staff

Mr. S. A. Shirley, Civil Engineering Technician, Staff

Ms. C. B. Pugh, Secretary

Ms. S. H. Lewis, Clerk-Typist, Staff

The APCRP is under the general supervision of Mr. B. O. Benn, Chief, Environmental Systems Division, and Mr. W. G. Shockley, Chief, Mobility and Environmental Systems Laboratory. The APCP, which includes the APCRP, is administered by OCE through the Recreation-Resources Management Branch, Construction-Operations Division. Program Monitor at OCE is Mr. H. Roger Hamilton.

This bulletin is published in accordance with Army Regulation 310-2. It has been prepared and distributed as one of the information dissemination functions of the Mobility and Environmental Systems Laboratory of the Waterways Experiment Station. It is principally intended to be a forum whereby information pertaining to and resulting from the Corps of Engineers' nationwide Aquatic Plant Control Research Program (APCRP) can be rapidly and widely disseminated to Corps District and Division offices as well as other Federal agencies, State agencies, universities, research institutes, corporations, and individuals. Contributions are solicited and will be considered for publication so long as they are relevant to the management of aquatic plants as set forth in the objectives of the APCRP, which are, in general, to provide tools and techniques for the control of problem aquatic plant infestations in the Nation's waterways. These management methods must be effective, economical, and environmentally compatible. This bulletin will be issued on an irregular basis as dictated by the quantity and importance of information to be disseminated. Communications are welcomed and should be addressed to the Mobility and Environmental Systems Laboratory, ATTN: W. N. Rushing, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss. 39180, or call 601-636-3111, Ext. 3542.

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Commander and Director

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