

A Q U A P H Y T E



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CENTER FOR AQUATIC PLANTS

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VETIVER GRASS - AN EXOTIC, BUT . . .

Deliberately spreading an exotic plant around the world sends chills down the spines of many people, especially those charged with controlling exotic weeds. Many exotic weed problems come readily to mind - hydrilla, water hyacinths, water milfoil, melaleuca, Australian pine, giant salvinia, torpedo grass, and others, depending on which part of the world you live in. In Florida alone, millions of dollars are allocated each year for the control of introduced exotic species. So why is the World Bank and the U.S. National Research Council (NRC) touting the use of an exotic species of grass, native to India, that grows two to three meters high with roots up to three meters deep?

Vetiver grass (*Vetiveria zizanioides*) is a coarse perennial "stiff-stem" grass found in the tropics of the Old World. It is in the same family as maize, sorghum, sugarcane and lemongrass. Named in 1771 by Linnaeus, *zizanioides* means "by the riverside", reflecting that it is commonly found along waterways in India. It is described as both a xerophyte and a hydrophyte (World Bank, 1990), or semiaquatic (Cook, 1990). Another species native to Africa, *V. nigriflora*, is aquatic.

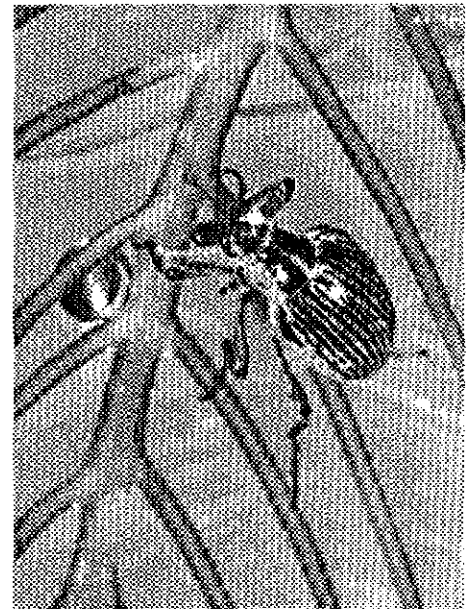
Vetiver tolerates an exceptionally wide pH range, and grows in any type of soil regardless of fertility. Its long, fibrous roots form a dense underground curtain. The grass is disease resistant, fire resistant, salt tolerant, and contains a strong aromatic oil that makes it unpalatable to rodents. It can withstand trampling and grazing by large animals because the plant crown remains below the surface of the soil. It also can withstand drought. The NRC states that "Vetiver is at home on the interface between land and water. It is one of the few terrestrial plants able to take wet conditions, even total immersion. For this reason alone, it might become outstandingly useful." (1993) In an aquatic situation, might it become an outstanding nuisance?

ADVANTAGES

The features that make vetiver grass sound potentially formidable also make it sound like a rather remarkable plant for erosion control and water retention. Agricultural agents in developing countries recommend vetiver grass as a contour hedge for farming on sloping land. When planted as a tight hedge along the contour of the land, vetiver significantly slows water run-off from fields which allows time for water to soak into the soil before continuing along the normal watershed. The run-off also is filtered by the grass so that soil and organic debris collect at the hedge. This process causes a large, earthen terrace gradually to build up in front of the hedge, further stabilizing the sloping land and providing more land for farming. The extensive roots of vetiver grass are fibrous and grow straight down as opposed to spreading outward, which would interfere with crop growth. The deep roots anchor the plant firmly in the ground and stabilize soil even on steep slopes with large amounts of water run-off.

Vetiver grass also appears to be effective for stabilizing gullies when planted as a barrier across them. When used as a border grass, its dense growth is reported to prevent the rhizomes of weedy grasses from invading crops. In Ethiopia, the local

[See Vetiver on Page 8]



NATIVE WEEVIL EATS EXOTIC WEED

Interest is being shown lately in the North American weevil, *Eurhynchius lecontei*, as a biological control agent for the exotic submersed plant Eurasian watermilfoil (*Myriophyllum spicatum* L.). The weevil has been associated with declining populations of watermilfoil in the northeastern United States.

Robert Creed and Sallie Sheldon (Department of Biology, Middlebury College, Vermont) have studied *E. lecontei* in Brownington Pond in Vermont since 1990, and have surveyed many other New England lakes for *Eurhynchius* and other herbivorous insects. Their work shows that all life

[See WEEVIL on Page 7]

Videophile

Here are three more APIRS-produced videotape programs for your viewing pleasure...

Aquatic Pest Control Applicator Training, Part I and Part II

Part I, 28 min., IFAS Catalog No. VT-1068;
Part II, 30 min., IFAS Catalog No. VT-1069.

These programs teach the basic knowledge necessary to become "certified" as a restricted use pesticide applicator in aquatic pest control (category 6) in Florida. Topics include a brief history of aquatic plant management, laws, herbicide technology, biological control, mechanical control and environmental effects. The programs were adapted from the *Aquatic Pest Control Applicator Training Manual* (IFAS Publ. SM-3), edited by Dr. Ken Langeland.



NHRA Gainesville Raceway Wastewater Treatment System

15 min., IFAS Catalog No. VT-455

In this program, Dr. Jerome Shireman (UF Department of Fisheries and Aquatic Sciences) explains the design and functioning of an innovative sewage treatment system, which processes the waste of 100,000 spectators at the annual Gatornationals auto racing event. This "batch" system uses aquatic plants as part of the treatment process, features on-site water disposal, produces fish and pine trees as salable end-products, and occupies only five acres of land.



Hormone Induced Spawning Of Grass Carp

25 min., IFAS Catalog No. VT-038

Grass carp are an effective biological control of submersed aquatic weeds, as well as a food-fish in many countries. Written by Mr. Roger Rottman (UF Department of Fisheries and Aquatic Sciences), this video covers brood fish, mixing hormones, injecting fish, taking the spawn, inducing triploidy (by pressure), incubating eggs, stocking the fry, and raising them to salable fingerlings.



Programs may be borrowed from the Information Office (904/392-1799). Or they may be purchased from IFAS Publications, IFAS Building 664, Gainesville, FL 32611-0001 (904/392-1764). Each videotape costs US\$15.00 (plus .90 tax for Florida residents), payable to the University of Florida. Checks or purchase orders are accepted. Specify VHS or European PAL format.

A T T H E C E N T E R

GRASS CARP SYMPOSIUM

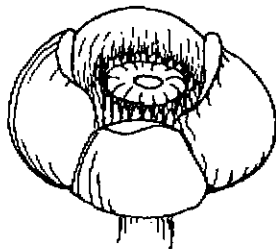
During a symposium to be held March 7-9, 1994, researchers and managers from across the U.S. will assess the environmental impacts of using grass carp in large lakes and reservoirs in the southern United States. The meeting will convene at the University of Florida Reitz Union.

It is co-sponsored by the Center for Aquatic Plants, the Florida Department of Environmental Protection, the Florida Game and Fresh Water Fish Commission, the U.S. Army Corps of Engineers - WES, the Tennessee Valley Authority, and B.A.S.S., Inc. For information, contact Bobbi Goodwin at 904-392-9613.

NUPHAR STUDY BEGINS

Dr. Ken Langeland, together with recent weed science graduate Mr. Brian Smith, will be conducting studies on spatterdock (*Nuphar luteum*) seed germination and ecological factors affecting seedling survival. Dr. Michael Kane of the Environmental Horticulture Department also will be working on the project to develop micropropagation techniques for *Nuphar*.

Spatterdock and other native plant populations have significantly declined in Lake Griffin, Florida. The researchers hope to apply their findings to restoration efforts in the lake during a pending drawdown. The restoration work will be coordinated with the Florida Game and Fresh Water Fish Commission.

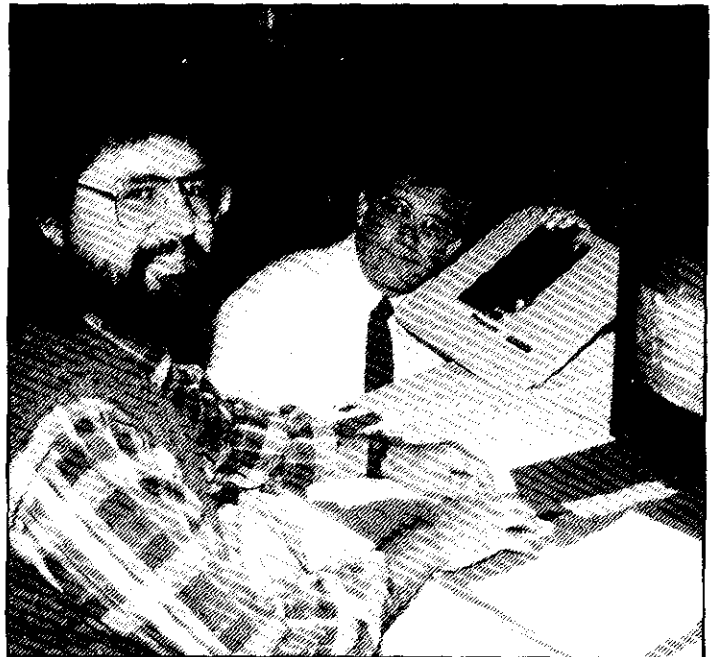


AQUATIC PLANT HERBARIUM

'Til now at the University of Florida, most aquatic plant identification services and all aquatic plant archiving have been done by the university's herbarium. The Center for Aquatic Plants has long needed its own herbarium.

Now, room has been constructed and herbarium cabinets have been purchased for the start of an aquatic plant collection to be housed at the Center. Dr. Ken Langeland intends to make use of the many samples that Florida LAKEWATCH volunteers and others frequently bring to him for plant identification. With the help of the Herbarium, Langeland will preserve and catalog the specimens into a herbarium collection which will be open to the public.

Although the collection will concentrate on Florida species, Langeland wants to include specimens of exotic species with weed potential for Florida such as *Lagarosiphon*, *Nechamandra*, and others. He hopes to acquire these specimens through exchange with other herbaria.



HAVE DISC, WILL TRAVEL

The use of "interactive videodiscs" in training and education has increased in recent years. Inexpensive off-the-shelf videodisc players and TV sets are all that are required to take advantage of this technology, which provides random access video and instructional segments, guided by the user by on-screen menus. Many of you have used them in the form of "information kiosks" in shopping centers, airports and museums. Many of your children use them in school to learn about everything from biology to art.

Recently, a prototype interactive videodisc on the identification and control of submersed aquatic plants was demonstrated at the annual meeting of the U.S. Army Corps Aquatic Plant Control Research Program (APCRP) in Baltimore. The videodisc is under development by the University of Florida Center for Aquatic Plants and the APCRP. The goal is to develop better training materials for Corps water managers throughout the country.

Above, disc developer Vic Ramey demonstrates the prototype to Greg Jubinsky, of Florida's Department of Environmental Protection. Ramey holds a copy of the prototype in the form of a rewritable optical disc.

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Hydrocotyle ranunculoides in the Canning River

by R. Ruiz-Avila, V. Klemm and N. Siemon, Environmental Investigations and Assessments Division, Swan River Trust, Perth, Western Australia

The Swan-Canning River is a major river system flowing through Perth, the capital of Western Australia. In the early 1980s the aquatic weed *Hydrocotyle ranunculoides* was observed in a creek and within five years it had spread into the Canning River Regional Park. *Hydrocotyle ranunculoides*, a common aquarium plant, was readily available throughout Western Australia. In the Canning River it probably originated from the release of garden and aquaria wastes into drains. The weed remained fairly static in the river system until early 1991, when the distribution suddenly became more extensive.

It is now a major problem which must be controlled in the short-term and eradicated in the long-term.

In the Canning River *Hydrocotyle ranunculoides* is a floating, stoloniferous plant with a creeping stem. Profuse filiform roots grow down from the stem into the water and the leaves emerge above. The plant anchors to the bank and grows vegetatively, forming large dense mats up to several hundred meters long and one meter deep. When broken off from a mat, a small piece of stem can grow into a new mat, making any eradication attempts difficult.

By September 1992, the estimated volume within the Canning River Regional Park had increased to 420 tonnes along approximately six kilometers of the river. The infestation of *Hydrocotyle* in the Regional Park is a serious problem as the mats affect the ecological and recreational values of the River. There was widespread concern that *Hydrocotyle* may be transported to

irrigation channels and other naturally occurring fresh water bodies in the State. This could result not only in environmental degradation but also economic loss including reduced access to water for crop irrigation.

In 1992 *Hydrocotyle ranunculoides* was "declared" by the Agriculture Protection Board, requiring control and eradication of the plant. In association with other state government agencies, local government and community representatives, the Swan River Trust has designed a two part control and eradication strategy. Both strategies are

Hydrocotyle from the Canning River Regional Park and its associated drains during the summer of 1992/1993. This strategy relied largely on physical techniques (removal) with selective use of chemicals. Biological and ecological control techniques were either unsuitable or unavailable for use in the short-term but will be used where possible in the long-term.

The program operated by removing the weed from a section of the river and then moving the operations downstream for the next stage. Physical removal involved the cutting of floating mats of



Canning River in 1992 before being completely choked by *Hydrocotyle*.

based on the concept of integrated control using a combination of mechanical, chemical, biological and ecological control techniques where appropriate. This approach reduces the potential environmental impacts of any one control technique.

Short-term control program

The aim of the short-term control strategy was to remove the majority of

Hydrocotyle with sickles and scythes from small boats. The mats were pushed by small boats to the weed harvester which then floated them to the bank where they were removed by backhoe. Approximately 2,000 tonnes were removed using these methods. The weed was then used for composting.

[See *Hydrocotyle* on page 5]

[Hydrocotyle, From Page 4]

After most of the weed had been removed, chemical control techniques were used along the banks to prevent new mats growing out. The rhizomes of *Hydrocotyle* can grow to 15 cm below the soil on the bank and a translocative herbicide is required for these to be destroyed. Glyphosate was selected on the basis of glass-house experiments and its low toxicity to mammals, fish and microbes and its low to medium toxicity to birds and other aquatic life. Preliminary assessments of the chemical control program have indicated that treatment was successful.

Long-term eradication program

The aim in the long-term is to eradicate this weed from the river system, thereby preventing its spread through the state. A combination of techniques will be used in the long-term strategy. These include biological, ecological, physical and chemical methods.

At this stage a biological control for *Hydrocotyle* is not available and may take up to ten years to develop. It is unlikely that a suitable biological control agent will be developed and approved for release in the near future. Ecological techniques which may be used include the reduction of nutrient loads to the river and removal of nutrient rich sediments. The reduction of nutrients to the Canning River would reduce the opportunities for invasion of other aquatic weed species.

Chemical control will be used on an on-going basis to prevent regrowth of any small fragments. The use of physical removal by boats and backhoes will be necessary if mats generate.

A surveillance program has been initiated to ensure early detection and control of any outbreaks. On-going monitoring of aquatic invertebrates and pesticide levels is being undertaken as part of both the short and long-term programs to assess the environmental impacts.

Based on strategies used to control other aquatic weed species in Australia, eradication may be an optimistic goal. In three to five years plant numbers will probably be reduced to levels that allow regular but low levels of control activity. If this is the case, control and

MEETINGS

FIFTH ANNUAL FLORIDA LAKES MANAGEMENT CONFERENCE. April 27-29, 1994, Ramada Hotel Resort, Orlando, Florida.

The conference theme is "Lake Ecology and Management". It is co-sponsored by the Florida Lake Management Society (FLMS) and the Lakes Education/Action Drive (LEAD). For information, contact G. Medley, City of Lakeland Lakes Program, 407 Fairway Avenue, Lakeland, FL 33801, 813-499-8272.

21st ANNUAL CONFERENCE ON WETLANDS RESTORATION AND CREATION. May 19-20, 1994, Sheraton Grand Hotel, Tampa, Florida.

This annual conference provides a forum for nationwide exchange of results of scientific research in the restoration, creation and management of freshwater and coastal wetland systems. For information, contact F.J. Webb, Hillsborough Community College, Plant City Campus, 1206 N. Park Road, Plant City, FL 33566, 813-757-2104.

EWRS 9TH INTERNATIONAL SYMPOSIUM ON AQUATIC WEEDS. September 12-16, 1994, Trinity College, Dublin, IRELAND.

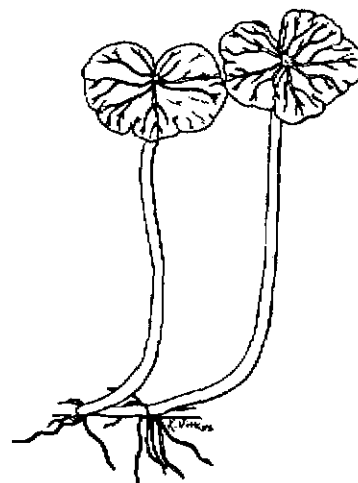
The European Weed Research Society organizes this aquatic weed symposium every four years. As have the previous eight, the upcoming symposium relates to the biology, ecology, spread and control of aquatic weeds in temperate and tropical climates.

Of particular concern this time are the effects aquatic weeds have on the functioning of aquatic ecosystems, natural biological community processes and man's use of water. Scientists, engineers, managers, conservationists and environmentalists all will find a forum where they can meet in comfortable surroundings and exchange ideas.

For more information, contact Dr. Joe Caffrey, Central Fisheries Board, Mobhi Road, Glasnevin, Dublin 9, IRELAND.

management, rather than eradication, will be the most feasible option.

For those interested in more details, write for a free copy: *Hydrocotyle ranunculoides*: A control strategy for the Canning River Regional Park, Report No. 6, Swan River Trust, by V.V. Klemm, N.L. Siemon and R.J. Ruiz-Avila, 1993, 62 pp. Order from R. Davies, Chairman, Swan River Trust, 16th Floor, London House, 216 St. George's Terrace, Perth, Western Australia, 6000, AUSTRALIA.



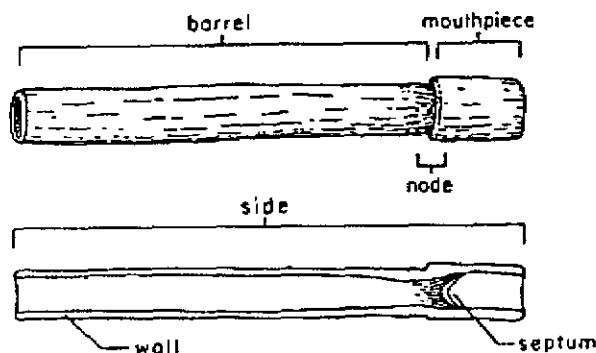
Phragmites australis

600-year-old cigarettes

At the Red Bow Cliff Dwelling in Arizona, hundreds of prehistoric cigarettes have been found, some wrapped in cotton, some tied together, and others adorned with miniature bows.

K.R. Adams of the Crow Canyon Archaeological Center in Cortez, Colorado, sampled a dozen of the cigarettes and confirmed previous suggestions: the 600-year-old smokes are made from the stems of the giant reed (*Phragmites australis*), and contain tobacco (*Nicotiana* spp.). The reed "barrel" of the cigarette was stuffed with tobacco. The tobacco was lit and smoked; the tough reed exterior did not burn, and was used again.

In her review of other research, the author found that other "historic North American groups" (Hopi, Comanche, etc.) smoked parts of at least 13 kinds of plants, and at least one kind of bird feathers.



INVENTORY REDUCTION SALE

The thirty years collection of the **Journal of Aquatic Plant Management**, the official journal of the Aquatic Plant Management Society, is now for sale.

The collection includes Volumes 1-30, 1962-1992. It costs US\$150 plus \$20 postage and handling.

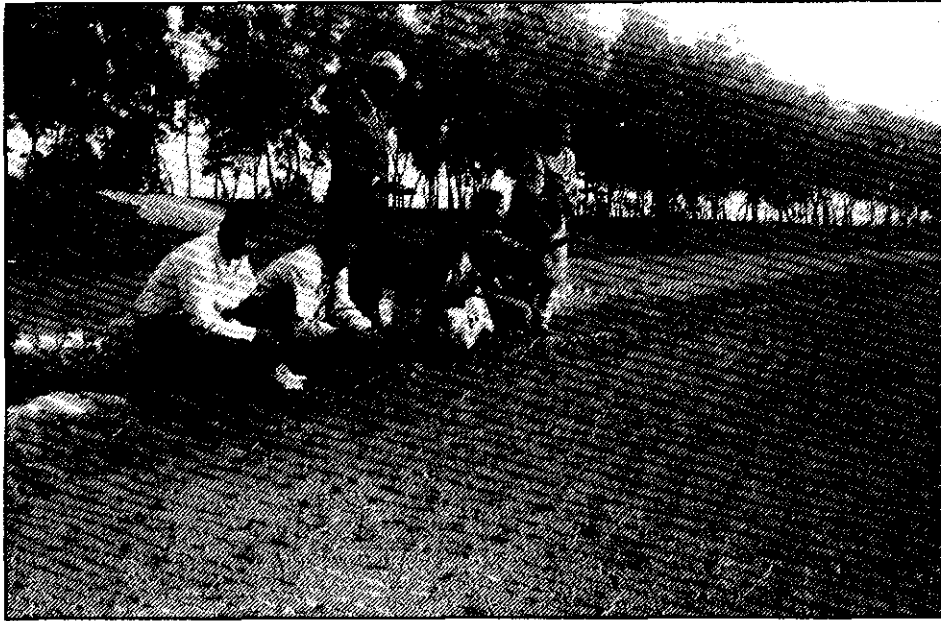
Order from:
APMS Secretariat
P.O. Box 2695
Washington, DC 20013-2695

Make checks and purchase orders payable to A.P.M.S. Inc.

Note: Volumes 3 and 4 are in short supply and photocopies will be supplied if necessary. Volumes 1-7 and 9-20 in 1 issue/yr; Volumes 8 and 21-30 in 2 issues/yr. This offer includes the separate 1985 "Milfoil Proceedings". Allow 4 to 6 weeks for delivery.

For more information about the use of giant reed cigarettes by native Americans, see "Prehistoric reedgrass (*Phragmites*) "cigarettes" with tobacco (*Nicotiana*) contents: a case study from Red Bow Cliff Dwelling, Arizona", by K.R. Adams, *J. Ethnobiology* 10(2):123-139, 1990.

The APIRS database includes more than 1,000 articles about the use of aquatic plants for food, medicine, construction, weaving, etc. A sampling from the database using the term "ethno" ("used by or related to a people or race") retrieves about 25 citations.



Biofertilizer technology for dry season rice

Millions of tons of topsoil and nutrients are displaced by erosion every year. Much of it runs off into ponds, lakes and rivers. Billions of dollars in commercial fertilizer are needed by farmers to replace the lost nutrients. If only farmers could reclaim the nutrients from the water and replace them on their crops...

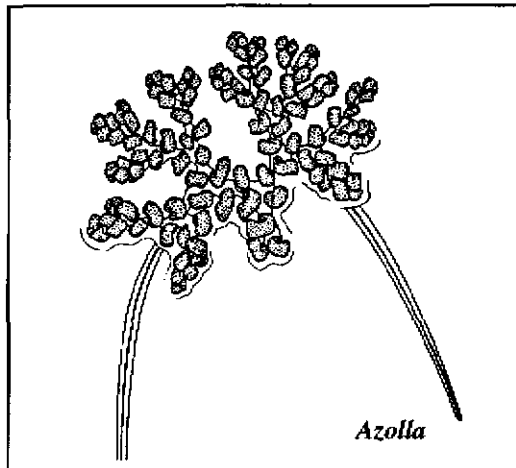
The small floating ferns of the genus, *Azolla*, scavenge nutrients from polluted waters and, in symbiosis with the bacteria, *Anabaena*, "fix" nitrogen. Because it is so rich in nutrients, *Azolla* is used as "biofertilizer" by rice farmers in China, Vietnam, Thailand, India and elsewhere.

In India, a major problem is not having enough *Azolla* biomass growing near rice fields at the time biofertilizer is needed most, especially during dry season rice culture. Dry season rice culture in India usually begins around March.

Therefore, Indian researchers are looking for ways to keep large quantities of *Azolla* under cultivation during the cold months prior to March. Investigators are studying the effects of different tree canopies, in terms of how well trees protect *Azolla* from lethal cold temperatures, and how tree leaf leachates affect *Azolla* growth. (The fallen dead leaves of some trees kill *Azolla* while the leaves of other trees "remarkably increase" its biomass production and nitrogen content.)

Other investigators are studying the production of spores. The use of spores could have advantages over the use of grown plants: spores can easily over-winter, and can be easily transported, and would not require the use of additional water bodies for grow-out purposes. Spore collection, storage, packing and distribution could become village industries.

Above, Dr. D.P. Kushari and his colleagues at the University of Burdwan are working to overcome the problems of using *Azolla* as a biofertilizer for dry season rice in India. Contact them at the University of Burdwan, Department of Botany, Golapbag, Burdwan-713 104, West Bengal, INDIA.



[Weevil, From Page 1]

stages of the weevil are associated with Eurasian watermilfoil. Adults lay their eggs on the meristems; larvae burrow into and feed on the meristem before moving down and into the stem. Pupation occurs inside the stem. Adults feed on the stems, leaves and leaflets of watermilfoil, and mate on the plant. They appear to concentrate feeding on the upper portions of the plant, removing significant amounts of photosynthetic tissue. Also, stem damage from both adults and larvae causes watermilfoil to lose its buoyancy and sink. The researchers suggest that the loss of buoyancy may be more significant in controlling the plant than the loss of leaves.

The weevils appear to prefer the exotic *M. spicatum* over the native milfoil *M. sibiricum* Komarov (= *M. exalbescens* Fernald). Creed and Sheldon suggest that the weevil may have either expanded its diet to include *M. spicatum* or undergone a host shift from the native plant to the exotic one.

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