Watch Out Water-hyacinth!

New Jungle Enemies Are Coming

Above, grey-white nymphs of *Taosa* plant hoppers feed on heavily damaged water-hyacinth. The sap-sucking insects not only damage and weaken the weed, they introduce plant pathogens.

HUGO CORDO (K8800-2)

HUGO CORDO (K8800-1)

Petioles of water-hyacinth densely punctured by oviposition marks of *Taosa* plant hoppers.

You can't get to Iquitos, Peru, without a boat or a plane. But this jungle-locked city of 350,000 in the rainforests of the upper Amazon River is the business and tourism hub of Peru's eastern lowlands.

In the late 19th century, rubber made Iquitos a major trade center. Today, tourists can visit old rubber-baron mansions like *Casa de Hierro* (Iron House), designed by Gustave Eiffel of Paris.

Iquitos has a different appeal for Agricultural Research Service entomologist Hugo Cordo. "This region may be the world's richest source of natural enemies of water-hyacinth," he says. Cordo leads the ARS South American Biological Control Laboratory in Buenos Aires, Argentina.

Water-hyacinth, *Eichhornia crassipes*, is a free-floating perennial herb. The plants grow about 3 feet tall as they float on the water's surface, with stems intertwining to form dense mats.

In the Amazon the plant is held in check by natural enemies such as insects and microbes. These organisms stress the plants, controlling the mat's expansion. But water-hyacinth has escaped to friendlier waters, especially since the 1800s. Often, visitors, drawn by its lush leaves and blue-to-lavender flowers, have taken it home as an ornamental.

A Floating Nightmare

Out of its enemies' reach, water-hyacinth has become the worst floating aquatic weed in many tropical and subtropical parts of the Americas, Asia, Australia, and Africa. In Africa it infests every major river and nearly every major freshwater lake. In the United States, it flourishes in hundreds of bodies of water in Hawaii and California and throughout the South from Texas to the Carolinas.

Today, increased cooperation by governments and scientists around the world is turning up the heat on water-hyacinth. The more unique natural enemies that scientists can find and evaluate, the more likely they can deploy new biological control cadres suited to the weed's various growth stages and to different climates and other conditions.

At worst, this plant may be a killer. In the Sepik area of Papua New Guinea, it has been blamed for making people starve. According to Australian scientists K.L.S. Harley, M.H. Julien, and A.D. Wright, people "could not access subsistence gardens, hunting areas, catch fish, or travel to market to sell and buy produce" because of dense water-hyacinth mats.

More typically, water-hyacinth damages water quality by blocking sunlight and oxygen and slowing the water's flow. Capable of doubling within a couple of weeks, it can grow faster than any other plant. By choking out other vegetation, it makes an area unusable by plants and animals that live in or depend on the water. Fish spawning areas may vanish.

In the Florida Everglades of the United States, the snail kite *(Rostrhamus sociabilis)* is endangered partly because this bird can't find apple snails—its

JASON STANLEY (K8843-1)

The *Megamelus* plant hopper (about 3 mm long) may provide badly needed help in controlling water-hyacinth.

favorite food—where the weed has smothered the snail's favored food plants. In some parts of the world, the mats form habitat for disease-carrying mosquitoes as well as snail species that are intermediate hosts for schistosomiasis, among the world's worst parasitic diseases.

Uncontrolled, water-hyacinth robs water from potential drinking and irrigation supplies. The mats can block boat travel. Chunks of mat can break free to clog downstream pump stations supplying water for drinking, irrigation, and hydropower.

Chemicals and mechanical removal, the primary weapons against the weed, are costly and often ineffective.

Searching for Its Nemesis

Scientists believe that the best bet for a long-term solution is to introduce one or more natural enemies as biological controls.

Two decades ago, Cordo and ARS entomologist Jack DeLoach in Temple, Texas, led an effective biological control program at Argentina's Dique los Sauces reservoir. In the 1970s, ARS researchers Ted Center and Neal Spencer were the first to release in the United States two South American weevils *(Neochetina bruchi* and *N. eichhorniae)* and the water-hyacinth borer *(Sameodes albiguttalis).*

These and other organisms are being deployed in more than 20 other countries, including Australia, Cuba, Egypt, Honduras, Indonesia, Malaysia, Mexico, Panama, South Africa, Thailand, Vietnam, and Zimbabwe. There have been many successes, but results have been variable and the weed continues to cause problems.

"For years," says Cordo, "we thought most of the best potential biological control agents were already found."

"But until now," Center notes, "no one had really looked for them in the upper Amazon. That is probably the area where water-hyacinth originated—where you might expect to find the greatest diversity of natural enemies." Center leads ARS' Aquatic Plant Control Research Unit in Fort Lauderdale, Florida.

This scientific optimism brought Cordo, Center, and three other scientists to Iquitos in late April 1999. The others were entomologist Martin Hill with South Africa's Plant Protection Research Institute and plant pathologists Harry Evans and Djami Djeddour of CABI Bioscience in England.

They searched for natural enemies along 180 kilometers of the upper Amazon and the two rivers that converge to form it—the Ucayali and Marañon.

Into the Thick of It

On April 27, guide Andrés Guerra motored the group down the Amazon in a small aluminum boat. "We were looking for water-hyacinth growing in *cochas,*" Cordo says. *Cochas*—bayous and depressions away from the river channel—are typically concealed behind the wall of rainforest lining a river channel.

The natural beauty of water-hyacinth's flower and foliage has helped it spread to become a floating nightmare in many tropical and subtropical areas.

WILLEY DURDEN (K8801-1)

CHRISTINE BENNETT (K8843-2)

***Thrypticus* fly (about 2 mm long).**

Eventually the group stopped at an area Guerra said was near *cochas*. With a machete, he hacked low branches and vines to clear the boat's path through the flooded forest. "For a half hour," says Cordo, "we thought we were heading to nothing. But suddenly, the *cochas* were there. We steered into the water-hyacinth mat and began using our hands and a sweep net to collect insect and plant samples."

In all, the scientists collected hundreds of natural enemies and plant samples at 30 sites in 7 days. From the first day, the excitement was about a tiny insect, a water-hyacinth fly that none of the scientists had seen before.

In Buenos Aires, Cordo's team had already been testing several promising insects, including three species of *Thrypticus* flies collected since 1996 in Argentina. Now, it appeared they had found a new *Thrypticus.*

The female *Thrypticus* deposits an egg in a water-hyacinth petiole—the stalk that attaches the leaf to the stem. The young larva feeds on the inner tissue. Within the petiole it digs ultranarrow tubes called mines. The mines have one or more tiny spurs that exit the petiole's outer skin. "Water doesn't enter these tiny orifices," Cordo says, "and we don't know why the fly makes them. But they may serve as doorways for pathogens to enter and further weaken the plant."

Each *Thrypticus* species has a unique mining pattern. One is shaped like the letter "U"; another is C-shaped. But at site 1—and later, other sites—the scientists found ringlike mines with several orifices. "We believe the *Thrypticus* that made these is a new species," Cordo says. "And it appears to be a specialist in attacking very young petioles."

A Bountiful Harvest

During the trip, the scientists also found as many as three new species of *Taosa* plant hoppers. Only one had been reported in the scientific literature. *Taosa* and *Megamelus* plant hoppers are sap-sucking insects that, like their whitefly cousins, can transmit plant pathogens. Cordo says the *Taosa* especially "are impressive because of their impact in combination with a pathogen we have not yet identified. Infested plants were short, weak, and full of spots made by the pathogen."

The insect identifications are preliminary, but 11 species new to science have been collected so far by the ARS research team on water-hyacinth and its relatives in Iquitos and northern Argentina since 1996: six *Thrypticus*, three *Taosa*, and two *Megamelus* species.

TED CENTER (K8801-2)

Water-hyacinth in bloom.

The ARS scientists at Buenos Aires have been conducting numerous studies of the insects' biology and behavior. They will screen colonies of insects they collect to find out which might do the most damage to water-hyacinth.

They are also making sure water-hyacinth is the only important plant attacked. "Along with crops, this means testing ornamentals and plants in natural settings," Cordo says. "We've already determined that the new *Thrypticus* and one of the *Megamelus* do not attack plants in other families. And they will not attack the one U.S. plant in the water-hyacinth family that we don't want to hurt." That plant, pickerel weed, is used by many small aquatic animals.

Cordo, Center, and Hill, the South African scientist, are collaborating to determine how best to rear *Megamelus* and *Thrypticus* for lab and outdoor tests. "With luck," Cordo says, "*Thrypticus* might be ready to import in 2 or 3 years, for testing first in the Fort Lauderdale lab. With *Megamelus*, that time may come sooner, since we already know how to rear small lab colonies of it."—By **Jim De Quattro,** ARS.

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