U.S. ARMY CORPS OF ENGINEERS

TESTIMONY OF:

Michael J. Grodowitz, Ph.D.

Research Entomologist

Engineer Research and Development Center

Vicksburg, MS

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ON:

Efforts to Control and Eradicate the Invasive Weed, Giant Salvinia

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Mr. Chairman and other Members of the Subcommittee, I am Michael J. Grodowitz, Ph.D. I work for the U.S. Army Corps of Engineers, Engineer Research and Development Center. Thank you for the opportunity to testify today on efforts to control and eradicate the Invasive Weed, Giant Salvinia.

Giant salvinia (*Salvinia molesta*), a native of Brazil, is a floating fern introduced into the United States through the aquatic nursery trade. Since its introduction in the middle to late 1990's, giant salvinia has dispersed naturally and by humans, and in less than 20 years can now be found as far west as the Hawaiian Islands, east into the peninsula of Florida, and north into Virginia. It is one of the world's worst weeds and is causing manifold problems throughout the sub-tropical and tropical regions of the earth. Impacts are varied and include hindering navigation; disrupting water intake for municipal, agricultural and industrial purposes; degrading water quality; decreasing floral and faunal diversity; impacting threatened and endangered species; and increasing mosquito breeding habitat for species that are known to transmit encephalitis, dengue fever, malaria, and rural filariasis or elephantiasis.

Giant salvinia causes significant problems in over 20 other countries including Australia, New Zealand, Fiji, the Philippines, India, Indonesia, Malaysia, Singapore, Papua, New Guinea, the Ivory Republic, Ghana, Zambia, Kenya, Namibia, Botswana, South Africa, Madagascar, Columbia, Guyana, and several Caribbean countries (including Cuba, Puerto Rico, and Trinidad). This list increases yearly. In the United States, it is now found in at least 90 localities and is especially troublesome in southern states including Texas, North and South Carolina, Louisiana, Georgia, Florida, Alabama, Mississippi and west into Arizona, and California.

Giant salvinia reaches damaging infestation levels because of its tremendous growth rate. While it has been shown to only reproduce vegetatively (i.e., viable spores are not produced) this is more than enough to allow it to form surface mats up to 1 m thick with plant numbers approaching 5000/m^2 and biomass production of upwards of 100 tons/ha/year. Even greater production is possible under more favorable conditions. It has been known to double in number in one to eight days, depending on environmental conditions.

Numerous control strategies have been implemented for the management of salvinia. These include the use of traditional methods such as mechanical control (i.e. cutting or plant removal) and chemical applications. Mechanical control options are not particularly effective. They are expensive and often do not produce results needed for even partial management. However, in certain instances, especially small isolated

areas, mechanical control may be employed with some success. The use of chemical technologies can be effective but tend to produce only short-term control and can become expensive, especially when multiple treatments are needed over the course of a growing season. The use of alternative control methods such as biological control is highly promising and has been shown to produce long-term sustainable control. One agent has been approved for release in the United States, the salvinia weevil (*Cyrtobagous salviniae*), and is the method of choice for management in many overseas locations. While effective, biological control can take several years and there is some concern that it may not be particularly effective in the more northern extreme of salvinia's distribution. Other methods employed for salvinia control in the United States include flushing and drawdowns. Increasing water flow to 'flush' plants out of a waterbody or drainage can reduce biomass locally but may increase the distribution of salvinia downstream. Drawdowns (which serve to desiccate and kill the plant) do reduce biomass and can isolate the plant into smaller areas allowing easier access for mechanical removal or chemical treatment. However, when water levels increase remaining plants can be scattered throughout the water body making treatment even more difficult.

Currently, chemical control is the most widely used management strategy in the United States for the control of salvinia. A wide variety of products are employed mainly those containing diquat, glyphosate, and to a lesser extent fluridone and carfentrazone-ethyl. Active ingredients recently labeled for aquatic use including penoxsulam and flumioxazin, have been evaluated and are effective but have yet to be used on a wide scale. As indicated earlier, chemical applications can be highly effective producing dramatic control (> 90%) in a manner of days or months. However, several factors often dictate the need for repeat applications and diligent post-treatment monitoring. One important factor is the rapid growth rate of salvinia which allows the plant to easily outpace the current application of chemicals. Probably a more important factor is the ability of salvinia to re-grow from small buds or plants that are missed during chemical application, especially in backwater coves where overhanging vegetation can hide small plant populations or where plant growth is dense and underlying layers are protected from surface sprayed herbicides. These plant fragments can be smaller than ¼ inch. In addition, the plant can easily be transported by a variety of human mediated means. Thus, water bodies where salvinia has been eradicated can be easily re-infested. Therefore, the rapid growth rate of salvinia and its excellent dispersal ability necessitates the use of greater amounts of chemicals with increased labor costs for application which leads to a never-ending cycle of chemical use.

The use of biological control is gaining increased favor in the United States. Over the last five years, rearing operations for the salvinia weevil have been developed at the Federal, state, and local levels, allowing the release of large numbers of weevils in a

variety of water bodies, particularly in Texas and Louisiana. Such an active approach to the use of biocontrol is promising and is allowing the more widespread application of a technology that offers the possibility of longer and more sustainable control. However, set-backs have occurred. First, releases of weevils from the various rearing operations are not coordinated to any large extent between the various agencies and institutions; i.e., no central database is available allowing for easy consultation and comparison. Also, in many cases, there is only minimal monitoring of release sites using sampling protocols designed to document weevil populations and subsequent impact over the long term. Hence, information on current numbers of biocontrol agents and impact levels, which is essential to make informed decisions on the need for additional releases, is lacking. In addition, numbers of weevils released is often reported differently by different agencies leading to erroneous information exchange on actual numbers introduced. Unusually cold weather has also hampered the establishment of the weevils in many sites in the northern distribution of salvinia. Historic cold events over the last two winters have significantly reduced the extent of the salvinia infestations especially along and just north of the I-20 corridor. This has increased the effectiveness of chemical applications because of the smaller size of the infestations. Several sites in these areas were targeted for release of the weevil. However, with the reduction in salvinia populations establishment of the salvinia weevil could not be confirmed and may have been unsuccessful due to the extreme cold and mortality of the plants.

The following are steps needed to ensure the implementation and success of a working and well coordinated management plan for successful control of salvinia:

1. Increase public awareness – While some effort has been put toward educating the public on the dangers of this invasive species, additional work is needed. This is especially important since salvinia can easily be transported from one water body to another through human mediated transport including boats, trailers, and live wells, among others. Emphasis needs to be directed toward ensuring that people adequately clean all equipment before entering and leaving a water body. This is not easily accomplished, but continued non-compliance will only allow the plant to spread to new locations as well as re-infest sites where management options were employed successfully in the past. Stronger penalties and fines may have to be implemented for non-compliance along with a coordinated educational program. It is important to note that giant salvinia is listed as a Federal noxious weed by the USDA which prohibits importation into the US and across state lines. It is also listed as a noxious weed in Florida, North Carolina, Mississippi, Texas, Oklahoma, California, Arizona, Louisiana, Alabama, South Carolina and Georgia based on state regulations which go further to prevent its spread and sale within these individual states.

2. There is a need to develop common guidelines on what site characteristics dictate application of either chemical and/or biocontrol techniques. While developing such selection criteria can be complex, there are certain characteristics that will allow intelligent selection of applicable technologies. Items that should be considered include extent of infestation, number of high priority sites needing rapid reduction, accessibility of sites for chemical application, latitude, among others.
3. It is important to develop and implement standardized sampling protocols for monitoring insect release sites for population size and impact and to determine actual numbers released from various rearing facilities. This includes the development of standard methods for reporting such information that can be used across the region.
4. We must ensure that monitoring for new infestations is accomplished on a continual basis. Implementing such procedures will identify and allow treatment of new infestations before they reach levels where management becomes untenable. This process is known as early detection, rapid response (EDRR) and is an essential component of successful management programs.
5. It is important to understand and address underlying causative factors allowing the formation of damaging infestations of giant salvinia. One of the more important causative factors is high nutrient levels that allow for increased and explosive plant growth. While it is difficult to minimize nutrient influx into water bodies, several strategies have been used with varying success. These include repairing leaking septic systems or positioning the septic fields away from the water body, implementation of regulations prohibiting fertilization of lawns right up to the water's edge, and ensuring that sewage treatment plants use tertiary treatment processes to limit nitrogen and phosphorus loading. One potential method is the use of re-vegetation techniques to establish a diverse community of non-invasive native vegetation that will act as nutrient sinks to reduce nitrogen levels thereby limiting plant growth and reducing the chance of new infestations by salvinia as well as other invasive species including waterhyacinth, hydrilla, and Eurasian watermilfoil, among others. This includes the use of emergent species near the water's edge to catch and contain nutrient run-off from the surrounding landscape and the establishment of a diverse submersed and floating leaved aquatic plant community to reduce nutrients in the sediment and in the water column, and provide competitive pressure through shading, filling of empty spaces, etc.
6. Finally, advancement of applied research would enable development of more efficient and efficacious methods for the control of salvinia. This includes but is not limited to identification and registration of new chemicals and chemical combinations that are more environmentally compatible and possess increased

selectivity for salvinia. Also, it is important to continue researching better methods of rearing, releasing, establishing, and monitoring the salvinia weevil and associated impact. More importantly, better methods need to be developed to more successfully integrate these two methods in an effort to enhance control. However, funding for this type of research will continue to be difficult particularly in today's budget environment.

In conclusion, salvinia management in the United States has come a long way since its introduction in the 1990's. Diligent application of chemicals and the development of several large and successful weevil rearing facilities is a testament to that statement. However, more work is needed. This includes a more coordinated response to human mediated transport and new infestations, a better educated public, increased compatibility and application of sampling protocols on a National level, addressing high nutrient loads, and continuing research and development.

I have included a U. S. Army Corps of Engineers report published in 2004 that provides more detailed information on salvinia and the available management options. Thank you for the opportunity to testify today and I will be happy to answer any questions you may have.