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Demonstration Project: Giant Salvinia

Toledo Bend Reservoir and Surrounding Areas in Louisiana and Eastern Texas

Environmental Assessment, March 2001

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Table of Contents

I. Introduction

A. Plant Biology and Background

Giant salvinia is a free-floating aquatic fern, native to South America, with a tremendous growth rate and the potential to significantly affect water-reliant agricultural industries, recreation, and the ecology of freshwater habitats throughout much of the United States. The upper surfaces of its leaves are covered with hairs terminating in a cage-like structure that serves as an air trap, which somewhat insulates it from cold temperatures. The air trap also renders the leaves practically unwettable and thus difficult to treat with herbicides. The root mass, actually a modified leaf, and the spore-producing nodules, found as chains among the roots, hang beneath the surface part of the plant in the water. The spores are not viable (Chilton *et al.,* 1999). The plant reproduces vegetatively through fragmenting and from dormant buds breaking away (Mitchell and Gopal, 1991, as cited in Oliver, 1993, and Barrett, 1989). A colony consists of many leaf pairs connected by branching rhizomes. The colony is easily broken, thus producing viable fragments.

The colonizing or immature stage of giant salvinia is characterized by small leaves that lie flat upon the water. As the plants rapidly expand and compete for space, the leaves become larger, crowding occurs, and the plants are pushed upright. Mats may grow to a meter thick and can cover large areas (Thomas and Room, 1986, as cited in Chilton *et al.,* 1999).

Giant salvinia grows best in stagnant or slow-moving waters. It can tolerate a wide pH range. While able to survive severe winters, a temperature of 25 °C to 28 °C (77 °F to 81 °F) is preferred (Westbrook, 1984). Nitrogen is usually the limiting nutrient and, with temperature, accounts for between 40 percent and 80 percent of the variance in growth rates observed at different sites, respectively (Room, 1990). While it is highly adaptable, it will not colonize brackish or marine environments (Chilton *et al.,* 1999), although it has been reported to tolerate saline water (Stirton, 1978).

Because giant salvinia is a free-floating plant, it disperses by passive means (water currents and wind) and by "hitchhiking." Animals may carry the plants over short distances, but humans can spread it widely on fishing gear and boating equipment (Westbrook, 1984). Intercontinental dispersal and dispersal within the United States probably occur when giant salvinia is sold in the nursery trade, either intentionally as a plant for aquaria or for ponds or unintentionally when it "hitchhikes" with other aquatic plants collected for academic study, or sold for aquaria or for ponds (Westbrook, 1984; Suggs (pers. com.), 1999; Nash (pers. com.), 1999). Although native to southeastern Brazil, giant salvinia is now found in North America, South America, Africa, Asia, Australia, New Guinea, and Oceania.

The dominant characteristic of giant salvinia is its tremendous growth rate, which makes it an aggressive invader. Observations in Toledo Bend Reservoir noted that a small, unobstructed patch of giant salvinia doubled in size in a few days during the winter of 1998/99 (Nash (pers. com.), 1999).

Where it occurs outside its native range, particularly in the tropics and subtropics, giant salvinia has become a problematic aquatic weed with the potential to choke irrigation systems, streams, and lakes. The mats also may harbor snails and insects that carry human and animal diseases (Westbrook, 1984). In a single growing season, giant salvinia can destroy a thriving water community by forming a destructive mass, halting transportation, killing fish, and promoting disease (Barrett, 1989). Giant salvinia is considered a direct threat to rice farming (Westbrook, 1984). It gives off hydrogen sulfide (H_2S) which can damage copper components of hydroelectric generators. The thick mats, which can develop on open lakes, are avoided by small and large boats alike.

In the past several years, giant salvinia has been detected in the United States, mostly in association with the nursery trade in aquatic plants. Generally, detections have been in small, confined sites and are currently contained or have been eradicated. Such detections have occurred in Alabama, Arizona, Florida, Hawaii, Indiana, Louisiana, Maryland, Missouri, North Carolina, South Carolina, Texas, and Virginia. Of more serious and immediate concern is the current infestation in Toledo Bend Reservoir and the surrounding areas in Louisiana and eastern Texas. This is a major infestation in a large body of water.

B. Experiences With Eradication and Control Programs

The biology of giant salvinia makes it difficult to control; although control, and in some cases eradication, has been achieved in various locations throughout the world. Table 1 shows various control methods used to eradicate or control giant salvinia and their results.

Table 1. Methods Used to Control Giant Salvinia

Control method	Site	Comments
Diquat	Australia	One-eighth as effective as paraquat
Diquat	Malaysia	Effective in controlling giant salvinia
Diquat	Australia	Hand removal followed by diquat spray was successful on the Adelaide River
Diquat	Toledo Bend	Mixture of diquat and 5% double chelated copper was very effective in a small test
Diquat followed by fluridone	South Carolina	2-acre lake treated twice with diquat and once with fluridone eradicated giant salvinia
Fluridone	New Zealand	Ineffective in controlling giant salvinia
Fluridone	New Guinea	Ineffective in controlling giant salvinia
Fluridone	Toledo Bend	0.5-acre isolated area treated with 20 parts per billion (ppb) showed good results in a test
Paraquat and wetting agent	Australia	Repeated applications were successful
Glyphosate	Australia	Reported to be ineffective
2,4-D	India	Successfully employed to control giant salvinia
0.05% solution of household detergent	laboratory test	85% decrease in chlorophyll and 75% decrease in protein after 48 hours
AF101 (detergent and kerosene)	Australia	Caused rapid toxicity to giant salvinia
Hand removal	India	The manual labor of 30 men successfully controlled a 1500-hectare infestation in a reservoir by removing about half the infestation over 3-months; the process had to be repeated annually
Salvinia weevil	India	Giant salvinia infestation reduced to 1% of former size
Salvinia weevil	South Africa	Giant salvinia infestation reduced to 1% of former size
Salvinia weevil	Botswana	Giant salvinia infestation reduced to 1% of former size
Salvinia weevil	Sepik River, Papua New Guinea	Dramatic decrease in the area infested by giant salvinia from 250 square kilometers (km^2) to 3 km^2 in only 1.5 years
Salvinia weevil	Australia	Complete and rapid control of giant salvinia

Table 1—continued

Table 1—continued

Control method	Site	Comments
Salvinia weevil	Papua New Guinea	Complete and rapid control of giant salvinia
Salvinia weevil	Namibia	Complete and rapid control of giant salvinia
Salvinia weevil	Northern Territory, Australia	High water temperatures in seasonal bodies of water were associated with failure of the weevil to control giant salvinia
Salvinia weevil	New South Wales, Australia	Variable control by the weevil was attributed to the cooler climate being unfavorable for the weevil.
Salvinia weevil	Sri Lanka	Weevil populations did not expand until levels of nitrogen in the salvinia tissue were increased; then major infestations of giant salvinia were destroyed by the insect

SOURCE: Various studies cited in Oliver, 1993, and Chilton *et al.,* 1999

In summary, various biological characteristics must be considered before an eradication or control program can be designed for giant salvinia infestations. Methods are available; however, they must be used in combination with each other for a successful eradication program. The use of herbicides can be effective if a surfactant is added that destroys the ability of the cage-like hairs on the leaves to trap air, thus allowing the herbicide to penetrate the giant salvinia leaves. Physical control is difficult because the plant grows rapidly. It is difficult for manual labor to stay ahead of the plant growth, but booms and nets have met with some success in confining infestations and maintaining salvinia-free areas. However, booms and nets are subject to breaking when tons of windblown salvinia are pressing them. Biological control using the salvinia weevil has been promising also; however, to be effective in reducing the biomass of salvinia, conditions must be good for the survival and growth of the weevil. The eradication team's vigilance is important also because of the enormous growth potential of giant salvinia.

II. Need for the Proposed Action

Executive Order 13112, Invasive Species, addresses the issue of nonnative species entering the United States, becoming established, and causing environmental and/or economic harm. The executive order, among other things, requires Federal agencies to detect and respond rapidly to control populations of invasive alien species in a cost-effective and environmentally sound manner.

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), is proposing a program to eradicate and prevent the spread of giant salvinia, an aquatic weed that has been found in areas of Louisiana and eastern Texas. APHIS' authorities for involvement in this proposed program include the Plant Protection Act (7 U.S.C. 7701, *et seq.)*, the National Invasive Species Act of 1996 (16 U.S.C. 4701 *et seq.)*; the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 *et seq.*); the Federal Noxious Weed Act (7 U.S.C. 2801–2814); and the Executive Order 13112, Invasive Species. APHIS prepared this environmental assessment to analyze the environmental impacts of the proposed action and its alternatives in compliance with the National Environmental Policy Act (42 U.S.C. 4321 *et seq.)*.

Giant salvinia is an invasive alien aquatic weed species that has been on the Federal Noxious Weed Act list for more than 15 years (USDA, APHIS, 1999; Westbrook, 1984). It has the potential to cause major disruptions to agriculture, commerce, recreation, wildlife, and natural areas. It can infest waters in the United States as far north as the Mid-Atlantic States, Indiana, and Missouri. Giant salvinia has the potential to infest waters throughout the country and particularly in areas that do not experience long periods of ice cover (Whiteman and Room, 1991, as cited in Chilton *et al.,* 1999). Thus far, the minor infestations that have occurred in the United States have been eradicated with State and local resources. The current infestation in areas of Louisiana and eastern Texas, centered at Toledo Bend Reservoir, is much larger in scope than the previous infestations. Eradication of this infestation will require a large-scale, dedicated and vigilant effort by all parties involved. Because the infestation crosses State boundaries, Federal assistance and coordination can be used to facilitate the eradication efforts.

III. Affected Environment

Giant salvinia was discovered in several private ponds in eastern Texas in the summer of 1998. On September 24, 1998, the Sabine River Authority discovered giant salvinia in Toledo Bend Reservoir. By December 1998, it was reported in oxbow lakes of the Sabine River below Toledo Bend Reservoir and at Swinney Lake, a 13-acre wetland at an estuary along the Trinity River in Texas. A giant salvinia infestation also has been found in Lafayette Parish, Louisiana.

The potential treatment areas consist of those parts of lakes, ponds, and slow moving or still waters in Louisiana and eastern Texas that are infested with salvinia. This includes parts of Swinney Lake, Toledo Bend Reservoir, the Sabine River watershed in Texas and Louisiana, and Lafayette Parish. The primary treatment areas are in the Toledo Bend Reservoir. This reservoir is the largest in the South and the fifth largest in the United States. It has many coves and backwaters with little or no current and, thus, is susceptible to giant salvinia infestations. These same characteristics contribute to the high potential for treatment success. The reservoir is heavily used for water-related recreation activities, especially fishing and boating. Some potable water intakes occur in the reservoir. The intake pipes are generally found approximately 5 feet off the bottom of the reservoir and at least 5 feet below the water surface. Irrigation water diversions do not occur from the reservoir itself; however, irrigation water withdrawals do occur from the Sabine River.

IV. Proposed Alternatives

A. Eradication Using an Integrated Approach (Preferred Alternative)

Eradication using an integrated approach would provide the program with all available tools and control methods, including chemical methods, mechanical (physical) methods, biological control organisms, and Federal regulatory controls (quarantines). Depending on the specific site and circumstances, all of these methods could be used individually or in any combination. This alternative affords the program the flexibility to use an appropriate control method, or combination of control methods, under the various circumstances and conditions in which salvinia might be found within the proposed treatment area.

1. Control methods

a. Herbicides and surfactants

The herbicides proposed for use in the program include a diquat dibromide formulation labeled for use on *Salvinia* species, Reward®, and another herbicide labeled for use on aquatic weeds, fluridone (Sonar™). Also, the use of either of two surfactants (Thoroughbred™ and AQUA-KING) is included in the proposed plan, and a chelated copper compound herbicide (Cutrine®-Plus) is also included should the surfactants be ineffective. All chemicals will be applied according to the label directions, including label rates (as summarized in table 2), use intervals, reentry times, posting of notices, and site restrictions.

The herbicides and surfactants will be applied using the appropriate application equipment (a hand gun sprayer or booms) from airboats or outboard motor-driven boats. Initially, herbicide alone or herbicide/surfactant applications will be used at the lowest label rates. If the lower rates prove ineffective, they will be increased.

The application rates or application intervals will never exceed those stated on the labels.

Table 2. Proposed Herbicides and Surfactants

Herbicide/ chemical	Range of label application rates, (per surface acre)	Active ingredients
Diquat dibromide (Reward®)	1.0 lb a.i.–4.0 lb a.i.	6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediium dibromide \1
Fluridone (Sonar™)	0.027 lb a.i.–4.0 lb a.i.	1-methyl-3-phenyl-5-[3-trifluoromethyl)phenyl]-4(1*H*)-pyridinone \2
Thoroughbred™	6 ounces	blend of polyalkyleneoxide modified polydimethylsiloxane and nonionic surfactants \3
AQUA-KING	1 quart	alkylphenol-hydroxypolyoxyethylene, glycols, isopropanol \4
Cutrine®-Plus	0.6–3.0 gal./acre-foot	chelated elemental copper \5

\1 EPA, 1995
\2 SePro, 1994
\3 Estes, Inc., 1994a
\4 Estes, Inc., No date
\5 Applied Biochemists, 1997a

b. Mechanical control

Physical control is accomplished by use of methods that either (1) directly remove the target plants from the water body, (2) cause *in situ* death of the target plant by inflicting sufficient physical damage (by chopping or shredding), (3) impede the free movement of the target plant within the water body (using booms), or (4) alter the infested waterbed in a manner that eliminates or reduces the extent of suitable habitat for problematic growth of the target plant. Generally, physical control methods are not among the preferred methods for large-scale control of free-floating plants (Madsen, 1997, and Wade, 1990). This is caused by both the escapability of free-floating plants (Culpepper and Decell, 1978) and the excessive biomass associated with these species (e.g., giant salvinia of up to 80 tonnes/hectare; Oliver, 1993). Also, with giant salvinia, many of the plant fragments that would be produced by mechanical chopping or shredding will remain viable, thus defeating the purpose of this method.

Any physical control of giant salvinia is likely to be limited to the use of booms and other physical barriers to keep salvinia out of areas where it has been eradicated. In small infested areas, manual removal may be used in combination with other techniques. Mechanical removal is a possibility, but is unlikely to be used because of the expense and lack of available mechanical harvesters. Choppers and shredders are not likely to be used because they may contribute to the spread of salvinia by physically breaking the salvinia plants into smaller pieces; these pieces are often viable and can escape detection until they have multiplied into a new infestation.

c. Biological control

Cyrtobagous salviniae, a weevil, has been identified as a biological control agent that is host-specific to *Salvinia* species (Forno, 1983, Room, *et al*., 1981, Thomas and Room, 1986, and Cilliers, 1991). Adults feed on the leaves and preferentially on newly formed leaf buds, and larvae feed within the roots, rhizomes, and leaf buds. Combined feeding actions of adults and larvae can be devastating with reported impact to field populations sometimes observed in just several months instead of years, as typically seen with other biological control agents (Sands and Schotz, 1984). The weevil will be collected from Florida where it is feeding on *Salvinia minima*, a closely related species, and overseas. These weevils will be moved, under APHIS permit, to USDA inspected high-containment facilities where they will be screened to ensure they are pathogen- and parasite-free before their release. The effectiveness of this weevil is dependent upon climatic conditions, such as temperature, plant nutritional status, and other abiotic and biotic conditions. In the United States, the time required for effective control will probably be longer than in tropical climates because of the cooler weather. The establishment, spread, and effectiveness of the weevil to control salvinia will be evaluated whenever the method is used.

d. Regulatory controls (quarantine)

State regulations in Texas and Louisiana allow the States to control outbreaks, seize salvinia plants, issue stop sale orders to nurseries and other places that sell salvinia plants, issue warnings to property owners requiring them to take action concerning infestations in privately-owned areas, and establish quarantines. The Federal regulatory controls include interstate quarantines and inspections at aquatic plant retailers and producers in all States.

2. Public education

State cooperators have proposed projects to educate the public so that they will recognize giant salvinia and, when they detect it, have the appropriate information to notify the responsible authority(ies). Also, State cooperators will conduct boat ramp inspections, post descriptive notices, and inform boat owners and operators of the need to be aware of the potential for the plant to spread.

B. Establishment of a Biological Control Program (No Herbicide Applications)

Under this alternative, APHIS would be involved in the elements of the project related to biological control. In this demonstration project, under this alternative, chemicals would not be used, although mechanical controls could be used. Other Federal, State, or local agencies or private individuals could use any of the listed control methods.

C. No Action (No APHIS Action)

Under the no action alternative, APHIS would not be involved in any aspect of *Salvinia molesta* eradication efforts. State and local authorities and other Federal agencies would likely continue to pursue eradication in reservoirs, lakes, ponds, and irrigation and drainage ditches under their purview using available funds and personnel. In addition, private individuals attempting to rid their backyard ponds, docks, or boat ramps of salvinia could take action using either physical removal, herbicides registered for use on aquatic weeds, or possibly other chemicals that are not registered for this purpose.

APHIS would not provide personnel or funding for, nor support public education efforts. Public information programs sponsored by State and local authorities would remain at current levels subject to the resources available.

V. Impacts of the Alternatives

A. Eradication Using an Integrated Approach (Preferred Alternative)

1. Human health and safety

Impacts to human health and safety from the preferred alternative would, for the most part, be caused by the use of chemicals, including herbicides, surfactants, and other adjuvants. The greatest exposure to surfactants would likely occur during mixing with the herbicides. The action plan proposes to use all surfactants and herbicides at the recommended application rates (Chilton *et al.,* 1999). Workers are under the same constraints when working with surfactants as with herbicides. They must wear personal protective equipment, if required by the label, and adhere to all label restrictions.

Potential impacts to workers or the public would result from exposure through chemical contact, ingestion, or inhalation. Workers may be exposed during the mixing of herbicide formulations and addition of surfactants or copper complexes, during spraying operations, and to the plant if they remove treated vegetation from the water and manually dispose it. The public may be exposed during recreational activities, including boating, fishing, swimming, hunting, and hiking in adjacent areas; drinking contaminated water (possibly including tap water because reservoirs are treatment areas); ingesting foods cooked in or mixed with contaminated water (such as baby formula and drink mixes) or eating fish from contaminated water; and bathing.

Impacts from the other control methods may occur from accidents; routine use of biological, mechanical, or regulatory controls are not likely to result in impacts to human health and safety. Combining the control methods in an integrated approach will result in impacts that will be additive, for the most part. Information on human health effects from exposure to the combinations of herbicides, surfactants, and copper complex is unavailable, contributing to an uncertainty in risk. Although the degree of risk, in this case, is not quantified, the program operating procedures and the restricted treatment areas (i.e., only the infested areas of lakes, ponds, and reservoirs) should minimize potential for exposure and, therefore, risk of health impacts.

a. Herbicides and surfactants

(1) Diquat dibromide (Reward®)

Diquat dibromide, an herbicide, shows moderate acute dermal toxicity and primary eye irritation effects. It also shows it has slight acute toxicity if inhaled or ingested. It causes slight skin irritation, but it is not a skin sensitizer. The U.S. Environmental Protection Agency (U.S. EPA) classifies diquat dibromide as a Group E carcinogen, which means evidence shows that it is not a carcinogen for humans. The reference dose (RfD) was determined to be 0.005 milligrams per kilogram per day (mg/kg/day) (expressed as diquat cation). Long-term exposures to doses greater than the RfD may cause cataracts and other eye lesions and weight changes in the adrenals and epididymides. Some signs of reproductive and developmental effects from long-term exposures were observed. Short-term (several weeks) inhalation exposures were associated with relative weight changes in the lungs and brain and with pathological changes in the lungs. All toxic effects (except changes in the lungs) were reversible (U.S. EPA, 1995).

Diquat dibromide is very soluble in water and ionizes in aqueous solutions. Compounds with this characteristic are expected to be absorbed very slowly and in very small amounts through the skin. Diquat dibromide is poorly absorbed from the gastrointestinal tract. It does not accumulate in the body tissues.

Diquat dibromide is immobile because it binds irreversibly to the soil. It is persistent and will accumulate in soil. Diquat dibromide also binds rapidly to suspended matter in the water column and becomes biologically unavailable. Because it does not accumulate in body tissues, it is not expected to bioaccumulate in fish.

Impacts to human health and safety from the use of diquat dibromide in an eradication program are expected to be minimal. Because workers, including mixers and applicators, will wear protective equipment and will not reenter the treatment areas for 24 hours after application, potential exposures to workers will not be at levels that result in adverse impacts. Inadvertent short-term overexposure to diquat dibromide may result in skin or eye irritation.

The label requires that treated areas be posted at specified distances downstream of the treatment area with signs stating restrictions for water use, including drinking, swimming, and irrigation of gardens (Zeneca, 1998). In addition, treated areas will not be retreated within 14 days. Exposures to the public will be minimized because of the chemical's characteristics and the precautions taken by program personnel. Diquat cation is known to bind tightly to organic particles, such as sediment, making it unavailable as a toxicant through contact with the suspended particles in water.

(2) Fluridone (Sonar™ A.S.)

Technical fluridone, an herbicide, shows slight acute toxicity if ingested; it is considered moderately toxic through acute inhalation exposure. The potential for eye irritation is moderate to severe. The pellet formulations and suspensions in water may cause slight dermal, skin, and eye irritation effects. An assessment of fluridone's carcinogenic potential was not available from the U.S. EPA when the information was published in the Integrated Risk Information System (IRIS) (U.S. EPA, 1990). The reference dose (RfD) was determined to be 0.08 mg/kg/day. A long-term exposure study in test animals showed effects on the kidneys, testes, and eyes, and showed decreased body and organ weights. Reproductive, developmental, and teratogenic effects were observed at the higher doses tested (Elanco, 1980a, cited in U.S. EPA, 1990).

Fluridone is stable to hydrolysis, but will photodegrade with a 34-hour half-life in natural pond water. If it is not degraded by light, fluridone is estimated to have a half-life of 20 days in water, and 90 days in hydrosoil; under anaerobic aquatic conditions, it may have a half-life of 9 months. Fluridone has a low potential for bioaccumulation in fish.

Impacts to human health and safety from the use of fluridone in an eradication program are expected to be minimal. Because workers, including mixers and applicators, will follow all label requirements, including the use of personal protective equipment, any potential exposures to workers will not be at levels that result in adverse impacts.

The highest possible application rate on the label would result in a water concentration of 0.15 parts per million (ppm) of active ingredient of fluridone. This is more than 1,000 times lower than the U.S. EPA-determined No Observed Effect Level (NOEL) of 200 ppm from an experimental study. Although this may not be protective of an acute, accidental exposure, measures to prevent such occurrences are incorporated into the plan as required by the label. For example, fluridone will not be applied in lakes or reservoirs within 1/4 mile of any functioning potable water intake (SePro, 1994).

The *"Salvinia Molesta* Status Report and Action Plan," (Chilton, 1999) recommends that fluridone only be used in static water regimes (e.g., ponds) where the treatment area is easily confined. This facilitates the label-required posting of signs to indicate treatment areas, thus reducing the possibility of public exposure.

(3) Thoroughbred™

Exposure to Thoroughbred™, a surfactant, may cause skin and eye irritation, which should be remedied by flushing with water. Repeated exposures to high dosages could increase dermatitis conditions (Estes, Inc., 1994).

(4) AQUA-KING

AQUA-KING, a surfactant, contains two ingredients the U.S. EPA considers to be hazardous: glycol butyl ether (<10% of formulation) and phosphoric acid (<5% of formulation). Exposure causes burns to the eyes and skin irritation. Inhalation of high mist concentrations may cause headaches and dizziness, and aspiration may cause lung damage (Estes, Inc., 1996).

(5) Cutrine®-Plus (Copper Chelate)

Cutrine®-Plus is an algicide and an herbicide registered for use in drinking water reservoirs, farm fish and industrial ponds, golf course water hazards, lakes, fish hatcheries and raceways, irrigation waters, and conveyance systems such as canals, laterals, and ditches (Applied Biochemists, 1997a). It contains three ingredients the U.S. EPA considers to be hazardous: copper carbonate, monoethanolamine and triethanolamine. Cutrine®-Plus is corrosive to skin, and contact with skin and eyes may cause irritation. Exposure to vapors or mists may cause irritation with pain, coughing, and discomfort to eyes, nose, throat, and chest. Repeated exposures may lead to skin sensitization (Applied Biochemists, 1997b).

b. Biological control

The impact to human health and safety from the release of the weevil, *Cyrtobagous salviniae*, to control salvinia is expected to be negligible. Any foreseeable impacts would be to workers from accidents while collecting or distributing the weevil.

c. Mechanical control

Impacts to human health and safety from using mechanical methods to control or eradicate giant salvinia could possibly result from accidents using mechanical equipment, water-related accidents on boats, or stress injuries from hand removal of heavy mats of salvinia. Also, if chemical treatments are conducted before removing the mats, workers could be exposed to the herbicides and surfactants.

d. Regulatory controls

No adverse impacts to human health and safety resulting from regulatory controls are expected. The use of regulatory controls will result in less spread of giant salvinia, fewer infestations, and diminished need to use other control measures that may have greater potential to adversely impact human health and safety.

2. Physical environment

Each impact to the physical environment (see table 3) described for chemical, mechanical, and biological control methods will result when an integrated control program is undertaken. An integrated control program against salvinia will negatively impact water quality in the short term, especially when chemical and mechanical methods are used. However, water quality will improve as those methods reduce salvinia infestations. Additionally, recreational, commercial, and industrial water uses will be impacted in the short term, but those uses will quickly return as salvinia decreases.

Table 3. Summary of the Comparative Impact of Control Methods

Potentially impacted resource	Control methods					
	A	B	C	D	E	F
Physical environment						
Water quality	–	–	◦	◦	◦	±
Water recreational uses	–	–	±	+	+	±
Water commercial/industrial uses	–	–	±	+	+	±
Nontarget species						
Plants						
Phytoplankton	–	–	+	+	+	±
Submersed macrophytes	–	–	±	+	+	±
Emergent macrophytes	◦	–	◦	◦	◦	±
Invertebrates						
Zooplankton	–	–	+	+	+	±
Macroinvertebrates	–	±	±	±	±	±
Vertebrates						
Reptiles and amphibians	±	◦	◦	◦	◦	◦
Game fish	–	–	+	+	+	±
Nongame fish	–	–	+	+	+	±
Waterfowl	–	+	+	+	+	+

Legend:
A = No control
B = Chemical control
C = Mechanical control
D = Biological control
E = Regulatory control
F = Integrated control

+ = beneficial effect – = negative effect ◦ = no effect ± = beneficial and negative effect

a. Herbicides and surfactants

When applied according to label directions, the herbicides used to control salvinia will cause localized and short-term decreases in water quality. The greatest impact herbicide application will have on water quality is the increase in biological oxygen demand that will occur as salvinia mats decompose after herbicide treatments. The decrease in dissolved oxygen will be most noticeable in small water bodies, such as ponds or in shallow, backwater areas of larger water bodies. In larger water bodies, such as many reservoirs, the typical water circulation patterns are likely to dissipate the reduced oxygen levels, thus the net effect on dissolved oxygen in the water body will be extremely minor. Water treated with herbicides may be restricted for recreational, commercial, or industrial uses. The label specifies such restrictions for each herbicide, and the herbicides will be applied according to the label.

b. Biological control

The use of biological control agents to control salvinia would have little impact on water quality. Salvinia mats cause a reduction in water quality parameters, such as dissolved oxygen; however, the gradual reduction of those mats by biological control agents would only gradually increase dissolved oxygen levels and restore other water quality parameters. Recreational, commercial, and industrial uses of the areas colonized by salvinia would be restored as the biological control agents reduce the plants, but the restoration would be much more gradual than if salvinia were removed by chemical or mechanical methods.

c. Mechanical control

Mechanically removing salvinia mats would have little impact, either positive or negative, on water quality parameters. Although dissolved oxygen levels below salvinia mats are likely to be lower than in surrounding waters uncolonized by salvinia, oxygen levels would not be expected to recover immediately after salvinia is physically removed. In areas where salvinia is mechanically removed, recreational, commercial, and industrial uses of that area would be hindered during the removal process, but perhaps no more than salvinia itself might hinder those activities if left uncontrolled. Once the removal process has been completed, those uses would be restored to levels present before the areas were colonized by salvinia.

d. Regulatory controls

No adverse impacts to the physical environment resulting from the use of regulatory controls are expected. The use of regulatory controls will result in less spread of giant salvinia, fewer infestations, and diminished need to use other control measures that may have greater potential to adversely impact the physical environment.

3. Nontarget species

Each impact to nontarget species (see table 3) described for chemical, mechanical, and biological control methods will result when an integrated control program is undertaken. Effects to nontarget species from an integrated control program against salvinia will increase in the short term, especially when chemical and mechanical methods are used. However, effects to nontarget species will decrease as those methods reduce salvinia infestations.

a. Herbicides and surfactants

Because the herbicides used to control salvinia infestations are nonselective, other aquatic vegetation in the treatment area also will be reduced. All emergent, floating, and submersed macrophytes exposed to the herbicides will be affected by the herbicidal action. Also, phytoplankton densities in the treatment area are likely to decline. It is not known how long the reduction in aquatic plants in treatment areas will last; this will be determined by several factors, including the amount of herbicide used, the duration of use, and how quickly plants, displaced by salvinia, immigrate to treated areas. Regardless, as the herbicides degrade and lose efficacy, the nontarget plants would be expected to recover. In situations where salvinia does not recolonize the treatment area, the plant assemblages that existed before treatment would likely become re-established.

In general, aquatic invertebrates in herbicide treatment areas would be expected to decline. Although the herbicides are not directly toxic to aquatic invertebrates, reducing all vegetation within the treatment area also would cause a reduction in zooplankton and macroinvertebrates. The reduced levels of dissolved oxygen in the treatment area also would cause reductions in invertebrate assemblages. Benthic detritivores (invertebrates that live on the bottom of water bodies and decompose organic matter) is one group of aquatic invertebrates that may increase in treated areas as vegetation dies.

Fish in the herbicide treatment areas are likely to be displaced by reduction in water quality, particularly from dissolved oxygen levels and the treatment activities. The herbicides are not expected to have direct toxic effects to fish. Once water conditions are restored to pretreatment levels, it is expected that fish assemblages would return to the treatment areas. Little effect is expected on reptiles and amphibians in herbicide treatment areas because few reptiles and amphibians would depend on salvinia as habitat and the herbicides have a low direct toxicity to those animals. Waterfowl would benefit from the increase in open water areas and the return of native aquatic vegetation (which may provide food sources) after the herbicides remove salvinia mats.

In accordance with section 7 of the Endangered Species Act, APHIS has consulted with the Fish and Wildlife Service (FWS) on the use of chemicals to control giant salvinia. For the State of Louisiana, the FWS concurred with APHIS' determination that the use of the chemicals, according to label directions, other than fluridone, is not likely to adversely affect endangered and threatened species or their habitats. For fluridone, the FWS recommended its use be prohibited in any stream that contains listed aquatic species.

For the State of Texas, the FWS recommended that APHIS contact the FWS Field Offices responsible for the areas to be treated to work out avoidance techniques to prevent impacts.

Implementation of these recommendations will be carried out by the Program if APHIS is involved in chemical treatments. In addition, this information has been shared with the State and other Federal agencies involved in this project.

b. Biological control

The salvinia weevil is expected to maintain *Salvinia molesta* at a low level or perhaps eradicate it. Thus it will, in effect, create conditions on water bodies similar to conditions before *Salvinia molesta* was introduced. The insect itself will be an unobtrusive addition to the local invertebrate fauna. The best information shows that the weevil, *Cyrtobagous salviniae,* is entirely reliant on plants in the genus Salvinia; thus, the only impact it should have on other plants or insects is through the effects of its control of *Salvinia molesta.*

Release of the weevil, *Cyrtobagous salviniae,* is not expected to have negative impacts on nontarget species because it is host-specific to *Salvinia* species. As salvinia mats decrease, use of the restored areas by native species should return.

APHIS has consulted with the FWS on the potential effects of the use of biological control on endangered and threatened species and their habitats. The FWS has concurred with APHIS' determination that the introduction of *Cyrtobagous salviniae* is not likely to adversely affect endangered and threatened species or their habitats. The FWS requested that they be contacted when the releases are initiated.

c. Mechanical control

Mechanical control methods for giant salvinia would mostly impact submersed and floating macrophytes. Procedures used to harvest or manipulate salvinia mats also are likely to cause the direct removal of any aquatic plants (most likely submersed macrophytes) in the treatment area. Salvinia removal is not likely to affect phytoplankton and emergent macrophytes, such as cattails.

Invertebrates generally would benefit from the mechanical removal of salvinia. As salvinia mats are removed, light penetration will increase in the water column, increasing phytoplankton densities, which in turn will support higher densities of zooplankton. Macroinvertebrate assemblages also will increase in areas where salvinia is removed and, thus, improve water quality conditions.

It is likely that fish would soon return to treatment areas because mechanically removing salvinia will not adversely affect water quality but will quickly restore open water habitat. Depending on the severity and extent of the salvinia infestation, it is reasonable to expect that fish would readily utilize the habitat after the salvinia is mechanically removed. Also, waterfowl would benefit from the increase in open water areas restored after the salvinia mats are mechanically removed. Little effect is expected on reptiles and amphibians in these areas because few of them would depend on salvinia as habitat.

d. Regulatory control

The regulatory control of salvinia is an administrative action that will not affect the physical environment or nontarget species directly. However, by reducing the potential for salvinia to enter natural water bodies, existing aquatic habitats will not be disrupted in those bodies where salvinia has the potential to become established. Conversely, regulatory control will not alleviate the environmental damages caused by salvinia to infested water bodies.

Each impact to the physical environment and nontarget species described for chemical, mechanical, and biological control methods will result when an integrated pest management program is undertaken. Water quality and effects to nontarget species in an integrated program against salvinia will decrease in the short term, especially when chemical and mechanical methods are used. However, water quality will increase and effects to nontarget species will decrease as those methods reduce salvinia infestations. Additionally, recreational, commercial, and industrial water uses will be impacted in the short term, but those uses will quickly return as salvinia decreases.

B. Establishment of a Biological Control Program (No Herbicide Applications)

1. Human health and safety

Impact to human health and safety is not expected from the release of the weevil, *Cyrtobagous salviniae*, to control salvinia; however, if an impact were to occur, it would be minimal. Any foreseeable impacts would be to workers from accidents while collecting or distributing the weevil. If physical or mechanical controls are used in conjunction with the program, then potential impacts from this alternative would be from accidents using mechanical equipment, water-related accidents on boats, or stress injuries from hand removal of heavy mats of salvinia.

2. Physical environment

The use of biological control agents to control salvinia would have little impact on water quality. Salvinia mats cause a reduction in water quality parameters, such as dissolved oxygen, but the gradual reduction of those mats by biological control agents would gradually increase dissolved oxygen levels and restore other water quality parameters. Recreational, commercial, and industrial uses of the areas colonized by salvinia would be restored as the plants are reduced by biological control agents, but the restoration would be much more gradual than if salvinia is removed by chemical methods.

3. Nontarget species

Reducing salvinia by releasing biological control agents would benefit submersed and floating aquatic macrophytes and phytoplankton in the infested areas. Although improvement would be more gradual than if chemical methods were used, the extent to which biological control agents would reduce the salvinia mats would again allow light to penetrate the water column, availing more nutrients for other plants. Emergent macrophytes are mostly not affected by salvinia mats, and reducing the mats would have little effect on emergent plants.

The biological control of salvinia would benefit invertebrate assemblages. As biological control agents feed upon and thereby reduce salvinia mats, the increase in phytoplankton would support more zooplankton. Macroinvertebrate populations also would increase with the improved water conditions that would occur as salvinia mats are reduced.

Fish that were intolerant of the conditions under salvinia mats would return as biological control agents reduce those mats. Waterfowl also would become more common in biological control areas as the salvinia mats decrease and open water areas increase. Reptiles and amphibians would most likely be unaffected by the presence of biological control agents, although biological control insects could become food items for some amphibians, reptiles, and fish.

C. No Action (No APHIS Action)

1. Human health and safety

Potential impacts to human health and safety from the no action alternative would result from deleterious effects to water resources because of the unchecked spread of giant salvinia. Infestations would continue to provide the source material from which other water bodies might be contaminated. Because of salvinia's rapid rate of spread, large water bodies used for boating, fishing, waterfowl hunting, recreation, transportation, aquaculture, water consumption, and agricultural irrigation would be rendered completely inaccessible and unusable for these purposes. People would travel farther, possibly to other States, to seek preferable locations for boating and fishing (harming local economy) and, in the process, inadvertently transport viable salvinia plants, thus facilitating contamination of other water bodies. With no effective monitoring or quarantine program, *Salvinia molesta* could easily spread to ponds, lakes, and rivers throughout the southern United States. It is highly likely that salvinia would at the very least impede uses of these water bodies, such that recreational pursuits, food fishing, water consumption, and water-dependent industries, including crawfish, catfish, and rice production, would suffer serious consequences.

Without a coordinated effort to educate the public, residents with backyard ponds or private boating access to lakes or reservoirs may not recognize the tremendous threat posed by the spread of this noxious aquatic weed and may assist its spread inadvertently by transporting it to other susceptible water bodies. Without Federal quarantines, there would be no consistent effort to restrict movement of the plants on boats and trailers moving between lakes and reservoirs. Nurseries would not be prevented from distributing the plant. Also, human health and safety could be impacted by private individuals attempting to eliminate or control infestations with chemicals not intended for that use. Additionally, there is the potential for giant salvinia infestations to harbor insect (e.g., mosquito) and snail pests capable of transmitting diseases.

2. Physical environment

The unabated growth and spread of salvinia that would take place under the "no action" alternative would have several undesirable effects on infested water bodies. Among the adverse effects that salvinia mats will have on the physical environment is deterioration of water quality parameters, such as light penetration, dissolved oxygen, and nutrients. These adverse effects would be most evident in small water bodies (e.g., ponds) where water circulation is restricted. In larger water bodies (e.g., large reservoirs), the degradation of water quality likely would be localized. Recreational uses of water bodies, including boating, fishing, and swimming, would decrease or be eliminated depending on the extent of the salvinia infestations. Commercial and industrial water withdrawals, such as irrigation or municipal water supplies, would be threatened by salvinia mats, which can clog water intake structures and increase water treatment costs to remove the vegetation.

3. Nontarget species

Salvinia mats prevent light from penetrating into the water column resulting in various effects on aquatic plants. Emergent macrophytes, especially those in well-established stands, would likely not be affected by salvinia mats because new growth is often from underground vegetative propagative structures that can withstand reduced light and nutrients within the water column. Conversely, submersed macrophytes and phytoplankton would likely be reduced gradually as salvinia mats form and reduce the light in the water column and absorb nutrients.

The formation of salvinia mats would negatively affect most aquatic invertebrates. Zooplankton densities would decrease under the mats because of the decrease in phytoplankton. Benthic invertebrates would decrease as dead salvinia plants collect on the bottom and oxygen decreases (Oliver, 1993). Motile invertebrates, such as crayfish, would leave areas where decaying plants cause oxygen depletion.

Although some fish could initially be attracted to the cover provided by salvinia mats, most fish would avoid areas where dense, extensive mats are found and where oxygen levels are lower than in surrounding areas uncolonized by salvinia. Likewise, some amphibians and reptiles could be attracted to the insects and other invertebrates that colonize salvinia mats, but those animals could eventually prefer other habitats as the mats become more dense and plants begin to decay. Food and loafing resources for turtles might become more limited as mats thicken and water quality diminishes. Because mats restrict the open water that most waterfowl require and make underwater food resources unavailable, it is likely that waterfowl would avoid areas colonized by salvinia.

D. Special Considerations (E.O. 12898 and E.O. 13045)

This EA is consistent with Executive Order (E.O.) 19898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The implementation of this proposed cooperative USDA, APHIS–States of Louisiana and Texas demonstration eradication project will not result in disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. As required by this E.O., opportunities for full participation in theNational Environmental Policy Act process by such populations will be provided through an announcement of the availability of the EA in the *Federal Register*.

In accordance with E.O. 13045, Protection of Children From Environmental Health Risks and Safety Risks, the environmental health or safety effects on children of actions described in the EA have been evaluated. It is concluded that the proposed action will not disproportionately affect the health or safety of children.

VI. Mitigation Measures (Including Monitoring)

Environmental samples will be tested for herbicide residues to address potential human health and potential environmental effects associated with herbicide treatments to control salvinia. The environmental monitoring plan specifies the sample number and type, as devised by the Environmental Monitoring Team, Riverdale, Maryland. Water and fish samples will be collected from treated waters and analyzed at the National Monitoring and Residue Analysis Laboratory in Gulfport, Mississippi. Additional samples will be collected if there are accidents or complaints. The Environmental Monitoring Team will report results at the conclusion of the project.

VII. Agencies and Organizations Consulted

Cooperators:

Louisiana Department of Wildlife and Fisheries (LDWF)
Louisiana Department of Agriculture
Sabine River Authority (SRA, Louisiana and Texas)
Texas A&M University (TAMU)
Texas Aquatic Plant Management Society (TAPMS)
Texas Department of Agriculture (TDA)
Texas Parks and Wildlife Department, Rhandy Helton (TPWD)
U.S. Geological Survey (USGS)
U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS)
U.S. Army Corps of Engineers, Dr. Michael Smart (USACE)
U.S. Department of Agriculture, Forest Service (FS)
U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS)

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Finding of No Significant Impact
for
Demonstration Project: Giant Salvinia, Toledo Bend Reservoir and Surrounding Areas in Louisiana and Eastern Texas

Environmental Assessment, March 2001

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), has prepared an environmental assessment (EA) for a demonstration project to eradicate and prevent the spread of the aquatic weed, giant salvinia, in the Toledo Bend Reservoir and surrounding areas in Louisiana and eastern Texas. Giant salvinia (*Salvinia molesta*) is an invasive alien aquatic weed species that has been on the Federal Noxious Weed Act list for more than 15 years. The EA, incorporated by reference in this document, is available from:

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
4700 River Road, Unit 134
Riverdale, MD 20737

The EA considered the impacts of three alternatives and the use of various methods for eradicating and preventing the spread of giant salvinia. The alternatives considered include (1) the preferred alternative—eradication using an integrated approach (including the possible use of aquatic herbicides and surfactants; mechanical control, biological control organisms, and Federal regulatory controls), (2) establishment of a biological control program, and (3) no action. The proposed demonstration project is needed to comply with relevant regulations and to advise involved parties on the methods to eradicate and prevent the spread of giant salvinia.

APHIS has complied with section 7 responsibilities of the Endangered Species Act of 1973 (16 U.S.C. 4332 *et seq.*) by consulting with the U.S. Department of the Interior, Fish and Wildlife Service (FWS) with regard to the protection of endangered and threatened species or their habitats. APHIS will adhere to protective measures specified by the FWS for this project.

APHIS has determined that implementation of alternative A, eradication using an integrated approach, of the giant salvinia demonstration project in the Toledo Bend Reservoir and surrounding areas in Louisiana and eastern Texas, with associated operating procedures and mitigation measures as identified in the EA, will not significantly impact the quality of the human environment.

The finding of no significant impact was determined based on the following:

1. The herbicides proposed for use have label requirements restricting their use to certain aquatic environments and circumscribed areas that limit the potential for human exposure. They will be used only in discrete areas with existing giant salvinia infestations, and only directly on the plant. The available toxicological data on the herbicides indicate that the levels of potential exposure to humans will be low enough so that effects, if any, would be mild as well as short-term. Accidental exposures of workers or the public to high levels of the herbicides, which could result in more severe effects, are not anticipated and are unlikely. Release of the biological control organism, *Cyrtobagous salviniae*, is not expected to cause any impact to human health.

2. The herbicide treatments will affect most aquatic life in the vicinity of and for certain distances downstream from treatment areas. Direct impacts from the herbicides will occur to some nontarget vegetation, whereas indirect impacts—reduction in vegetation and reduced levels of dissolved oxygen—will alter the environment for fish and aquatic invertebrates. Once water conditions return to pretreatment levels, the affected organisms are expected to recolonize the area as before treatment. Reptiles and amphibians should not be affected; waterfowl may benefit from greater open water areas following herbicide treatments. Based on host specificity testing, the use of the biological control organism, *Cyrtobagous salviniae*, for salvinia species is not expected to impact nontarget organisms.

3. APHIS has conducted section 7 consultation with the FWS and with the implementation of the recommendations of the FWS, a determination that the action "is not likely to adversely affect" endangered species or their habitats has been made.

4. Monitoring of human health and nontarget organisms will be conducted as described in the Environmental Monitoring Plan to assure that the conclusions are realized.

I have considered the information analyzed in the EA and base my finding of no significant impact on assessments of the potential impacts of the preferred alternative. Also, I find that the environmental process undertaken for this project is consistent with the principles of environmental justice, as expressed in Executive Order 12898, and of protection of children from environmental safety and health risks, as expressed in Executive Order 13045. Lastly, because the evidence presented indicates no significant environmental impact associated with this project, I further find that an environmental impact statement does not need to be prepared and the project may proceed.

/s/	9/13/01
Richard L. Dunkle Deputy Administrator Plant Protection and Quarantine	Date