

**NON-NATIVE AQUATIC VEGETATION CONTROL IN 2001**

by

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For almost 50 years, employees of the Texas Parks and Wildlife Department (TPWD) have been involved in a less glamorous side of fisheries management, the improvement of fish habitat by the removal/control of undesirable exotic vegetation. Appreciation is extended to each of the past employees for the knowledge base they helped build. Special appreciation is extended to the present Aquatic Habitat Enhancement staffs at Mathis, Bryan and Jasper who continue the tradition with their tireless efforts. No report is worth being read without reviews, and for this we thank the management biologists of Region III. Final comments, provided by TPWD Research Director Dick Luebke, improved the paper. The map preparation skills of Fred Janssen, Inland Fisheries Austin staff, and Shirley Thompson, TPWD Creative Services staff, are appreciated.

**ABSTRACT**

Invasive aquatic plants, primarily waterhyacinth [*Eichhornia crassipes* (Mart) Solms], hydrilla [*Hydrilla verticillata* (L.F.) Royle] and giant salvinia (*Salvinia molesta* D.S. Mitchell), have proven to be serious threats to the freshwater resources of Texas. This report will discuss control strategies implemented by Texas Parks and Wildlife Department on these three species, by public water body, during 2001. Also provided are known occurrences of all state-listed prohibited aquatic plants within the public waters (and private waters for giant salvinia) of Texas.

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## INTRODUCTION

Invasive, non-native aquatic vegetation continues to plague the freshwater resources of Texas. The Texas Parks and Wildlife Department (TPWD) maintains, within its proclamation, a list of "harmful or potentially harmful exotic plants" (Table 1). These species are considered the most likely to imperil the freshwater aquatic resources of the state. Non-native species have no natural control mechanism and unchecked growth can contribute to habitat degradation and reduction in access and navigation. This report will discuss control strategies used in 2001 (Jan-Dec) on the three plant species of most concern: waterhyacinth [*Eichhornia crassipes* (Mart) Solms], hydrilla [*Hydrilla verticillata* (L.F.) Royle] and giant salvinia (*Salvinia molesta* D.S. Mitchell).

TPWD supports and encourages an integrated pest management philosophy utilizing biological, chemical, mechanical, environmental manipulation and ecological intervention methods to manage or eradicate problematic exotic species. Control methods implemented in 2001 are discussed by water body. Known distribution of waterhyacinth, hydrilla and giant salvinia within Texas are shown in Figures 1-3, respectively. Appendix I lists the known occurrence during 2001, within Texas, of those species listed in Table 1. The Daily Log of Herbicide Operations card on which herbicide application operations are recorded is found in Appendix II. A list of the aquatic herbicides and surfactants employed by TPWD personnel, use rates and target plants is found in Table 2. A summary of the biological control insect, salvinia weevil (*Cyrtobagous salviniae*), releases in Texas during 2001 (including location and number) is found in Figure 4.

### Waterhyacinth

Problematic infestations of waterhyacinth have occurred in the United States since the early 1900's (Wunderlich 1962; Zeiger 1962). The exact year of introduction into Texas waters is unknown, but serious infestations appeared during the 1950's and chemical control programs were implemented. These aquatic plant management activities led to the formation of a Statewide Noxious Vegetation Control Program within TPWD. This program was initially administered through Dingell-Johnson funds. Later, the U.S. Army Corps of Engineers Aquatic Plant Control Program provided 70 % cost-share funding for control of waterhyacinth in Texas. Funding for the program was discontinued in the early 1990's.

Waterhyacinth is common along the Texas coastal bend and inland up to 250 miles. Caddo Lake, Lake Fork and Lake Quitman form the northern-most range of waterhyacinth in Texas. The main threat of waterhyacinth is to navigation, but the large, thick mats that eventually form cause severe ecological stress within aquatic systems (Hitchcock et al. 1949; Langeland 1987). In Texas, control has mostly been achieved using aquatic herbicides (2,4-D Amine, glyphosate, and diquat) but winter drawdowns and biological and mechanical control measures have also been utilized (Helton and Hartmann 1995; Cofrancesco 1998).

Waterhyacinth has been identified on 33 public water bodies within the state (Fig. 1). Lake Quitman was the only new infestation of waterhyacinth reported in 2001. The most severe infestations that required treatment in 2001 were on B.A. Steinhagen Reservoir and, in spite of winter mortality, Caddo Lake. Harsh winter conditions in December 2000 on Caddo Lake and Lake Livingston reduced waterhyacinth by an estimated 90%.

### **Hydrilla**

Hydrilla, a submersed aquatic plant, was first identified in the United States in 1960, but was not verified in Texas until 1969 near Houston (Klussmann et al. 1988). By 1975, infestations of this species were confirmed in Toledo Bend Reservoir, Sam Rayburn Reservoir, Lake Conroe, and Lake Livingston. By the late 1970's the plant began to create serious problems in a number of smaller heated reservoirs in the eastern half of the state. Hydrilla has been described as the "perfect aquatic weed" because of its highly specialized growth habit, physiological characteristics, and multiple modes of reproduction (Langeland 1996). Monotypic stands of hydrilla are common in many Texas reservoirs and, as a result, native plant diversity and coverage has declined (TPWD, unpublished data). Within the state, historical control methods for hydrilla have included herbicides and biological and mechanical means.

Currently, 91 public water bodies within Texas have hydrilla (Fig. 2). TPWD Inland Fisheries (IF) staff surveys estimate that in years when most reservoirs are at capacity, there may be as many as 45,000 - 75,000 acres of hydrilla statewide (TPWD, unpublished data). Hydrilla declines were noted in 2001 on Caddo Lake, Lake Murvaul, Toledo Bend Reservoir and Lake Fork. The exact cause of these declines is not known. In 2001, the only new infestation of hydrilla reported was on Lake Granger. The Tyler Nature Center Pond and Lake Raven were the only waters in which hydrilla was treated with an aquatic herbicide by TPWD personnel.

### **Giant Salvinia**

The highly invasive floating aquatic fern, giant salvinia, was first identified in the wild in the United States (South Carolina) in 1995. The second U.S. record, and the first for Texas, occurred with identification of the plant from a small wild population located in Houston during spring 1998 (Helton and Chilton 2001). Worldwide, where introductions of this species have occurred, severe human impacts resulted rapidly (Oliver 1993). Giant salvinia forms dense, thick, floating mats of vegetation which invariably conflict with all uses of an aquatic resource. Gradually, the alteration in the natural nutrient dynamic flow results in total degradation of the ecosystem (Oliver 1993). Studies on the growth of giant salvinia have found a leaf doubling time of 8.1 days under natural conditions (Mitchell and Tur 1975). In Texas, those rates may be reduced to 5-7

days due to climate and the eutrophic nature of some aquatic ecosystems (D.S. Mitchell pers. comm. 1999).

Giant salvinia has now been identified in four public reservoirs and 41 private water locations, which includes 10 commercial nurseries. Four new private water sites were verified in 2001. With the exception of four research sites, the plant has been eradicated in all private water bodies and nurseries where it has been found. Giant salvinia was found in Toledo Bend Reservoir in 1998 and Lake Texana in 1999. New infestations were documented at Lake Conroe and Sheldon Reservoir in 2000. No new infestations were documented on any public reservoirs in 2001. However, giant salvinia was confirmed in a 10-mile stretch of the Trinity River just above its entrance into Trinity Bay. As in 1999-2000, herbicide control programs continued on Toledo Bend Reservoir. A single day's treatment by San Jacinto River Authority (SJRA) personnel was all that was necessary on Lake Conroe in 2001. Extensive surveys by TPWD personnel could locate no salvinia on Sheldon Reservoir in 2001. No treatments were performed on Lake Texana.

The U. S. Department of Agriculture (USDA), with TPWD support, continued research on the development and production of the salvinia weevil as a biological control agent for giant salvinia. Research efforts focused on the Australian salvinia weevil. The success of this insect on infestations in other parts of the world has been thoroughly demonstrated (Room et al. 1981). Insect releases were initiated into Texas salvinia populations in October 2001. A total of 1,100 insects were released at four sites including Toledo Bend Reservoir, Lake Texana and two private water sites in Southeast Texas (Fig. 4). More releases were scheduled for spring 2002.

Public education efforts were continued to inform Texas citizens about the threat that giant salvinia poses to aquatic resources. State media sources and widespread distribution of a giant salvinia fact sheet have no doubt contributed to the quick discovery of new infestations. For the second consecutive year, actual reports of new infestations declined. Early detection of this plant species was instrumental in the control of giant salvinia on Lake Conroe. This factor alone will be critical if eradication is to be achieved, especially on reservoirs (Allen 2000).

## **AQUATIC PLANT MANAGEMENT BY WATER BODY IN 2001**

### **Lake Conroe**

Controlling Authority: SJRA. Contact: Blake Kellum, phone 936-588-7102, e-mail [blake@sjra.net](mailto:blake@sjra.net). Prohibited plants: giant salvinia, hydrilla, waterhyacinth.

Status: Lake Conroe contained infestations of giant salvinia, hydrilla, and waterhyacinth. SJRA conducted spot herbicide treatments for hydrilla and water hyacinth throughout the 2001 growing season. Giant salvinia was discovered in this reservoir in spring 2000 and was treated repeatedly in a cooperative effort between TPWD and SJRA. In 2001, giant



salvinia never became problematic largely due to the successful spraying operations in 2000. Only 0.25 acre of giant salvinia was treated, by SJRA personnel, during the year (B. Kellum, SJRA, pers. comm.). This represents a dramatic reduction in spray effort over that of 2000. Herbicide applicators employed Rodeo® (glyphosate) for better long-term control. The rate used was 1.00 % v/v (4 quarts per 100 gallons mix). A non-ionic surfactant (Aqua King Plus®) at 0.25% v/v (1 quart per 100 gallons mix) was used in combination with an organo-silicone surfactant (Thoroughbred®) at 12 oz or 0.1% v/v per 100 gallons mix.

Native vegetation continued to colonize new areas, thus discouraging establishment of exotic vegetation. A total of 15,000 waterhyacinth weevils (*Neochetina* sp.) were released, by SJRA, for biological control of waterhyacinth.

### **Lake Livingston**

Controlling Authority: Trinity River Authority (TRA). Contact: Spencer Karr, phone 936-365-2292, e-mail [traliv@livingston.net](mailto:traliv@livingston.net). Prohibited plants: waterhyacinth, hydrilla.

Status: TPWD personnel performed no spray operations on Lake Livingston in 2001. The waterhyacinth infestation that had developed in 2000 was substantially reduced by December 2000 freezing weather. TRA personnel treated 445 acres of waterhyacinth during 2001 and considered the infestation under control (S. Karr, TRA, pers. comm.). Rodeo® (glyphosate) at 1.0 % v/v with Aqua-King Plus® surfactant 0.25% v/v was used in treatments.

Although a minor infestation of hydrilla (<10 acres) was observed, no treatments targeting hydrilla were conducted by TPWD personnel on Lake Livingston in 2001.

### **Lake Houston**

Controlling Authority: City of Houston. Contact: Roger Holbert, phone 713-222-3520, e-mail [rogerholbert@cityofhouston.net](mailto:rogerholbert@cityofhouston.net). Prohibited plant: waterhyacinth.

Status: In 2001, waterhyacinth expanded to the extent that herbicide applications were required. Heaviest infestations were present in the Kingwood area and total area coverage was estimated at 1,000-1,500 acres. Heavy rainfall from tropical storm Allison in June 2001 flushed large mats of waterhyacinth into the main lake. Public concerns led to the implementation of aerial and ground applications in July 2001. TPWD crews assisted with some ground spraying. A major aerial spraying operation was conducted in July 2001 under the direction of personnel from the City of Houston and SJRA. Approximately 650 acres were treated in this manner with follow-up ground spraying by SJRA personnel. At the end of the season, SJRA had treated 800 acres and considered the plant under control. Rodeo® (glyphosate) was used but mix rates are not known.

### Sheldon Reservoir

Controlling Authority: TPWD. Contact: Rob Comstock, phone 281-456-9350, e-mail [robert.comstock@tpwd.state.tx.us](mailto:robert.comstock@tpwd.state.tx.us). Prohibited plants: giant salvinia, waterhyacinth.

Status: Giant salvinia was found in Sheldon Reservoir in July 2000. A cooperative effort was initiated by TPWD Public Lands (PL) and IF staff to apply aquatic herbicides (diquat and glyphosate) on the infestation. In 2001, no giant salvinia could be located on the reservoir.

A small population of waterhyacinth was treated by TPWD-PL staff, using labeled rates of Rodeo® (glyphosate) as needed. Cold temperatures in December 2000 also may have contributed to a reduction in coverage of waterhyacinth.

### Lake Raven

Controlling Authority: TPWD. Contact: Dennis Smith, phone 936-295-5644, e-mail [dennisedd.smith@tpwd.state.tx.us](mailto:dennisedd.smith@tpwd.state.tx.us). Prohibited plants: hydrilla, waterhyacinth.

Status: By spring 2001, the hydrilla infestation on Lake Raven had expanded to cover 80% of the lake (about 160 acres). The severity of the infestation was impacting the use of this water body located within Huntsville State Park. A true integrated control program targeting hydrilla was implemented on Lake Raven in 2000 by TPWD-PL and IF personnel. Spot-treatments were conducted using Aquathol K® (endothall) to improve public access in high use areas. A mechanical harvester and Weed Roller® was also used in an effort to control hydrilla around fishing piers and boat ramp. In 2001, IF staff conducted chemical treatments during May, August, and September. A total of 83.6 acres were treated. The May treatment was the largest at 76.9 acres. Sonar® (fluridone) was applied in two large coves that were heavily infested with hydrilla. Herbicide efficacy was poor, so two smaller treatments around critical public access points were made in August and September using Aquathol® (endothall). The effectiveness of all of these treatments may not be known until spring 2002. Because mechanical control was not cost-effective in 2000, it was not pursued as an option in 2001.

Biological control methods were also implemented in 2000 with the release of the hydrilla fly (*Hydrellia* sp.). In 2001, the impact of these releases could not be observed and no further releases were made. If the herbicide treatments conducted in 2001 prove to be ineffective, the introduction of triploid grass carp (*Ctenopharyngodon idella* Val.) may be considered to provide long-term management of the plant and possibly reduce the need for costlier chemical and mechanical controls. However, several issues, such as repair to a fish escapement barrier, must be resolved prior to the use of triploid grass carp.

No treatments targeting waterhyacinth were conducted by TPWD personnel on Lake Raven in 2001.

## Toledo Bend Reservoir

Controlling Authority: Sabine River Authority (SRA). Contact: Jim Washburn, phone 409-565-2273, e-mail [toledobend@datarecall.net](mailto:toledobend@datarecall.net). Prohibited plants: waterhyacinth, giant salvinia, hydrilla.

Status: December 2000 freeze events adversely impacted waterhyacinth in the North Toledo Bend Wildlife Management Area (NTBWMA). This area is jointly managed by TPWD Wildlife Division and Ducks Unlimited for migratory, over-wintering waterfowl. The area covers approximately 600 acres and some years (e.g., 1986) have seen almost total coverage by waterhyacinth. In 2000, 66 acres of waterhyacinth were treated by chemical spraying (2,4-D Amine) in the area. During spring surveys in 2001, no viable plants were discovered, so spraying was unnecessary. In previous years, annual herbicide treatments have been effective in maintaining waterhyacinth at low population levels within the NTBWA. Summer 2001 surveys revealed an increase of waterhyacinth outside the NTBWA in the Bayou Siepe and Tenaha Creek areas. The SRA was notified concerning these areas.

The biological control insect, waterhyacinth weevil, has been identified on waterhyacinth in the reservoir, but total insect populations have always been low. No recent releases of the insect to augment the population have been made. Considerable coverage of untreated waterhyacinth is present in the upper end of Toledo Bend Reservoir for the insect to populate.

Although giant salvinia was present in Toledo Bend in 2001, its coverage was drastically reduced compared to what it was in 1999-2000. TPWD personnel spent only 2 man-days spraying giant salvinia in 2001. Only 10 acres were sprayed on the Texas side of the reservoir, while Louisiana Department of Wildlife and Fisheries (LDWF) sprayed 122 acres. In 2000, a total of 1,196 acres were sprayed lakewide. This reduction, of almost 90%, is most likely attributed to the following three factors: (1) lakewide reduction of the plant as a result of aggressive spraying in 1999 and 2000, (2) winter freeze in December 2000 and (3) the SRA decision to drop the lake level to 163 ft msl (9 ft below conservation pool) to perform dam maintenance. The decline in the lake level in early fall 2001 through the end of the year made infested sites inaccessible, however, this helped to dessicate giant salvinia. In place of diquat, TPWD-IF personnel used a combination of the herbicide Rodeo® (glyphosate, at 0.75% v/v) and two surfactants, Aqua-King Plus® at 0.25% v/v (1 quart) and Thoroughbred® at 0.1% v/v (12 oz) for a foliar application. Since spraying began in May 1999, a total of 1,625 acres have been treated by TPWD and LDWF on Toledo Bend Reservoir. Efficacy estimates are near 95% with a single spraying. However, untreated plants have demonstrated a tendency to re-infest a previously treated area within a month during the peak growing season (when water temperatures are  $\geq 80^{\circ}\text{F}$ ).

Treatment efforts in combination with environmental factors have provided control on the giant salvinia population at Toledo Bend Reservoir. Herbicide applications have been successful in confining the plant to shorelines in cove areas and

creeks entering the lake. High priority locations for spraying will continue to be boat ramps and other public access areas in order to reduce the accidental transfer and introduction of this plant into other waters. In conjunction with this effort, signs have been posted at all boat ramps to inform the public. An accurate, quantitative assessment of winter impact is not available, but it seems to be occurring. December 2000 sub-freezing temperatures produced some shoreline ice, which resulted in observable plant mortality. Ice formation on surface waters containing giant salvinia has been reported to be a cause of plant mortality (Oliver 1993). However, the extent of winter-kill is not known, as thick mats of salvinia are effective at insulating themselves against freezing conditions. Water-level fluctuation may have additional impact on control, as plants are stranded out of the water for a significant amount of time. In 2001, surveys of infested areas affected by the fall (Sep-Dec) water-level drawdown confirmed some plant mortality. Environmental instability is a critical factor in decreasing the growth and expansion of giant salvinia (Peter Room, Commonwealth Scientific and Industrial Research Organisation, Australia, pers. comm.). In summary, excessive reservoir water level manipulation in 2000 (by as much as 5 ft), and then again in 2001 (9 ft), along with adverse winter weather conditions (as opposed to previous mild winters) in December 2000, all contributed to a slow-growth year in 2001. The plant did not exhibit the growth and vigor it did in 2000.

Research continued with a biological control agent, the salvinia weevil, and Toledo Bend Reservoir was the focal point of field operations. This research was led by USDA personnel in Florida and Texas. TPWD personnel were actively involved collecting pre-release plant biomass data. In October 2001, the Australian salvinia weevil, which had been in quarantine in Florida, was released into a research site on Toledo Bend Reservoir (Fig. 4). A total of 220 insects were released. Further insect releases into Toledo Bend Reservoir are expected to occur in spring 2002. Evaluations of all releases will continue into 2002-2003.

No chemical treatments targeting hydrilla were conducted on Toledo Bend Reservoir by TPWD personnel in 2001.

### **Lake Texana**

Controlling Authority: Lavaca-Navidad River Authority. Contact: Jack Nelson, phone 361-782-5229, e-mail [lnra@ykc.com](mailto:lnra@ykc.com). Prohibited plants: giant salvinia, waterhyacinth, hydrilla.

Status: Since giant salvinia was identified in the main reservoir in 2000, herbicide treatments have been complicated by excessive growth of waterhyacinth. Giant salvinia is now present along most of the shoreline. No treatments were conducted in 2001. The Australian salvinia weevil was released at two sites on Lake Texana in October 2001 (Fig. 4). A total of 220 insects were released at each site, located in the upper end of the lake. In 2002, these releases will be evaluated by USDA and TPWD personnel.

No chemical treatments targeting waterhyacinth or hydrilla were conducted on Lake Texana by TPWD personnel in 2001.

### **Caddo Lake**

Controlling Authority: Cypress Valley Navigation District. Contacts: Tom Wagner, phone 903-665-2794, e-mail [ASBasin@aol.com](mailto:ASBasin@aol.com) and Mike Ryan, TPWD, phone 903-938-1007, e-mail [mike.ryan@tpwd.state.tx.us](mailto:mike.ryan@tpwd.state.tx.us). Prohibited plants: waterhyacinth, hydrilla.

Status: Consecutive freezing weather events, with ice, in December 2000 had a considerable impact on waterhyacinth populations in Caddo Lake. Estimates of 3,000+ acres before the winter weather were reduced to 250-300 acres by early summer 2001. Aquatic herbicide applications, with Weedar 64® (2,4-D Amine at 1.0% v/v) and Aqua-King Plus® surfactant (0.0625 % v/v), were initiated in July and continued into early November. A total of 317 acres were treated using this method. Target areas included public-access locations, residential frontage, and boat roads to popular angling/waterfowl hunting areas. These treatments were successful with post-treatment surveys confirming near 100% efficacy. Only small, scattered patches of waterhyacinth remained at the end of the year.

Surveys indicated the further decline of hydrilla on Caddo Lake in 2001. From a high of 5,500 acres in 1998, only 150 acres of the plant could be found. The reasons for this decline of over 95% are unknown, but reduced vital plant nutrient availability in the lake hydrosol is suspected. No hydrilla was treated in 2001.

### **J.D. Murphree WMA (Jefferson County)**

Controlling Authorities: TPWD Wildlife Division, J.D. Murphree WMA, Jefferson County Drainage District #6 (DD#6) in Beaumont for Taylor and Hildebrandt bayous. Contacts: Jim Sutherlin (TPWD), phone 409-736-2551, e-mail [james.sutherlin@tpwd.state.tx.us](mailto:james.sutherlin@tpwd.state.tx.us), Cecil Peltier (DD#6), phone 409-842-1818, e-mail [cwpeltier@aol.com](mailto:cwpeltier@aol.com). Prohibited plant: waterhyacinth.

Status: In 2001, no treatments were conducted by TPWD-IF staff on any of the waterways in Jefferson County. Waterhyacinth within the Big Hill Bayou system, which traverses through the J.D. Murphree WMA, was treated by TPWD Wildlife Division staff. DD#6, with jurisdiction over Taylor and Hildebrandt bayous, utilized a private pesticide applicator to treat waterhyacinth in their area. December 2001 surveys indicated effective control of waterhyacinth in areas with a history of concern.

## Lake B.A. Steinhagen

Controlling Authority: U.S. Army Corps of Engineers (USACE). Contact: Ed Murtishaw, phone 409-429-3491, e-mail [ed.murtishaw@swfo2.usace.army.mil](mailto:ed.murtishaw@swfo2.usace.army.mil). Prohibited plants: waterhyacinth, hydrilla, common salvinia (*S. minima*), alligatorweed (*Alternanthera philoxeroides*).

Status: Vegetation treatments were conducted on this reservoir in 2001 for the first time since 1997. Heavy waterhyacinth infestations were impacting the use of USACE and TPWD parks and boating access sites. From July through September, a total of 261 acres of waterhyacinth was treated by TPWD-IF crews. Herbicide and surfactant (Weedar 64® and Aqua-King Plus®) were provided by USACE. These treatments successfully improved public access to all areas of the reservoir.

Water level drawdown during winter months has been an important tool in waterhyacinth management on Lake B.A. Steinhagen and this method of control has been more effective here than on any other infestation in the state. Since 1993-1994, drawdowns to 76 ft msl (5 ft below conservation pool) have been planned and implemented every other year. With an average depth of only 6 ft, drawdowns of this magnitude expose most of the upper lake to desiccation. Depending on the severity of the winter, some years have seen plant mortality of over 95% (Helton and Hartmann 1995). However, the drawdowns have not been near as effective in mild winter years and, with no herbicide treatment, waterhyacinth continues to expand. Based on TPWD surveys in June 2001, waterhyacinth coverage was estimated at 2,750 acres. To help support treatment activities, and for other USACE maintenance operations, the lake level was again lowered in September 2001 and held there through the winter months. This drawdown was longer than those in previous years and may have been more effective in causing mortality than previous attempts. Spring 2002 surveys will monitor effectiveness of the drawdown at eliminating waterhyacinth.

Although not evaluated, the repeated drawdowns appear to have impacted hydrilla and common salvinia on Lake B.A. Steinhagen. TPWD surveys indicate a gradual reduction in coverage of hydrilla from a high of almost 3,000 acres in the mid-1990's to just 425 acres in 2001. No treatments on hydrilla have been performed since 1997. The common salvinia infestation is the largest in Texas, but has stabilized at 250-325 acres. The plant is confined to backwaters and is mostly found in large mats of waterhyacinth. No spraying was done on common salvinia in 2001.

Alligatorweed is widespread in shallow areas and along shorelines, but is capably controlled by the introduced biocontrol insect, the alligatorweed flea beetle (*Agasicles hygrophila*, Selman and Vogt).

### Lake Fork

Controlling Authority: Sabine River Authority (SRA). Contact: David Parsons, phone 903-878-2262, e-mail [dparsons@sra.dst.tx.us](mailto:dparsons@sra.dst.tx.us). Prohibited plants: waterhyacinth, hydrilla.

Status: Waterhyacinth was first discovered in Lake Fork during the summer of 1996. The infestation was confined to a single location, the Glade Creek arm. Herbicide treatments were conducted that year by TPWD-IF personnel; 29 acres of waterhyacinth were treated. This action controlled the plant population for several years. However, surveys reported a more widespread plant distribution late in 2000. Spring 2001 surveys by TPWD-IF and SRA staffs confirmed the presence of waterhyacinth in most of the coves within the Caney Creek arm of the lake, with a few scattered plants in Little Caney Creek and in coves of the main Lake Fork Creek arm. The most problematic areas were again in the Glade Creek arm and other coves close by. Treatments were conducted in June 2001 by TPWD-IF personnel using Rodeo® (glyphosate) at 0.75% v/v and the surfactant, Red River 90®, at .25% v/v. Lake water was used in the mixing. All areas of the lake where waterhyacinth could be found, and accessed by boat mounted spray equipment, were treated. A total of 47.6 acres of waterhyacinth were treated. Observations during summer surveys verified good efficacy.

Because of the high fertility of the watershed, waterhyacinth could become a serious problem on Lake Fork if unmanaged. Spring surveys should be conducted annually, and if waterhyacinth is found, the necessary treatments should be implemented.

Hydrilla was monitored, but no treatments were done. Surveys have confirmed a decline in hydrilla, the cause for which is unknown.

### Armand Bayou Coastal Preserve

Controlling Authority: TPWD (Coastal Preserves). Contact: Mark Kramer, phone 281-474-2551, e-mail [mkramer@eul.net](mailto:mkramer@eul.net). Prohibited plant: waterhyacinth.

Status: Armand Bayou Coastal Preserve is located on the western shore of Galveston Bay and is one of only four Coastal Preserves in Texas. The preserve is considered an environmentally sensitive area with a wide diversity of native vegetation, both terrestrial and aquatic. The preserve staff first reported an increase in waterhyacinth in 1996. However, since that time, winter freezes and the flushing action on the bayou, created by high rainfall events, managed to keep the plant under control. In 2001, an increase in abundance of the plant was again observed. Aquatic herbicide applications were conducted by TPWD-IF personnel in July 2001. A total of 38 acres of waterhyacinth were sprayed with Weedar 64® (2,4-D). Subsequent surveys confirmed the effectiveness of treatments. A few plants were inaccessible to boat spray crews but, overall, waterhyacinth was reduced to non-problematic status.

### **Tyler Nature Center Pond**

Controlling Authority: TPWD-IF. Contact: Richard Ott, phone 903-566-2161, e-mail [richard.ott@tpwd.state.tx.us](mailto:richard.ott@tpwd.state.tx.us). Prohibited plant: hydrilla.

Status: This 2-acre lake, located on TPWD Management and Research Station property in Tyler, is used for environmental education and youth fishing events. Hydrilla was discovered in the lake and surveys indicated that the plant, in a short time, would create serious conflicts with existing programs. In October 2001, the entire pond was treated with a very low rate (1.0 ppm) of Aquathol G® (endothall) and Komeen® (chelated copper) at 0.5 ppm, used in combination. The low rate of the products used was designed to remove the existing hydrilla, retard tuber formation and thus impede the next year's growth, while minimizing damage to native vegetation. Surveys in November and December found a noticeable decline in hydrilla with little apparent damage to native plants.

### **Purtis Creek State Park Reservoir**

Controlling Authority: TPWD. Contact: Richard Ott, phone 903-566-2161, e-mail [richard.ott@tpwd.state.tx.us](mailto:richard.ott@tpwd.state.tx.us). Prohibited plant: hydrilla.

Status: Purtis Creek State Park Reservoir is a 355-acre impoundment owned by TPWD and specifically designed for fishing. Hydrilla infestations have historically restricted access to the Purtis Creek State Park swimming area, boat ramp, bank fishing areas, and fishing piers. Affected areas were treated with Sonar SRP® at a rate of 40 lb/acre, providing a prolonged concentration of the active ingredient fluridone at approximately 18-20 ppb. A total of 20.8 acres were treated using 832 lbs of chemical supplied by Purtis Creek State Park. Subsequent surveys indicated a high level of control which is expected to last for 2 years.

### **Rio Grande**

Controlling Authority: Texas Commission on Environmental Quality. Contact: Carlos Rubinstein, Region 15 Director and Rio Grande Watermaster, phone 956-430-6018, e-mail [CRubinst@tceq.state.tx.us](mailto:CRubinst@tceq.state.tx.us). Prohibited plants: Eurasian watermilfoil, hydrilla, waterhyacinth.

Status: Waterhyacinth continued to be a significant problem in the Rio Grande. Both waterhyacinth and hydrilla infestations were apparently contributing to the inhibition of downstream flow in the river, and the consequent closure of the mouth. Herbicides were still not approved for use in the main channel, and grass carp were still not permitted. However, mechanical removal was approved by both the U.S. and Mexico. Funds (\$50,000) for mechanical removal of waterhyacinth in the lower reaches of the river were obtained from the Texas Natural Resources Conservation Commission. During July



2001, 193 acres of waterhyacinth were removed using a mechanical shredder. Water flow visibly increased the same day in areas where waterhyacinth was shredded. Future plans include the stocking of over 500,000 hydrilla flies in the river during 2002 to help suppress hydrilla expansion.

Eurasian watermilfoil, although present in the Rio Grande in 2001, had not yet reached problematic proportions in the areas surveyed.

### **Lake Austin**

Controlling Authorities: Lower Colorado River Authority (LCRA) and the City of Austin (The City). Contacts: John Wedig (LCRA), phone 512-473-3307, e-mail [john.wedig@lcra.org](mailto:john.wedig@lcra.org), Mary Gilroy (The City), phone 512-974-2717, e-mail [mary.gilroy@ci.austin.tx.us](mailto:mary.gilroy@ci.austin.tx.us). Prohibited plants: Eurasian watermilfoil, hydrilla.

Status: In 1999, 22.72 acres of hydrilla were discovered in Lake Austin. Routine drawdowns to help control the Eurasian watermilfoil population were not conducted in 2000. As a result, the hydrilla population expanded to 152 acres by May 2000, reaching a total of 196.41 acres in July 2000. Although still present, concerns over Eurasian watermilfoil were replaced by the rapid expansion of hydrilla. As a result, no treatments targeting Eurasian watermilfoil were conducted on Lake Austin in 2001. The inability of The City of Austin, LCRA, and TPWD to agree on the use of mechanical harvesters, herbicides, or triploid grass carp prompted a subsequent drawdown during January 2001. However, hydrilla continued its expansion and coverage increased to 221.18 acres by May 2001 and 244.24 acres by July 2001. Planning began for a radio-tagging study conducted by Southwest Texas State University to determine the efficacy of triploid grass carp use in the lake. Additional plans were made to introduce over 750,000 hydrilla flies in Lake Austin during 2002.

### **SUMMARY**

Because of climate and latitude, waterhyacinth and hydrilla have thrived in Texas. Dispersal mechanisms, like boat trailers, have invariably contributed to spread between sites. Although the history of giant salvinia in the state is recent, this prohibited plant species may eventually re-define what is meant by "problematic". Past treatment and monitoring data have shown that in most years some infestations of waterhyacinth and hydrilla will require intensive management efforts in waters where they are present (TPWD, unpublished data). All known infestations of giant salvinia, whether private or public and not used for research purposes, have been treated with resolve for eradication. The release of the salvinia weevil in Texas in October 2001 adds a potential long-term management technique to control efforts. New TPWD directives emphasize the need to eradicate new infestations of waterhyacinth, hydrilla and giant salvinia as they are identified.

**PRIORITIES FOR 2002**

- 1a Any state-controlled water (state park, WMA) with giant salvinia.
- 1a Other public waters with giant salvinia.
- 1a Any new infestation of giant salvinia in private waters.
- 1b Any state-controlled water with a noxious vegetation control problem (primarily waterhyacinth or hydrilla).
- 1b Other public waters with noxious vegetation problems.
- 2a Other public waters with native vegetation problems.
- 2b Technical assistance to private water owners for vegetation management procedures other than for giant salvinia.

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Table 1. Harmful or potentially harmful exotic aquatic plants in Texas, 2001.

Scientific name	Common name
<i>Spirodela oligorhiza</i> *	giant duckweed
<i>Eichhornia crassipes</i> *	waterhyacinth
<i>Hydrilla verticillata</i> *	hydrilla
<i>Myriophyllum spicatum</i> *	Eurasian watermilfoil
<i>Eichhornia azurea</i> *	rooted waterhyacinth
<i>Panicum repens</i> *	torpedograss
<i>Pistia stratiotes</i> *	waterlettuce
<i>Lagarosiphon major</i>	lagarosiphon
<i>Alternanthera philoxeroides</i> *	alligatorweed
<i>Melaleuca quinquenervia</i>	paperbark
<i>Ipomoea aquatica</i>	water spinach
<i>Salvinia minima</i> **	common salvinia
<i>Salvinia molesta</i> **	giant salvinia

\* Plants identified in Texas.

\*\* Only two species of the genus *Salvinia* have been identified in Texas, but all are prohibited.

Table 2. Summary of information regarding aquatic herbicides and surfactants used to treat prohibited plant species in Texas.

Target plant	Herbicide (a.i.)/ surfactant	Rate (ppm or ppb)
waterhyacinth	Rodeo® (glyphosate)/ Aqua-King Plus® non-ionic surfactant	3 qt/acre (1ppm) 0.25-2.0 qt/acre
waterhyacinth	Weedar 64® (2,4-D Amine)/ Aqua-King Plus® non-ionic surfactant	1 gal/acre (1.7 ppm) 0.25-2.0 qt/acre
hydrilla	Aquathol Super K® (endothall granular)	8.8 - 17.6 lb/acre-ft (2-4 ppm)
hydrilla	Aquathol K® (endothall liquid)	1.3 - 2.6 gal/acre-ft (2-4 ppm)
hydrilla	Sonar®SRP (fluridone)	32-80 lb/acre (60-150 ppb)
hydrilla	Sonar® A.S, (fluridone liquid)	8-32 oz/acre* (10-150 ppb)
giant salvinia	Rodeo® (glyphosate)/ Aqua-King Plus® non-ionic surfactant Thoroughbred® organo-silicone surfactant	1-2 gal/acre (1.3-2.6 ppm) 1-2 qt/acre 12 oz/acre
giant salvinia	Reward®(diquat)/ Aqua-King Plus® non-ionic surfactant Thoroughbred® organo-silicone surfactant	3 qt/acre (0.7 ppm) 1-2 qt/acre 12 oz/acre
giant salvinia**	Sonar® A.S. (fluridone liquid)	1 qt /acre (80 ppb)

\* Variables dictate optimum use rates (passive or flow-through).

\*\* Preferred use for salvinia is in small ponds or lakes where total lake treatment is possible.

Figure 1. Waterhyacinth distribution in Texas, 2001.

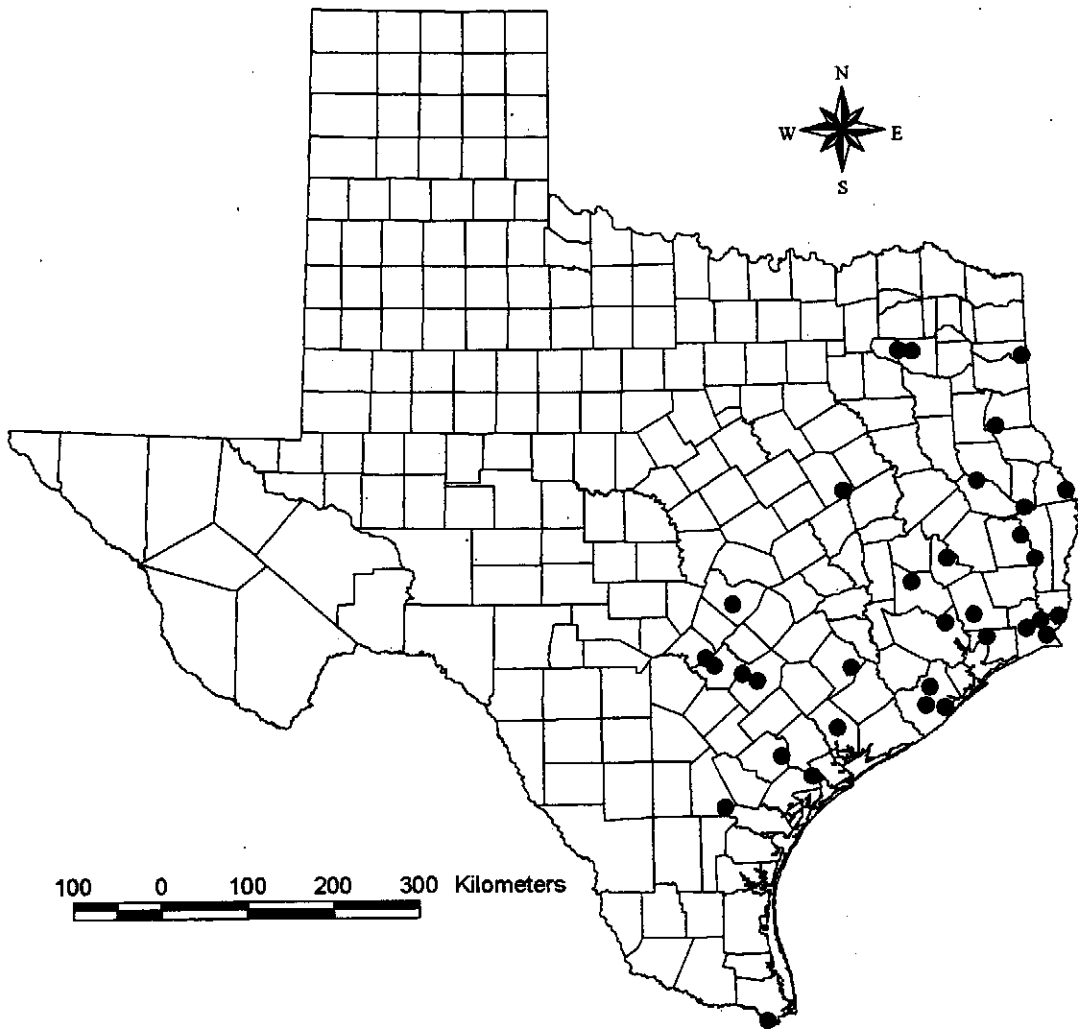


Figure 2. Hydrilla distribution in Texas, 2001.

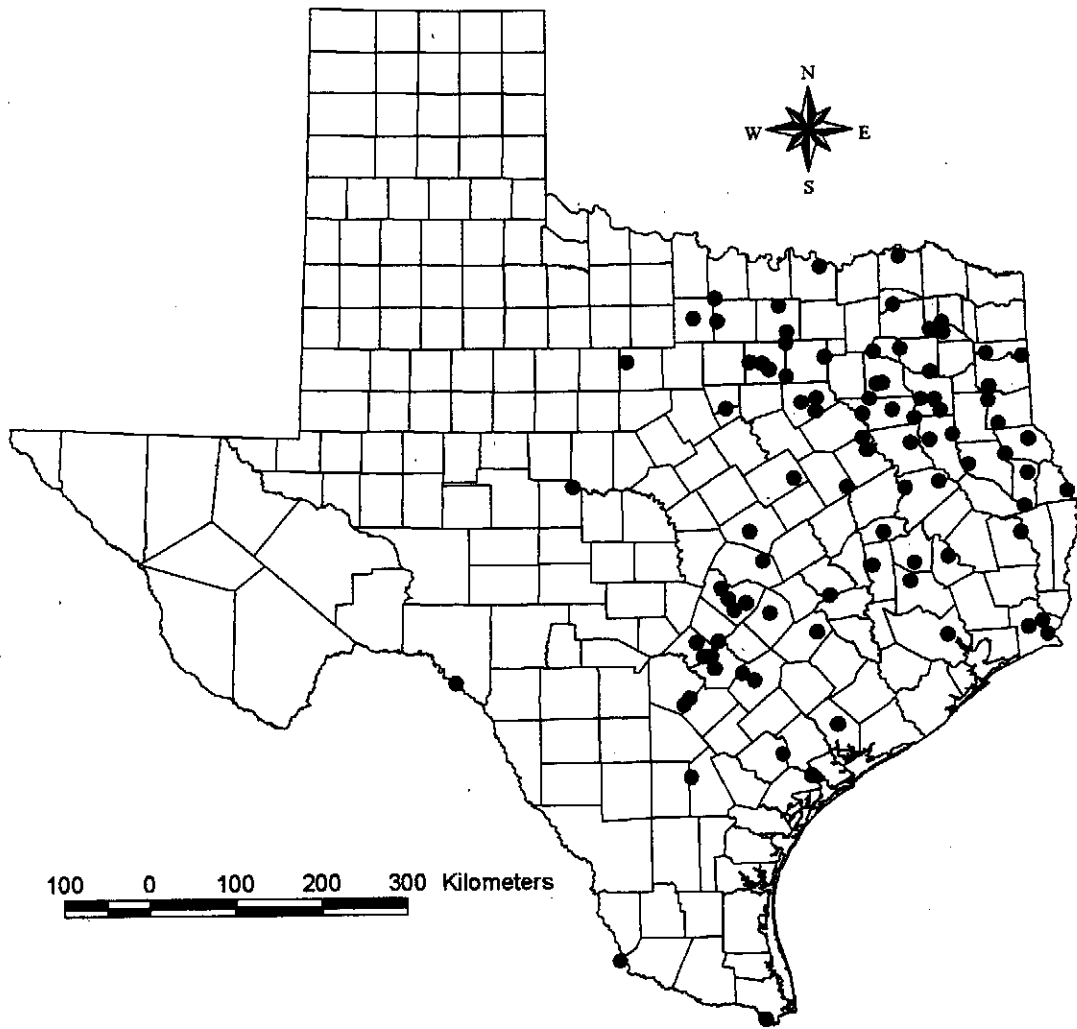


Figure 3. Giant salvinia distribution in Texas, 2001.

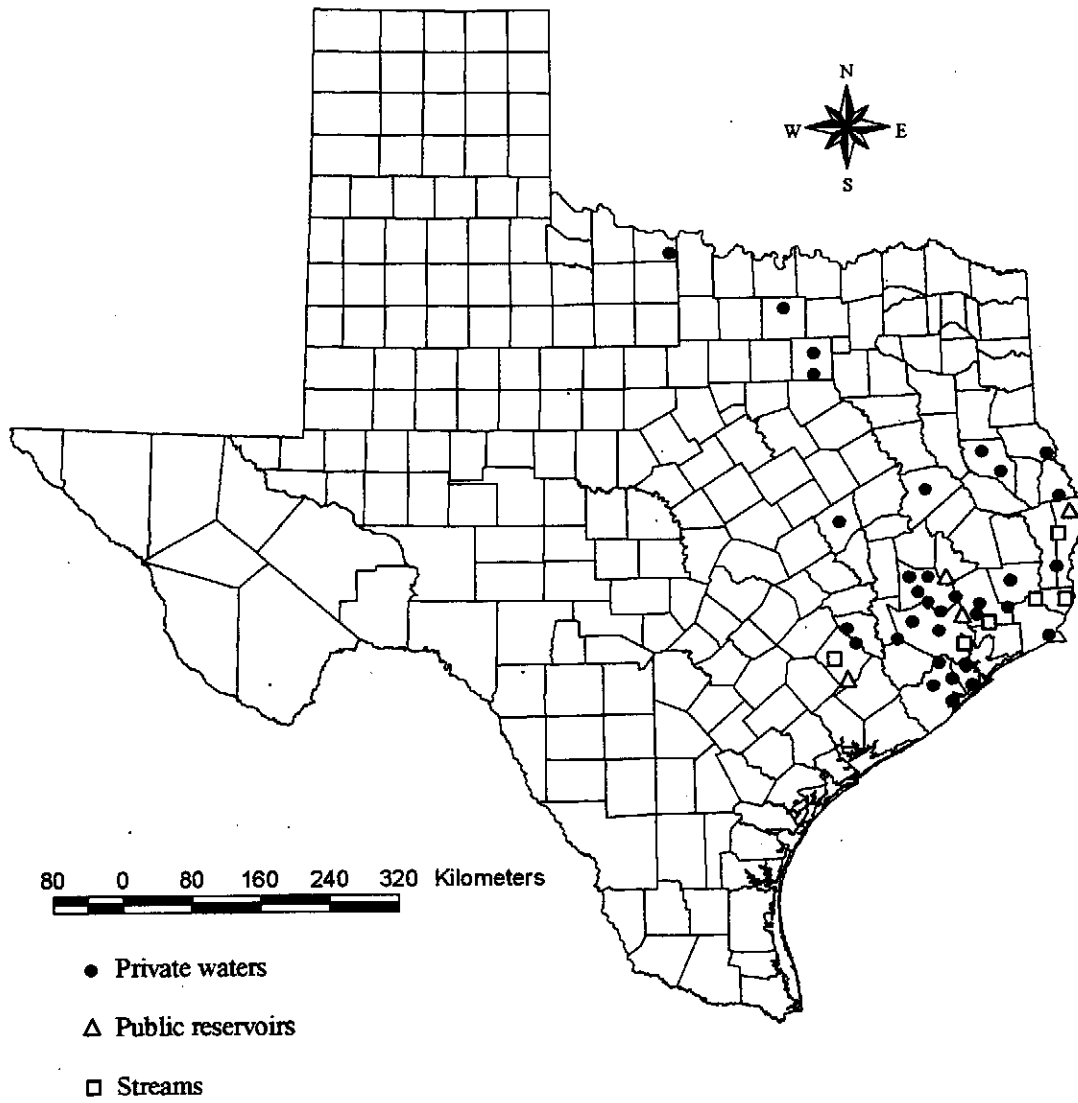
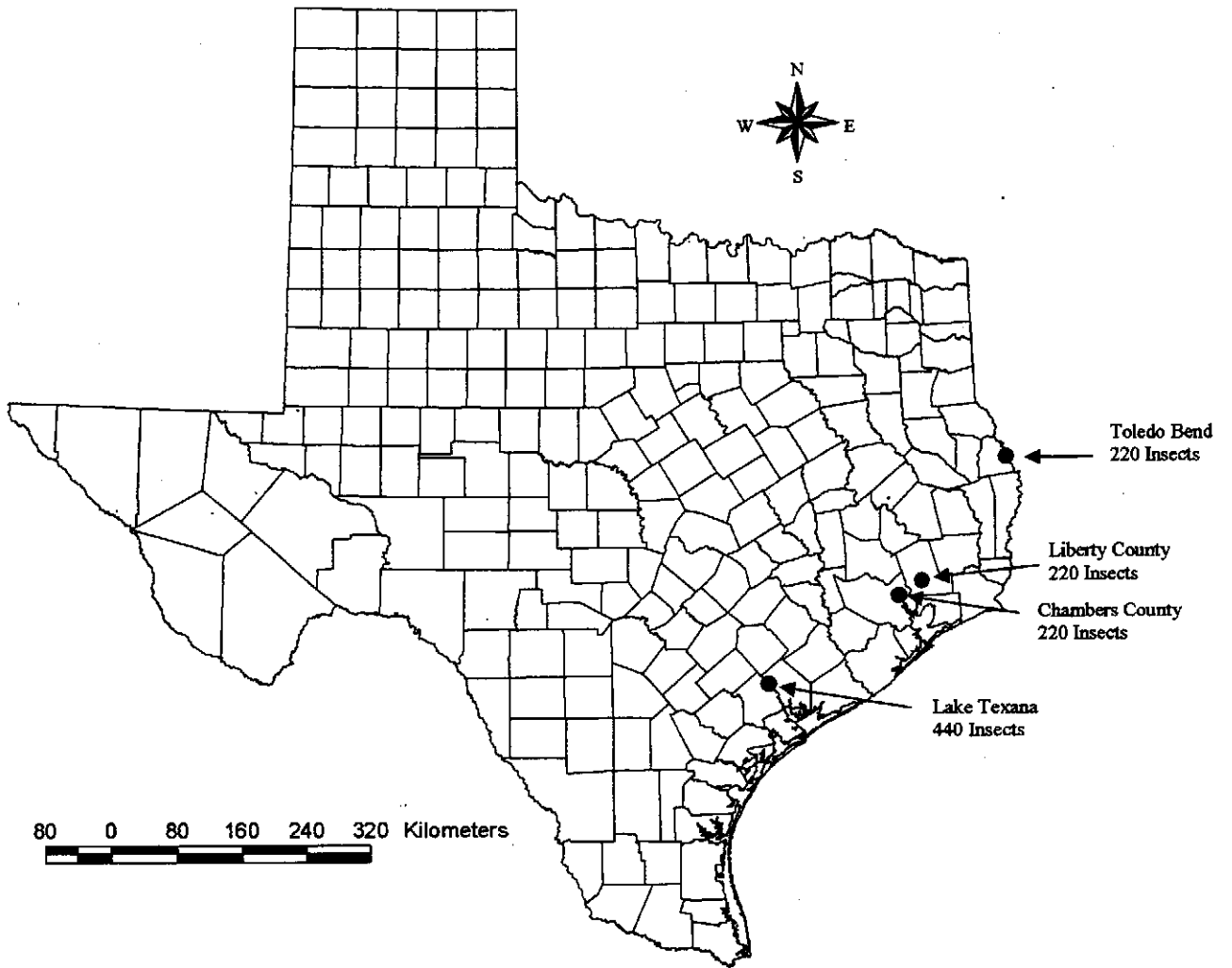




Figure 4. Australian salvinia weevil release locations in Texas, October, 2001.



Appendix I. Statewide occurrence of non-native (listed) aquatic vegetation in Texas, 2001. Information represents only what was reported by district management crews during routine habitat surveys and vegetation was not treated unless so noted.

Water body	Size (acres)	Waterbody code	Listed species	Acres infested
Armand Bayou	300	1945	waterhyacinth	38*
Bardwell	3,570	0041	hydrilla	0.5
B.A. Steinhagen	16,830	0694	common salvinia	325
			hydrilla	425
			waterhyacinth	261*
Bellwood	170	0064	hydrilla	5
Bob Sandlin	9,460	0646	hydrilla	20
			Eurasian	.
Caddo	25,400	0128	watermilfoil	90
			hydrilla	150
			waterhyacinth	350*
Conroe	21,000	0192	alligatorweed	2
			giant salvinia	0.25*
			hydrilla	3
			waterhyacinth	10
Fork	27,690	0433	hydrilla	198
			waterhyacinth	50*
Houston	12,240	0368	waterhyacinth	1,500*
Jacksonville	1,352	0389	hydrilla	75
Limestone	13,680	0447	waterhyacinth	20
Livingston	90,000	0451	hydrilla	<10
			waterhyacinth	445*
Palestine	23,433	0566	alligatorweed	469
Purtis Creek State Park	354	0593	hydrilla	20.8*
Quitman	814	0596	waterhyacinth	5
Raven	239	0599	alligatorweed	6
			hydrilla	17.5*
			waterhyacinth	<0.1
Sam Rayburn	114,500	0640	common salvinia	5
			hydrilla	8,531
			waterhyacinth	10
Sheldon	1,200	0667	waterhyacinth	<5*
Stillhouse Hollow	6,430	0696	hydrilla	25

## Appendix I. Continued.

Water body	Size (acres)	Waterbody code	Listed species	Acres infested
Toledo Bend	185,000	0734	giant salvinia	10*
			hydrilla	9,830
			waterhyacinth	375
			Eurasian	
			watermilfoil	3,800
			torpedo grass	675
Tyler Nature Center	2	1831	hydrilla	0.5*
Waxahachie	650	0361	hydrilla	6.5

\* Infestation treated during 2001. The area actually treated may be different than the number appearing in the column.

