

Hydrilla: a Case Study
**The State of California's Noxious
Weed Eradication Programs**

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The California Department of Food and Agriculture has three programs that involve weed control, all within the Division of Plant Industry, Integrated Pest Control Branch. These are the Biological Control, Weed and Vertebrate, and the Hydrilla Programs.

Biological Control Program

The Biological Control Program primarily involves weeds that are generally widespread and not amenable to eradication. Some biocontrol agents have been released on weeds that are considered to be eradication projects. Agent releases on these weeds are done primarily due to the size of an infestation, difficulty of terrain, or their occurrence in sensitive areas that preclude the use of pesticides.

Weed and Vertebrate Program

The Weed and Vertebrate Program has twenty-seven weeds currently under eradication, control or containment. Eight district biologists and support staff work closely with County Agricultural Commissioners' personnel to detect new infestations, provide training on identification and control, and conduct control and eradication measures.

The primary objective of the weed program is the early detection and control or eradication of certain noxious weeds given an "A" rating under "Pest Ratings of Noxious Weed Species and Noxious Weed Seed", published by the State of California, Department of Food and Agriculture, Division of Plant Industry. The Food and Agricultural Code of California (Div. 4, Chap. 1, Art. 1, Sec. 5004) defines a noxious weed as "any species of plant which is, or is liable to be detrimental or destructive and difficult to control or eradicate." Noxious weeds are rated as either "A", "B" or "C" in California, under the following descriptions based on distribution within the state.

- A Eradication, quarantine, or other holding action at the state or county level. Quarantine interceptions to be rejected or treated at any point in the state.
- B Intensive control or eradication, where feasible, at the county level. Quarantine or other holding action at the discretion of the County Agricultural Commissioner.
- C Control, or eradication, as local conditions warrant, at the county level. Quarantine or other holding action at the discretion of the County Agricultural Commissioner. The noxious weed program is a cooperative effort with the County Agricultural Commissioners.

The twenty-seven A rated weeds currently under eradication, control or containment within the state are:

1. Bidly bidly - *Acaena anserinifolia*, *A. novaezelandiae* and *A. pallida*
2. Punagrass - *Achnatherum brachychaetum*
3. Camelthorn - *Alhagi maurorum*
4. Alligatorweed - *Alternanthera philoxeroides*
5. Fertile capeweed - *Arctotheca calendula*
6. Plumeless thistle - *Carduus acanthoides*
7. Musk thistle - *Carduus nutans*
8. Diffuse knapweed - *Centaurea diffusa*

9. Iberian starthistle - *Centaurea iberica*
10. Spotted knapweed - *Centaurea maculosa*
11. Squarrose knapweed - *Centaurea squarrosa*
12. Skeletonweed - *Chondrilla juncea*
13. Yellowspine thistle - *Cirsium ochrocentrum*
14. Wavyleaf thistle - *Cirsium undulatum*
15. Bearded creeper - *Crupina vulgaris*
16. Dudaim melon - *Cucumis melo* var. *dudaim*
17. Leafy spurge - *Euphorbia esula*
18. Halogeton - *Halogeton glomeratus*
19. Dalmatian toadflax - *Linaria genistifolia* spp. *dalmatica*
20. Scotch thistle *Onopordum acanthium*
21. Illyrian thistle *Onopordum illyricum*
22. Taurian thistle *Onopordum tauricum*
23. Harmel - *Peganum harmala*
24. Smooth groundcherry - *Physalis virginiana* var. *sonorae*
25. Wormleaf salsola - *Salsola vermiculata*
26. Golden thistle - *Scolymus hispanicus*
27. Perennial sowthistle - *Sonchus arvensis*

Thirteen other weeds have been declared eradicated from California. These are: whitestem distaff thistle (*Carthamus leucocaulos*), giant dodder (*Cuscuta reflexa*), serrate spurge (*Euphorbia serrata*), Russian salttree (*Halimodendron halodendron*), blueweed (*Helianthus ciliaris*), tanglehead (*Heteropogon contortus*), creeping mesquite (*Prosopis strombulifera*), heartleaf nightshade (*Solanum cardiophyllum*), Torrey's nightshade (*Solanum dimidiatum*), Austrian peaweed (*Sphaerophysa salsula*), wild marigold (*Tagetes minuta*), Syrian beancaper (*Zygophyllum fabago*), and meadowsage (*Salvia virgata*). Other weeds approaching eradication at the Statewide level include Camel thorn, dudaim melon, golden thistle, smooth groundcherry, Illyrian thistle and perennial sowthistle.

Hydrilla Program

Hydrilla (*Hydrilla verticillata* (L.f.) Caspary), is a noxious non-native submersed aquatic weed. Two different biotypes of this weed have been found in the United States, suggesting at least two separate introductions of this plant. The dioecious biotype of hydrilla was first identified in Florida in 1960, where it was believed to have been introduced in the 1950's. This infestation has since spread throughout the southeastern United States into Texas and California. The monoecious biotype was first detected in the Potomac River, near Washington D.C., in the 1980's and has since spread south into several states and has also been found in Washington and California.

The dioecious biotype of hydrilla was first found in California in 1976, in a thirty-acre lake near Marysville, Yuba County. Since then, hydrilla has been found in seventeen counties in California. In 1993, the monoecious biotype was found for the first time in California, in Tulare County, at an aquatic nursery. A second infestation of monoecious hydrilla was found in Clear Lake, Lake County, in 1994. These are the only two infestations of this biotype in California.

Hydrilla is able to form dense mats that can fill an entire water column with biomass, impeding water deliveries in irrigation systems, affecting recreational uses and displacing native vegetation. The establishment of this weed in many water bodies in Florida costs millions of dollars a year to manage this weed.

Various Federal, state and local agencies, aware of the potential negative impacts of hydrilla, contribute monies, manpower or other support to the eradication program. Contributing state agencies include the Department of Boating and Waterways, Department of Water Resources and the Department of Fish and Game. Federal agencies include the Bureau of Reclamation, Bureau of Land Management, United States Army Corps of Engineers and the United States Department of Agriculture - Animal Plant Health Inspection Service and

Agricultural Research Service. Numerous local and county agencies are also involved with the program, including the Yolo County Flood Control and Water Conservation District, Imperial Irrigation District and Lake County Public Works Department. When an infestation of hydrilla is detected the local lead agency is the County Agricultural Commissioner. The California Department of Food and Agriculture, Integrated Pest Control Branch is responsible for administering and conducting the statewide eradication program.

Of the seventeen counties in California that have had infestations of hydrilla, eradication has been achieved in nine of them; Los Angeles, Monterey, Riverside, San Bernardino, San Francisco, Santa Barbara, Sonoma, Sutter and San Diego (see attached table).

Detection and Training Activities

Eight district biologists working from five district offices, target pet shops, aquatic nurseries and water bodies with high recreational use for periodic detection surveys for hydrilla. Biologists from the local County Agricultural Commissioners Office often assist in the in these surveys or conduct their own surveys of pet shops to look for a number of prohibited species, including hydrilla.

In addition to conducting detection surveys, district biologists provide training on identification of hydrilla to County Agricultural Commissioners, state and Federal agencies and to other interested groups such as bass clubs. Informational brochures and pamphlets are also distributed to many pet shops, bait shops and marinas.

New finds

In 1996, three new infestations and one recurrence of hydrilla were detected following two years with no detections. The first new infestation was a golf course pond and two upstream ponds, adjacent to the Sacramento River, near Redding, Shasta County. The second infestation was a four-acre pond on Bear Creek and a few scattered plants in the creek, near Wallace, Calaveras County. The third new infestation was found in Tulare County, near Springville, at a private recreational fishing facility. This involved six ponds with a total surface area of approximately twenty acres. Hydrilla also recurred in a previously infested pond near Mountain Ranch, Calaveras County. This pond had not had visible hydrilla for two years. Plants apparently resprouted from dormant tubers.

Program changes

In 1996, Sonar, a systemic aquatic herbicide, was registered for use in California and applied to the infestations in Shasta, Yuba, Lake, Calaveras and Tulare Counties. Also, new Global Positioning System (GPS) and Geographical Information System (GIS) were introduced and utilized this year. The systems allow for accurately marking plant locations, measuring surface areas of water bodies and producing quick and accurate maps.

Current Hydrilla Projects

Imperial County

Hydrilla was first detected in the All American Canal, which supplies water to the Imperial Irrigation District (1113), in June 1977. Delimiting surveys at that time found hydrilla in the western portion of the IID system, encompassing 385 miles of canal. By 1987, hydrilla had spread to the middle third of the IID system and infested approximately 600 miles of canal, 32 ponds or reservoirs (161.4 acres) and 79 privately owned delivery ditches. This occurred despite an intensive control program. Hydrilla was also detected in four canals in the Mexicali Valley Mexico, approximately 10 miles south of the All American Canal. In 1988, CDFA, IID, U.S. Department of Agriculture-Animal Plant Health Inspection Service (USDAAPHIS) and the Imperial County Agricultural Commissioner (ICAQ) developed and implemented an action plan for hydrilla eradication in the Imperial and Mexicali Valleys. The objective of this program was the removal of hydrilla from all aquatic sites within Imperial County and Mexicali Valley. The lead agency for hydrilla eradication in Mexico is USDA-APHIS, Latin American Region.

The hydrilla-infested Imperial Valley water system is a gravity-flow network of supply canals, lateral canals, reservoirs, farm ditches, ponds, drains, and the New and Alamo Rivers. Triploid grass carp (TGQ) were stocked throughout most of the system to eliminate all aboveground biomass and prevent new tuber formation. In cooperation with the California Department of Fish and Game, TGC are stocked on a yearly basis, maintaining a stocking rate of 100 fish per mile for flowing systems and 100 fish per acre for ponds and reservoirs. In conjunction with the extensive use of TGC, herbicides, mechanical (mudpumps, draglines and backhoes), cultural (drawdowns prior to treatment and excavation) and physical (roguing by hand and shovel) methods have been utilized. Progress toward eradication has been excellent.

In 1996, project activities consisted of surveys of all water bodies within the system, removal of hydrilla when found and stocking of TGC. CDFA staff detected hydrilla in four IID canals and five drains. Plant infestations found in IID canals totaled 268 feet with 3.1 downstream miles, compared to 15 feet of plants and 6.5 downstream miles in 1995. Eight farm-side canal locations and two small ponds (each less than one acre) were also found infested, compared to 21 canals and one pond in 1995. Farm canals are on private property which receive IID water. These infestations were cleaned using the following methods: hand shovels, mudpump, backhoe or stocking TGC.

The IID Biocontrol Section stocked 16,479 TGC into canals, drains, reservoirs and ponds in the Imperial Valley. In addition, the IID Biocontrol Section supplied the Mexico Hydrilla Eradication Program in the Mexicali Valley with 1,500 TGC.

Table 1. Hydrilla infested sites 1990-1996:

Year	IID			Farm		
	Canal	Spills	Drains	Canal	Ponds	
1990	142	1	N/a	92		21
1991	99	2	N/a	79		11
1992	106	9	N/a	86		5
1993	52	6	5	46		1
1994	27	6	6	28		1
1995	3	2	5	21		1
1996	4	0	5	8		2

n/a = data not available

In 1994, hydrilla was found in the Orange Canal, a previously uninfested portion of the HD system. Only three plants were found. The early detection of this infestation, coupled with the rapid response of plant removal has apparently eradicated this infestation before establishment. No plants were found at this location during surveys in 1995 and 1996.

Calaveras County

Two separate infestations of hydrilla exist in Calaveras County. The first infestation was detected in May of 1988, consisting of seven farm ponds along the Bear Creek drainage, between the towns of Burson and Wallace. Bear Creek enters the Sacramento-San Joaquin Delta approximately 26 miles downstream from the lowest pond on the creek.

Chemical applications, physical excavations of bottom soils and treatment with a soil fumigant in some of the ponds has reduced this infestation to three ponds that have had only a few plants each in the last few years. However, in June 1996, a new four-acre pond, approximately one mile downstream from the lowest previously known infested pond, was found to have hydrilla. Plants were scattered, at a very low density, leading to the assumption that the infestation was probably no more than two years old. High water flows in early 1995 may have flushed plant material from an upstream location. A few plants were also found in the creek between the ponds. Most of the plants in the pond and creek were physically removed, then the areas treated with Komeen, a copper based aquatic contact herbicide, followed by applications of Sonar, a systemic aquatic herbicide. Excellent control was achieved.

The other three ponds in the Bear Creek drainage had only a few plants. These were removed and the ponds treated with either Komeen or Sonar or both materials.

The other infestation in this county is in two ponds near Mountain Ranch. These ponds were excavated and fumigated, one in 1991, the other in 1992. Hydrilla reappeared in 1993. All plants were removed physically or with a suction dredge. No plants were found during surveys in 1994 and 1995. In 1996, plants reappeared in the larger pond, were treated with Sonar.

Yuba County

This six-acre pond was found to be infested with hydrilla in August 1990. Various chemical treatments have occurred annually since that time. In addition, plant removal by diver-assisted dredging has been used on a limited basis. In July 1996, only one plant was found during a survey. The plant was removed and the entire pond treated three times with Sonar during the growing season. No additional plants were found following the treatments.

Shasta County

The Shasta County infestation was first found in 1985, when hydrilla was detected in seven ponds located next to the Sacramento River. An additional four ponds were found infested in 1986. Due to the close proximity to the river and the potential threat to California water systems, the Governor of California issued a Proclamation of Emergency to facilitate eradication efforts. Four of the ponds were chemically treated and filled with soil. The remaining seven ponds received herbicide treatments. By 1994, only one of the original eleven ponds contained a few scattered plants. No plants were found in this pond in 1996, but Sonar was applied twice to control plants that may have been missed during surveys.

In October 1994, two new ponds (three and ten acres) were found to be infested with hydrilla at Anderson River Park, near the City of Anderson. Both ponds were treated in 1994 and 1995 with Komeen. In 1996, both ponds were treated with Sonar. Plants have not been found in the 3-acre pond since 1994.

In July 1996, a new infestation was found at Riverview Golf Course near Redding. This infestation consisted of three ponds that were all connected by water flow. The golf course pond was actually two ponds connected by a narrow channel with a total area of approximately one acre. Upstream from the golf course pond is a six-acre pond and further upstream is a thirty-acre pond. The 30-acre pond only had hydrilla in the lower 15 acres and that was lightly scattered single plants or small clumps. The 6-acre pond was moderately to heavily infested throughout, and the golf course ponds were heavily infested. The initial introduction of hydrilla was most likely made to the 6-acre pond or the golf course pond.

Divers using a suction dredge removed most of the plants from the 30-acre pond. However, several areas had large cobbles, making the suction equipment ineffective. All ponds were initially treated with Komeen. The 6-acre pond and the golf course ponds were subsequently treated with Sonar. Since the 30-acre pond was an irrigation source on the golf course, Sonar was not applied due to possible damage to greens. The golf course has since developed an alternate water source, so Sonar will be applied to the 30-acre pond in 1997.

Staff in a California Highway Patrol helicopter, equipped with GPS, was used to locate ponds. A total of 56 ponds were found by this manner and later inspected. No new infestations were detected.

Shasta County Mosquito Abatement personnel were given training on hydrilla identification and how to submit samples. This was done in the hopes that any other infestations of hydrilla could be detected earlier and eradicated more easily. Abatement personnel submitted over thirty plant samples from water bodies inspected for mosquito larva. None were positive for hydrilla.

Project personnel survey 30 ponds within the eradication area; 42 outside the eradication area and the Sacramento River from the Rodeo Grounds to Butte City, a distance of 47 miles.

Madera/Mariposa Counties

In June 1989, hydrilla was detected in Eastman Lake by CDFA and Madera County Agricultural Department biologists conducting a scheduled detection survey of aquatic sites in the area. Scattered patches of hydrilla were found in the northern section of the lake and along the eastern and southeastern shoreline (100

acres). An extensive delimiting survey of all known aquatic sites in the area determined that hydrilla was established in the Chowchilla River and in the West Fork of the Chowchilla River. Approximately 25 miles of river were infested with various amounts of hydrilla, ranging from single plants to dense patches.

An intensive eradication program, initiated in 1989, has drastically reduced the hydrilla infestation. When the infestation was found in Eastman Lake, the lake level was reduced to minimum pool, exposing 10 acres of infested hydrosol. Once this area became dry, the soil was fumigated with metam-sodium. Regularly scheduled Komeen applications over the next three years has resulted in no plants detected since 1993. The quarantine of the lake has been lifted, except for a small area where the river enters the lake.

Treatments and dredging activities in the river reduced plant numbers to low enough numbers that physical removal of plants is the predominant control method utilized for eradication since 1993. Komeen applications are still made to areas where plants might visibly be missed. Suction dredging was conducted where high plant numbers were found and was productive in the past, however now, due to the low plant numbers found, only a few tubers are dredged.

Table 2. Number of plants removed 1993-1996:

1993	6,500
1994	2,100
1995	2,350 *
1996	650

*higher water year, dormant tubers previously above water line probably germinated

Tulare County

A small hydrilla infestation was found in June of 1993 at a water lily nursery near Visalia. This was the first time the monoecious hydrilla biotype had been found in California. Three small ponds totaling 0.6 acre were infested. A wholesale aquatic nursery in Maryland was responsible for shipping lilies infested with hydrilla.

The ponds were dried, rototilled, treated with Basamid (a granular soil fumigant), watered and then tarped. The pond owner has not opted to refill the ponds with water. Declaration of eradication will be made after the ponds are filled with water and inspected.

In October of 1996, hydrilla was found at a recreational fishing facility near Springville. A total of six ponds were infested. Ponds ranged in size from .02 acre to 10 acres, with a total surface acreage of 20 acres. Plant densities in the ponds ranged from very dense to just a few plants.

During discussions with the owner, it appears that hydrilla has been a significant problem since CDFA personnel had inspected the pond in 1989 and found no hydrilla. The introduction of hydrilla most likely occurred after, 1989.

Korneen was applied to the 10-acre pond that was the most heavily infested of the ponds, to collapse topgrowth and facilitate the later application of Sonar. Several of the other ponds were also treated with Komeen, to spot treat mats of hydrilla. Entire pond treatments with Korneen to heavily infested ponds were not conducted, as dissolved oxygen could be depleted as plants decayed, harming aquatic organisms. All ponds were treated with Sonar at low rates multiple times and complete control of topgrowth was achieved.

Sonar will be applied to all infested ponds next season, as soon as hydrilla reappears.

Lake County

Clear Lake is California's largest natural lake with approximately 43,000 surface acres. The lake is almost 20 miles long by 8 miles wide and has approximately 100 miles of shoreline. Located approximately 100 miles north of San Francisco and 100 miles northeast of Sacramento, Clear Lake is a relatively shallow lake, with an average depth of 18 to 22 feet. Water temperatures range from the 75F in the summer to the 45F in the winter. These conditions are ideal for hydrilla, especially the monoecious biotype that is found in Clear Lake. Except for a small infestation recently eradicated from Tulare County, only the dioecious biotype has been found in

California. Fishing is the most popular year-round activity in Clear Lake and the lake has often been described as the "Bass Capitol of the West." The lake is host to a number of bass tournaments throughout the year. There are also populations of catfish, crappie and bluegill in Clear Lake. Because of the angling popularity associated with Clear Lake, the probability of hydrilla spreading via movement of boats out of the lake to other bodies of water within and outside of California is extremely high.

Hydrilla was first found in Clear Lake on August 1, 1994 during a routine detection survey conducted by personnel from the California Department of Food and Agriculture and the Lake County Department of Agriculture. The result of the initial delimiting survey indicated 175 to 200 surface acres of infestation along the shoreline of the upper arm of the lake. Since then, additional surface acres of infestation have been detected. As of January 1, 1997, approximately 646 acres of Clear Lake were infested with hydrilla. The current level of infestation includes 12 new areas, totaling 84 acres. A substantial portion of the infestation is located in the upper arm of the lake. Six infested areas are located in the lower arms southeast of the Narrows.

Project Components

Survey and detection, treatment, public information and awareness, and monitoring are the major components of the eradication project. The following summarizes the efforts and results associated with these activities in the past year.

Survey Detection

Detection surveys outside the hydrilla eradication area were conducted by the Department's associate agricultural biologist assigned to the district that includes Clear Lake. Surveys were conducted in cooperation with county agricultural commissioners and other cooperating agencies. In Lake County, Indian Valley Reservoir (4,000 acres), Highland Spring Reservoir (80 acres), Lake Pillsbury (1,980 acres), Blue Lakes (150 acres) and Thurston Lake (300 acres) were surveyed. In addition, major reservoirs and lakes in Colusa, Napa, Mendocino, Yolo and Sonoma Counties were surveyed, because movement of boats from Clear Lake to these bodies of water is relatively common. No hydrilla was found during these detection surveys.

Surveys in the eradication area constitute a major portion (approximately 50%) of the staff's field activities. There are two major objectives associated with survey operations. The first objective is to ascertain and evaluate the status of hydrilla growth in the infested areas. This includes determining when plants emerge from vegetative propagules in the hydrosoll and monitoring the plant populations prior to and after treatment. The second objective involves surveillance of noninfested areas of Clear Lake. These surveys are essential because timely detection of incipient infestations in the eradication area is a critical element of the hydrilla eradication project.

Scheduled water surface and subsurface surveys conducted by project personnel in boats and from the shoreline are the primary methods for hydrilla detection. Surveys are conducted by visual inspection of the water to identify rooted plants or plant fragments floating on the surface. In addition, project staff use a multi-pronged grappling hook-type device to retrieve plants rooted in waters where depth and turbidity prevent visual inspections. Scuba divers conduct underwater surveys on a limited basis to establish more accurate information on plant density. As progress toward eradication continues, underwater surveillance activities will increase in order to quantify reduction in plant populations.

Initial surveys during the 1996 season concentrated on the infested area. The first plant was found May 1. The initial find of hydrilla in 1995 was on May 8. Both were found in locations designated as Area 5, adjacent to the Big Valley Rancheria.

Tuber germination and plant growth were relatively slow during May. However, as water temperatures increased in June, detection of hydrilla increased significantly. The littoral (shoreline) zones in the infested and noninfested areas were surveyed on a two to three week interval through December. Detection surveys in the deep sections of the lake were initiated in August and continued on a monthly basis until the end of November. No hydrilla has been detected in these areas.

During July, August, September and November, project personnel conducted detection surveys of Cache Creek, starting at the confluence with Bear Creek and ending approximately 28 miles downstream at the Capay Dam. Personnel from the Bureau of Land Management (BLM) conducted surveys of Cache Creek from the dam at Clear Lake to Bear Creek confluence. No hydrilla has been found in Cache Creek.

Treatment

Initially in 1996, surface and subsurface applications of Komeen™ were utilized to control hydrilla. Komeen™ is a copper-based aquatic herbicide registered for use by the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation. Treated water can be used for agricultural, recreational and domestic purposes.

Depending on water depth and amount of vegetation present at time of treatment, Komeen™ was applied at the rate of 12 or 15 gallons/acre. The first application was made on June 18, 1996. Infested areas were treated on a monthly basis. The last treatment was completed on November 6, 1996. All the infested areas were treated at least once with Komeen™ and 13 areas were treated only once. Only single treatments of Komeen™ were required there because no additional plants were found or because the infested area was treated with Sonar™ and no additional Komeen™ treatments were required.

In 1996, the California Department of Pesticide Regulation issued a registration for Sonar™. Sonar™ is a systematic aquatic herbicide registered by the U.S. Environmental Protection Agency and widely utilized to control hydrilla and other submersed aquatic weeds outside of California. See the *Action Plan for Eradication of Hydrilla in Lake County* for additional information.

The slow release pelleted (Sonar™ SRP) formulation of Sonar™ was applied in all locations except one. The liquid formulation (Sonar™ A.S.) was applied in Holiday Harbor, a relatively small enclosed area with little water exchange.

Sonar™ SRP was applied with a mechanical spreader mounted on the front of the boats. The spreaders are commonly used to apply fertilizers and seeds in terrestrial situations. Applications were generally made at a rate of 10 parts per billion (ppb) twice a week for seven weeks. In some cases, application rates were increased to 20 ppb followed by subsequent treatments at 10 ppb. Sonar™ was applied at 20 to 30 ppb on a weekly basis in four locations. All the treated areas received a total maximum concentration of 140 to 150 ppb in accordance with label direction.

Complete control of all submersed aquatic weeds was obtained in all areas treated with Sonar™. In a few locations, a single application of Komeen™ was made after two or three Sonar™ treatments. These Komeen™ treatments were required to kill those mature plants that showed some signs of Sonar™ activity (chlorosis) but had not slumped to the bottom. Generally, once an infested area had been treated with Sonar™ no further use of Komeen™ was required. The first Sonar™ application was made on July 17, 1996 and continued throughout the remainder of the growing season. The last application was made on November 21, 1996. Applications were made during this time of the growing season to control plant biomass and stop production of tubers and turions, a major requirement for hydrilla eradication. Tuber and turion production in hydrilla is a response to changing photoperiod. As daylight hours decrease, generally starting around August 1 to 15, production of vegetative propagules increases significantly. From September through November, plant growth slows down and hydrilla transfers its resources and energy into tuber production. Sonar™ interrupts this process effectively and stops production of propagules.

The use of Sonar™ in Clear Lake has significantly reduced the amount of Komeen™ applied to Clear Lake. In 1995, 47,580 gallons of Komeen™ were applied. In contrast, 20,126 gallons of Komeen™ were applied in 1996, a 57.7% reduction in use.

The situation in Soda Bay is an excellent example of the effectiveness of Sonar™ to control hydrilla and reduce the need for additional Komeen™ applications. On July 29, 1996 approximately 20 plants were found scattered around several boat docks in Soda Bay. This 40 acre area was heavily infested with other aquatic weeds including coontail and pondweeds. The entire bay was treated with Komeen™ on August 1, 1996 to control all the plants. This treatment was necessary to facilitate detection of hydrilla once regrowth occurred. On August 12, 1996 Sonar™ was applied to a 14.7 acre section of Soda Bay and continued until October 1,

1996. Complete control of hydrilla was attained and no additional treatments of Komeen™ were required. Furthermore, the remaining 25.3 acres of Soda Bay did not require treatment and regrowth of other aquatic plants resumed in the area not treated with Sonar™.

Public Information and Awareness

Public information and awareness about hydrilla is an essential component of the project. Since public access to the lake is not restricted, this aspect of the project must be maintained for the duration of the project.

Table 3. Status of Hydrilla In California 1996

COUNTY	YEAR	WATER BODY	SIZE	STATUS
Yuba	1976	Lake Ellis	30.8 acres	Eradicated
	1990	One pond	6.0 acres	Active
San Diego	1977	Lake Murray	160 acres	Eradicated
	1977	One pond	<1 acre	Eradicated
Imperial	1977	45 ponds/reservoirs	270 acres	Active
		Imp. Irr. System	600 miles	Active
Santa Barbara	1977	One pond	.12 acre	Eradicated
	1993	One pond	<.01 acre	Eradicated
Riverside	1977	One pond	<1 acre	Eradicated
	1984	One pond	<1 acre	Eradicated
	1985	Three ponds	<1 acre	Eradicated
Monterey	1978	Private pond	.01 acre	Eradicated
Los Angeles	1980	Eight ponds	2 acres	Eradicated
	1983	One pond	<1 acre	Eradicated
	1985	One pond	<1 acre	Eradicated
Sonoma	1984	Spring Lake	72 acres	Eradicated
Sutter	1985	One pond	<.01 acre	Eradicated
	1990	One pond	<.01 acre	Eradicated
Shasta	1985	Seven ponds	133 acres	
	1986	Four ponds	23.5 acres	
	1994	Two ponds	13 acres	Active
	1996	Three ponds	37 acres	Active
	1996	One pond	4 acres	
Calaveras	1988	Seven ponds	23 acres	Active
San Bernardino	1988	Two ponds	0.6 acre	
		One pond	4 acres	
San Francisco	1988	One pond	<.01 acre	Eradicated
Madera/Mariposa	1989	One pond	2 acres	Eradicated
		Eastman Lake/ Chowchilla River	100/ 1,800 acres 26 miles	Active
Tulare	1993	Three ponds	0.6 acre	Eradicated
	1996	Six ponds	20 acres	Active
Lake	1994	Clear Lake	425 acres/ 43,000 acres	Active

Informational signs warning the public about hydrilla and reminding them to clean their boats and trailers before leaving the lake have been established at 28 public boat launching facilities. In addition, the three major highways (20, 29, and 175) to Clear Lake are posted with prominent signs.

Informational pamphlets, produced by the Department of Boating and Waterways and the Department of Food and Agriculture, are distributed by project personnel to businesses in the area. Approximately 24,600 pamphlets were distributed to all motels, sporting good stores, gas stations and many other retail establishments. Pamphlets were also distributed to 1,500 lakeshore homes around the lake.

Monitoring

An extensive monitoring program was conducted in 1996 by a newly established Environmental Monitoring group. This group of scientists from the California Department of Fish and Game, U.S. Department of Agriculture - Agricultural Research Service and the University of California developed and conducted a comprehensive program to identify and evaluate the impact of eradication activities to non-target organisms. Additional monitoring activities were conducted by Big Valley Rancheria. Results of the monitoring activities will be presented in a separate report and later distributed to all stakeholders and interested parties .

Progress and Plans for 1997

The hydrilla eradication program has significantly reduced the level of hydrilla in Clear Lake and prevented the spread to other bodies of water. Survey results indicate plant population is low and scattered in the infested area. Twelve new locations of hydrilla were detected in 1996. Seven of these locations contained only one or two plants. The remaining five locations contained six to twenty five plants. Spread of hydrilla to these new sites is disappointing; however, early detection was achieved and enabled project staff to respond quickly and effectively to prevent further spread within the infested area. Applications of Sonar™ and Komeen™ when necessary, will continue in 1997. Treatment protocols will be developed toward optimizing the use of Sonar™ at the lowest possible rate. For example, selected areas may be treated at 7.5 ppb twice a week for 10 weeks. While this treatment schedule increases the application period from 7 to 10 weeks, it reduces the initial herbicide concentration by 25%.