Appendix D
WHCP Fish Passage Protocol

Water Hyacinth Control Program
Fish Passage Protocol

Background

Water hyacinth (Eichhornia crassipes) is a non-native, free-floating aquatic macrophyte. Water hyacinth was first reported in California in 1904, and by the early 1980s, had become a significant problem for agriculture, boating and recreation, and wildlife in the Sacramento San Joaquin Delta and its tributaries. Water hyacinth is characterized by showy lavender flowers and thick, highly glossy leaves up to ten inches across. The plant grows from 1 ½ to 4 feet in height, and the floating portion of the plant can grow to more than four feet in diameter. In the Delta, the plant is found in sloughs, connecting waterways, and tributary rivers. The growing season for water hyacinth in the Delta is typically from March to early December. Water hyacinth spreads and grows rapidly under favorable temperature and nutrient conditions such as those found in the Delta in the summer months, and mats may double in surface area in six to fifteen days.

In 1982, SB 1344 amended the California Harbors and Navigation Code to designate the California Department of Boating and Waterways (DBW) as the lead agency for controlling water hyacinth in the Delta, its tributaries, and the Suisun Marsh. The DBW developed an interagency task force to coordinate the control activities of federal, state, and local interests and to resolve problems and concerns associated with public health and safety, and environmental impacts. The Task Force's primary role has been to review results of the previous year's treatment program and to develop and approve the water hyacinth treatment protocol each year. The DBW initiated the water hyacinth control program (WHCP) in 1983. The primary treatment method has been chemical. Almost 97 percent of the treatment uses 2,4-Dichlorophenoxyacetic acid, dimethlyamine salt (2,4-D), with limited amounts of diquat and glyphosate used in special circumstances. Treatment is typically conducted with hand-held sprayers from 19 to 21 foot aluminum air or outboard motor boats. The boats are equipped for direct metering of herbicides, adjuvants, and water into pump systems. Trained field crews spray the chemical mixture directly onto the plants. For the seventeen years between 1983 and 1999, the DBW treated between 160 and 2,700 acres of water hyacinth a year with no known measurable water quality or environmental degradation, including impacts on fish.

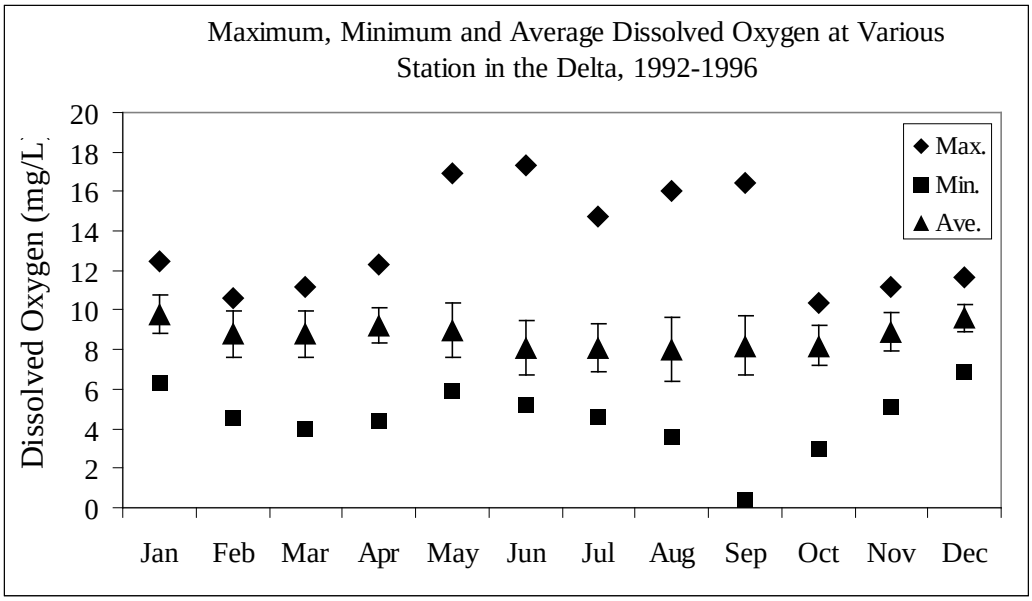
The DBW and cooperating counties halted the WHCP in 2000 after a legal action from the Delta Keepers claimed that the DBW must obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Central Valley Regional Water Quality Control Board (CVRWQCB). The DBW applied for the NPDES permit in January 2000, and the CVRWQCB developed permit conditions in October 2000, but did not issue a permit. In March 2001, the State Water Board issued the DBW a NPDES permit for the WHCP, incorporating most of the conditions developed by the CVRWQCB. One of the conditions requires the DBW to develop a protocol to be followed to ensure that the WHCP operations provide a zone of passage to fish at all times. This letter describes the fish passage protocol. The DBW also prepared a biological assessment for the WHCP in February 2001, and in June 2001 received a biological opinions and Section 7 permits for

the program. Conditions in the permits by the U.S. Fish and Wildlife Service and the National Marina Fisheries Service also promote fish passage in the Delta waters.

Dissolved Oxygen and Water Hyacinth

Dissolved oxygen (DO) is the content of oxygen found in water. DO is determined by temperature, weather, water flow, nutrient levels, algae, and aquatic plants. Generally, a higher level of DO is beneficial. Fish begin to experience oxygen stress or exhibit avoidance at levels below 5 mg/liter. DO levels drop in warmer temperatures, and increase with precipitation, wind, and water flow. Running water, such as the tidal water in the Delta, dissolves more oxygen than still water. High levels of nutrients in water reduce DO levels, while algae and aquatic plants can increase DO through photosynthesis, but decrease DO through respiration and decomposition. DO levels fluctuate throughout the day, and are typically lowest in the morning and peak in the afternoon. In deep, still waters, DO levels are lower in the hypolimnion (bottom layer of water) because there is little opportunity for oxygen replenishment from the atmosphere. As illustrated in **Exhibit 1**, DO levels measured at various locations in the Delta averaged between 8 and 9.8 mg/l.

Exhibit 1.



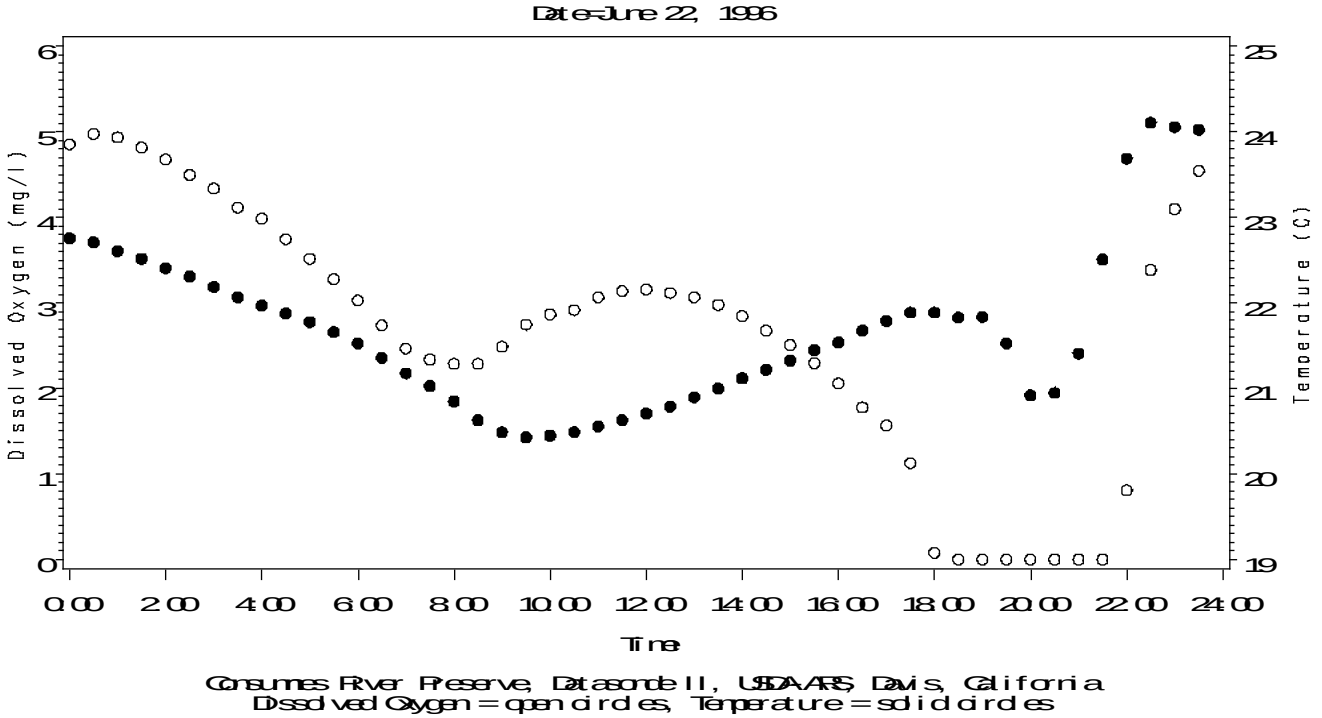
Concern exists that, following herbicide treatment, the biomass of decaying plant material will create a large biological oxygen demand, resulting in decreases in dissolved oxygen. The DBW recognizes that decaying water hyacinth has the potential to reduce DO levels. The label for Weedar 64 (2,4-D) notes that decaying weeds use up oxygen, and recommend treating only one half of a lake or pond to avoid fish kill. In larger areas of coverage in lakes and ponds, the label recommends leaving 100-foot strips. The label also recommends repeating treatment as necessary to kill regrowth and water hyacinth plants missed in the previous operation. For Rodeo (glyphosate), the label recommends treating the area in strips when there is full coverage of the weed in impounded areas to

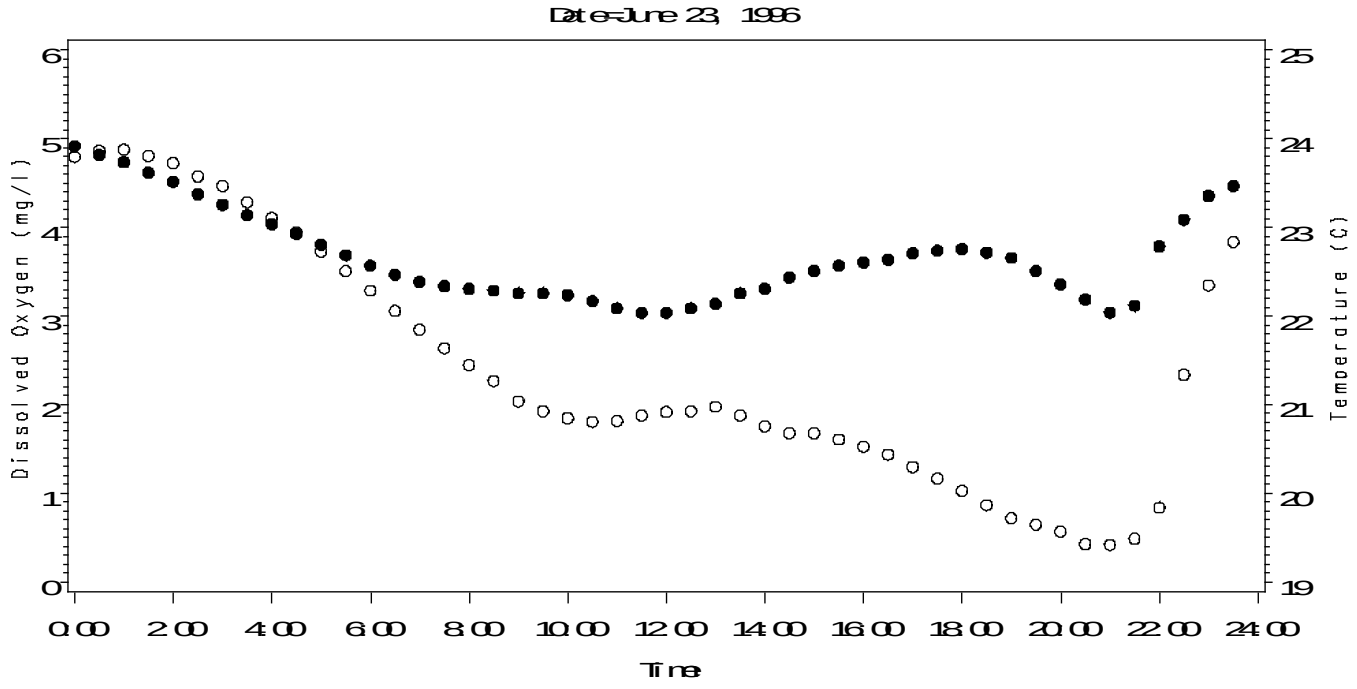
prevent oxygen depletion. Similarly, the Reward (diquat) label recommends treating only one half to one third of a water body at a time to avoid fish suffocation.

The DBW also contends that existing DO levels in large mats are already low, and that with adequate avoidance measures, further decreases in dissolved oxygen that would impede fish passage can be avoided and/or minimized. Large patches of water hyacinth can cause low dissolved oxygen levels (Toft 2000). Data summarized below indicate that DO levels under water hyacinth mats are lower than DO levels elsewhere in the Delta. In a study of DO in aquatic weeds in Texas, water hyacinth was found to have the lowest DO levels as compared to milfoil, hydrilla, pondweed, and a mix of native species, and was the only plant to have DO levels below 5 mg/l (Madsen 1997 in Toft). Toft found average spot DO measurements below 5 mg/l for water hyacinth and above 5 mg/l for pennywort (Toft 2000).

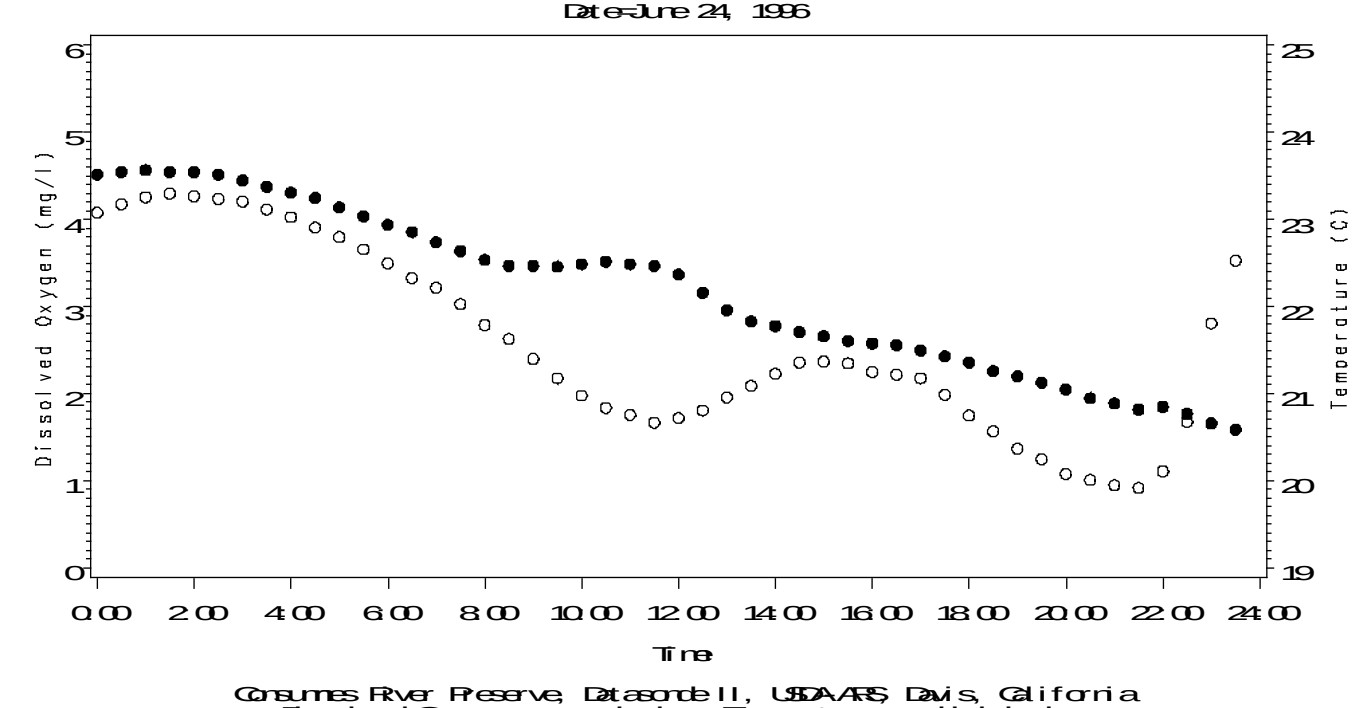
Research in the Delta conducted by the United States Department of Agriculture, Agricultural Research Service measured DO levels every half-hour under a large mat of water hyacinth that completely covered a 15-meter wide slough on the Consumnes River Nature Preserve. The slough was subject to tidal flows. Over a four-day period in June 1996 DO levels each day ranged from 0mg/l to just over 5mg/l. Only about 5 of 200 data points measured under the mat were above 5mg/l, and the vast majority of the data points were between 2 mg/l to 4mg/l (Spencer 2001). The results of the DO testing are shown in **Exhibit 2**. This data indicates that large infestations of water hyacinth across waterways, such as those that have occurred on the Merced and San Joaquin Rivers prior to treatment are likely to impede the passage of fish.

Exhibit 2. Four graphs depicting datasonde results under a dense mat of water hyacinth plants in a slough on the Consumnes River Nature Preserve.

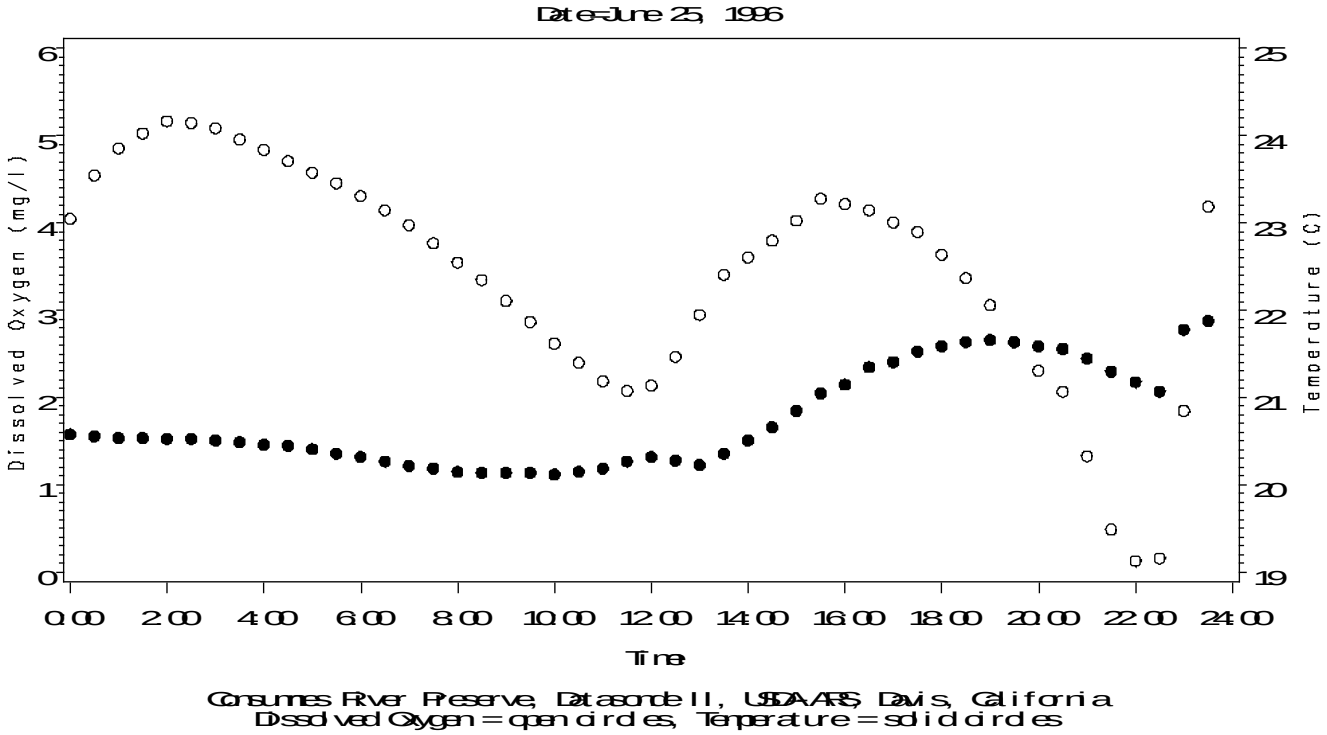




Consumnes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles



Consumnes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles



Consumnes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles

Decreases in DO resulting from treatment of water hyacinth are likely to be short-term since the Delta is a flowing rather than a standing water system. One of the long-term benefits of treating with herbicides is a reduction in the volume of water hyacinth in the Delta. Removing large patches of water hyacinth will allow DO levels to increase, thus enhancing the ability of fish to move unimpeded in Delta waters. It can be argued that such a benefit outweighs the impact of short-term localized decreases in dissolved oxygen.

Fish Passage Protocol

The DBW will take the following steps to ensure that the WHCP operations provide a zone of passage for fish:

1. For each site, the DBW staff shall treat no more than three (3) contiguous acres. After treating three maximum acres, staff must then skip at least one adjacent site before treating another site. DBW staff may not treat skipped sites until two tidal changes have occurred or, in non-tidal areas, until the next day.

2. DO levels will be measured and the DBW will treat according to permit conditions.

3. For completely infested dead-end sloughs greater than one acre, DBW staff shall treat no more than half the area at one time to allow for fish passage. The DBW will return to treat the remaining half according to the label instructions and permit conditions.

4. For completely infested moving waterways, such as across the entire width of a river, the DBW shall treat no more than half the area at one time, to allow for fish passage. The DBW will not treat the remaining area until the water hyacinth is decomposed or until a passage has opened up in the waterway.

5. If the DO levels in an area to be treated are at a level considered to be detrimental to fish species prior to treatment, the DBW may treat the entire area, therefore allowing the DO levels to increase once the water hyacinth is controlled.

References

DBW. 2001. *Egeria densa* Control Program Volume III: Response to Comments. Sacramento: California Department of Boating and Waterways. 90pp.

DBW. 2001. Water Hyacinth Control Program Biological Assessment. Sacramento: California Department of Boating and Waterways. 125pp.

Spencer, David. 2001 Personal communication and unpublished data. United States Department of Agriculture, Agricultural Research Service. Davis, California.

Toft, J.D. 2000. Community effects of the non-indigenous aquatic plant water hyacinth (*Eichhornia crassipes*) in the Sacramento/San Joaquin Delta, California. University of Washington. 86pp.

United States Environmental Protection Agency. Dissolved oxygen and biochemical oxygen demand, in Monitoring Water Quality. Washington D.C.: EPA Office of Water. http://www.epa.gov/owowwtr1/monitoring/volunteer/stream/vms52.html. 11pp.