UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

JUN 8 2001

IN RESPONSE REFER TO:
SWR-01-SA-5724

James N. Seiber, Director
United States Department of Agriculture
Pacific West Area, Western Regional Research Center
Agricultural Research Service
800 Buchanan Street
Albany, California 94710-1105

Dear Director Seiber:

Enclosed is the National Marine Fisheries Service's (NMFS) final biological opinion concerning the effects of the proposed Water Hyacinth Control Program in 2001 on the endangered Sacramento River winter-run chinook salmon (*Oncorhynchus tshawtscha*), threatened Central Valley spring-run chinook salmon (*O. tshawtscha*), threatened Central Valley steelhead (*O. mykiss*), and critical habitat of the Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon, and Central Valley steelhead.

The biological opinion concludes that the U.S. Department of Agriculture-Agriculture Research Service and State of California Department of Boating and Waterways' Water Hyacinth Control Program in 2001 is not likely to jeopardize the continued existence of the winter-run chinook salmon, spring-run chinook salmon, and steelhead trout, nor result in the adverse modification of their critical habitat. Because NMFS believes there will be some incidental take of winter-run chinook salmon, spring-run chinook salmon, and steelhead trout as a result of project operations, an incidental take statement is also attached to the biological opinion. This take statement includes several reasonable and prudent measures that NMFS believes are necessary and appropriate to reduce, minimize, and monitor project impacts. Terms and conditions to implement the reasonable and prudent measures are presented in the take statement and must be adhered to in order for take incidental to this project to be authorized.

The biological opinion also provides several conservation recommendations for winter-run chinook salmon, spring-run chinook salmon, and steelhead trout that include the use of adaptive management procedures that will decrease the risk of detrimental impacts on listed salmonids, and studies designed to explore alternative control measures on the water hyacinth to (1) reduce risks to juvenile salmonid rearing and adult/juvenile migration and in the Sacramento-San Joaquin Delta; (2) reduce dependence upon chemical controls in the Delta, and (3) focus on a long-term goal of eradication of the water hyacinth within the Sacramento-San Joaquin Delta.

This document also transmits NMFS' essential fish habitat (EFH) Conservation Recommendations for chinook salmon (*Oncorhynchus tshawtscha*) as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) as amended (16 U.S.C. 1801 et seq.) (Attachment B).

The USDA-ARS has a statutory requirement under section 305(b)(4)(B) of the MSFCMA to submit a detailed response in writing to NMFS that includes a description of measures proposed for avoiding, mitigating, or offsetting the impact of the activity on EFH, as required by section 305(b)(4)(B) of the MSFCMA and 50 CFR 600.920(j) within 30 days. If unable to complete a final response within 30 days of final approval, the Corps should provide NMFS an interim written response within 30 days. The District should then provide a detailed response.

We appreciate your continued cooperation in the conservation of listed species and their habitat, and look forward to working with you and your staff in the future. If you have any questions regarding this response, please contact Ms. Shirley Witalis in our Sacramento Area Office, 650 Capitol Mall, Suite 6070, Sacramento, CA 95814. Ms. Witalis may be reached by telephone at (916) 930-3606 or by FAX at (916) 930-3629.

Sincerely,

for Rebecca Lent, Ph.D.
Regional Administrator

cc: Lars Anderson, USDA-ARS, UC-Davis
Patrick Thalken, DBW, Sacramento
Arnold Roessler, USFWS, Sacramento
NMFS - Sacramento Admin File

Endangered Species Act -Section 7 Consultation

BIOLOGICAL OPINION

Agency: U.S. Department of Agriculture, Agricultural Research Service,
Pacific West Area, Western Regional Research Center

Activity: Water Hyacinth Control Program during 2001

Consultation Conducted By: Southwest Region, National Marine Fisheries Service

Date Issued: JUN 8 2001

I. CONSULTATION HISTORY

This document represents the National Marine Fisheries Service (NMFS) biological opinion (Opinion) based on our review of information provided by the U.S. Department of Agriculture, Agricultural Research Service (USDA-ARS) and the State of California Department of Boating and Waterways Weed Control Unit, for the implementation of the proposed Water Hyacinth Control Program during 2001 at several sites in the Sacramento/San Joaquin Delta and its tributaries, in accordance with section 7 of the Endangered Species Act of 1973, as amended (6 U.S.C. 1531 et sq.) (Act).

A biological assessment for the proposed Water Hyacinth Control Program was prepared by the State of California Department of Boating and Waterways (DBW) and submitted to NMFS on February 15, 2001. Formal consultation for the control program was initiated by letter dated April 16, 2001, from USDA-ARS, and received by NMFS on April 17, 2001.

On May 9, 2001, a meeting was held to discuss potential measures to avoid or reduce impacts of the Water Hyacinth Control Program on listed species in the Delta. In attendance were Lars Anderson of USDA-ARS, Patrick Thalken and Marcia Carlock of DBW, Wendy Pratt of NewPoint Group, Christopher Tatara of NMFS-Santa Rosa, and Mike Aceituno and Shirley Witalis of NMFS-Sacramento. The meeting discussion proposed an operations matrix of measures to reduce impacts to listed species.

In addition, DBW provided four reports on water hyacinth research to NMFS on May 11, 2001: (1) *Biological Control of Water hyacinth in the California Delta Technical Report A-88-7*; (2) *Toxic Trace Metals in Water hyacinth in the Sacramento-San Joaquin Delta, California*; (3) *Mechanical Removal of Water hyacinth, Contra Costa Canal*; and (4) *Mechanical Harvesting of Aquatic Plants, Technical Report A-78-3*.

On May 29, 2001, a final meeting was held between DBW and NMFS to discuss the terms and conditions in the draft Opinion on the Water Hyacinth Control Program at the request of DBW. In attendance were Don Waltz, Patrick Thalken, Tim Artz, and Marcia Carlock of DBW; Mike Aceituno, Diane Windham, Shirley Witalis, and Chris Tatara (by phone) of NMFS. During this meeting, the issuance of a short-term opinion for operations in 2001 was discussed and a schedule set for an upcoming consultation on long-term water hyacinth control operations. Therefore, this biological opinion analyzes the effects of the proposed action during 2001 only. Future operations after December 31, 2001 will be covered in another biological opinion.

II. DESCRIPTION OF THE PROPOSED ACTION

The USDA-ARS, in coordination with DBW, proposes to implement a program to control the invasive weed, water hyacinth, within the Sacramento/San Joaquin Delta and its tributaries and monitor the effects of such program on the ecosystem. Water hyacinth (*Eichhornia crassipes*), a South American member of the pickerelweed family (*Pontederiaceae*), is a non-native free-floating aquatic macrophyte that was first reported in California in 1904 in a Yolo County slough (Prokopovich et al.1985) and has since spread to 1,000 acres and 150 miles of waterways in the Delta. It can be found in both lentic and lotic aquatic systems. The plants vary in size from a few centimeters to over a meter in height. The glossy green, leathery leaf blades are up to 20 cm long and 5-15 cm wide and are attached to petioles that are spongy, inflated, and bulb-like. Numerous dark, branched, fibrous roots dangle in the water from the underside of the plant. The inflorescence is a loose terminal spike with showy light-blue to violet or white flowers. The fruit is a three-celled capsule containing many minute, ribbed seeds. Water hyacinth growing season in the Delta is typically from March to early December, with reduced growth or die-back during the cold winter months. Water hyacinth is extremely tolerant of fluctuations in water level, flow velocity, nutrient availability, pH, temperature, and toxic substances. It reproduces vegetatively and sexually, forming mats that move with water currents and wind, hindering navigation, disrupting recreational activities, clogging agricultural irrigation intakes, slowing water conveyances, displacing native vegetation, and upsetting the balance of the aquatic environment.

Water hyacinth has rapidly spread throughout inland and coastal freshwater bays, lakes, and marshes in the United States and in other countries. New plant populations often form from rooted parent plants and wind movements and currents help contribute to their wide distribution. Linked plants form dense rafts in the water and mud.

The water hyacinth life cycle begins when the spring overwintering plants initiate growth by producing daughter plants. These plants slowly increase in number and size during the spring and summer until the maximum biomass is reached in the late summer. Water hyacinths are in full bloom in late summer and early fall. Seeds form in the submerged, withered flower. By late fall some of the old leaves start dying and by January most plants have gone into senescence. Colonization of a new site begins with small plants at low plant densities. These plants increase in number and density without increasing in size until they produce a new mat. As a mature dense mat is formed, individual plant size continues to increase, but density decreases as the result of intraspecific competition. Water hyacinth reproduces sexually by seeds and vegetatively by budding and stolon production. Daughter plants sprout from the stolons and doubling times have been reported of 6-18 days. The seeds can germinate in a few days or remain dormant for 15-20 years. They usually sink and remain dormant until periods of stress (droughts). Upon reflooding, the seeds often germinate and renew the growth cycle.

Aquatic plants often play a beneficial role in the function and "health" of waterbodies in a variety of ways such as: producing dissolved oxygen (DO), cycling nutrients, driving the food chain, dampening wave action and currents, lowering water turbidity, and providing habitat for fish and wildlife. However, the excessive growth of aquatic vegetation (from exotic weed species such as Eurasian water milfoil, Brazilian elodea (*Egeria densa*), hydrilla, and water hyacinth, etc.) can result in undesirable impacts to aquatic ecosystems. For instance, the normal nighttime respiration of an overabundance of submersed vegetation can severely deplete DO levels, particularly during summer months or other periods of elevated water temperatures. In addition, thick plant stands reduce light penetration and restrict water circulation patterns to the point of producing extreme temperature, pH and nutrient stratification in the affected water column. These major and other more subtle consequences of excessive plants can have deleterious effects on the full range of aquatic organisms - fish, invertebrates, plants, etc. The result is often a reduction in the biodiversity of waterbodies (U.S. Army Corps of Engineers, 1998).

Dense mats of water hyacinth interfere with navigation, recreation, irrigation, power generation, and native aquatic flora and fauna. These mats competitively exclude native submersed and floating-leaved plants which are part of the habitat used by listed species and their forage base. Low oxygen conditions develop beneath water hyacinth mats and the dense floating mats impede water flow and create good breeding conditions for mosquitoes (CALFED, ERP Vol. 1, 2000).

USDA-ARS and DBW propose to control the growth and spread of water hyacinth in the Sacramento-San Joaquin Delta waterways with the aquatic herbicides Weedar® 64 and Rodeo®, using an adaptive management approach. The objectives of the Water Hyacinth Control Program (WHCP) are to: (1) limit future growth and spread of water hyacinth in the Delta; (2) improve boat and vessel navigation in the Delta; (3) utilize the most efficacious methods available with the least environmental impacts; (4) prioritize navigational, agricultural, and recreational sites with a high degree of infestation; (5) employ a combination of control methods to allow maximum flexibility; (6) improve the WHCP as more information is available on control methods used in the Delta; (7) monitor results of the WHCP to fully understand impacts of the WHCP on the environment; (8) improve shallow-water habitat for native fish species by controlling water hyacinth; (9) decrease WHCP control efforts, if sufficient efficacy of water hyacinth treatment is realized; and (10) minimize use of methods that could cause adverse environmental impacts. The WHCP will focus on clearing and maintaining adequate navigation channels for Delta users and clearing areas surrounding marinas, launch ramps, pumping facilities, and intake pipes.

History of the WHCP

The WHCP was initiated in 1982 with Senate Bill 1344, designating DBW as the lead agency for controlling water hyacinth in the Delta, its tributaries and Suisun Marsh. An interagency Task Force was established to coordinate control activities, resolve issues concerning public and environmental health, review results of the previous year's treatment program and develop and approve the following year's treatment protocol.

The DBW continued treating water hyacinth through the 1985 season when the U.S. Army Corps of Engineers (USACE) developed a State Design Memorandum for a Water Hyacinth control program and conducted an Environmental Assessment (EA) of the program and issued a Finding of No Significant Impact (FONSI) for operations within the Delta. The DBW acted as the State representative for the WHCP and continued treatment of water hyacinth through the 1999 season with various program changes and scope with input from the Task Force and monitoring being conducted by the USDA and California Department of Food and Agriculture (CDFA).

DBW employed herbicides as the preferred method of control for water hyacinth in the Delta for 17 years. Chemicals previously utilized in DBW's control program include aquatic herbicides Weedar®64 (2,4-Dichlorophenozyacetic acid, dimethylamine salt) (2,4-D), Rodeo® (glyphosate, N-(phosphonomethyl) glycine (isopropylamine salt), Reward® (diquat dibromide); adjuvants[1] Activator 90® (alkyl polyoxyethylene ether and free fatty acids), Placement® (amine salts of organic acids, aromatic acid, aromatic and aliphatic petroleum distillate), SR-11® (alkyl aryl polyethoxylates, compounded silicone and linear alcohol), Agri-dex® (paraffin base petroleum oil and polyoxyethylate polyol fatty acid esters), Bivert® (amine salts of organic acids, aromatic acid, aromatic and aliphatic petroleum distillates), and SurpHtac®(polyozyethylated (6) decly alcohol, 1-aminomethanamide dihydrogen tetraoxosulfate); and activator Magnify®(ammonium salts, aklyl polyglucoside, and dimethylpolysilozane). From 1983 - 1999, a total of 17,613 acres were treated with 4,861 applications of primarily 2,4-D (>95% total applied herbicide). For the last 6 years of the program, a total of 8,361 gallons of herbicide and 4,914 gallons of adjuvants were used in the WHCP.

The program was halted in December 1999 in response to a lawsuit from the environmental group DeltaKeeper for contending that the lack of a National Pollutant Discharge Elimination System (NPDES) permit for the operation of the WHCP was a violation of the Clean Water Act. An application to the State Water Resources Control Board (Water Board) for an NPDES was submitted on January 7, 2000 by DBW. On October 27, 2000, the Board members declined to issue the draft NPDES permit and tabled the matter. On November 22, 2000, the Water Board received a petition from DBW seeking review of their application, or a determination that an NPDES permit would not be required for the control program. Subsequently, the Water Board issued a NPDES permit for the WHCP, adopted by *Order: WQ 2001-07*, on March 7, 2001.

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[1] Adjuvants act as control agents to reduce chemical drift and spray of non-target areas and increase adhesion of the herbicide to the water hyacinth leaves.

Prior to 1999, the program appears to have been effective in reducing the distribution of the water hyacinth population within the treatment area from thousands of acres to several hundred acres. Following cessation of the program, the water hyacinth population returned to larger distribution levels, over 2,000 acres.

Biological Control Methods

Three insect species have been approved for use in controlling Water Hyacinth in California. The three species are the (1) *Neochetina bruchi*, Water Hyacinth beetle; (2) *Neochetinia eichhorniae*, Water Hyacinth weevil; and (3) *Samoedes albiguttalis*, Water Hyacinth moth. A three to five year time span is required for insect populations to reach levels that are necessary for water hyacinth population to be in substantial decline. Biological control methods were tested by DBW and the USACE between 1983 and 1985 (Stewart, et al. 1988). In the studies, different combinations of insects were introduced to four locations in the Delta. The biocontrol agents had only limited success in reducing water hyacinth in the Delta and were unable to disperse naturally or establish stable populations. The DBW and USDA are continuing studies on biological control methods, however based on the current biocontrol agents available the DBW has determined that biological control of water hyacinth is infeasible in the immediate future for economic and operational reasons. This biological opinion does not include the biological control of water hyacinth.

Mechanical Control Methods

The DBW has implemented a limited amount of mechanical control of water hyacinth in the Delta (DBW 1983) The methods include mechanical harvesting, chopping, hand-picking, and exclusion booms. Mechanical harvesting is ineffective for large scale control, very expensive, and cannot keep pace with the rapid plant growth in large water systems (Culpepper and Decell 1978). The use of booms can provide some relief from water hyacinth infestation but are not part of a long term solution. This biological opinion does not include the mechanical control of water hyacinth.

WHCP Adaptive Management

Proposed operation and maintenance activities include: (1) evaluating the need for control measures on a site-by-site basis; (2) selecting appropriate indicators for pre-treatment environmental monitoring; (3) treatment; (4) monitoring indicators following treatment and evaluating data to determine program efficacy and environmental impacts; (5) supporting ongoing research to explore the impacts of the WHCP and alternative control methodologies; (6) reporting findings from monitoring evaluations and research to regulatory agencies and stakeholders; and (7) adjusting program actions, as necessary, in response to recommendations and evaluations by regulatory agencies and stakeholders.

Daily Protocol

The proposed WHCP treatment season in 2001 would extend from mid-April through mid-December. Five (5) crews, each consisting of a Specialist and a Technician, would carry out the control program. A Field Supervisor would manage daily operations, and assign spray locations to the crews on a weekly basis. Approximately 307 treatment sites have been identified, and would be prioritized according to impact to navigation and extent of obstruction. Between 25 - 50 acres would be sprayed daily. Treatment locations would be determined by weather and tidal conditions, the presence of agricultural crops, native vegetation, potable water intakes, and wildlife. Herbicides would be applied from small boats using hand-held spray nozzles. Waste products, including both active and inert chemical ingredients and dead plants, would be left to sink into the substrate or be carried downstream by water flow. No chemicals will be discharged under high wind, water flow or wave action.

The DBW will follow the California Department of Pesticide Regulation procedures for pesticide application, and obtain a Restricted Use Permit from the County Agricultural Commissioner of each county where they will be treating. As a requirement of the NPDES permit, the DBW will follow monitoring protocol terms imposed by the Board.

Monitoring Program

Pre-treatment measurement results of dissolved oxygen and chemical residue will determine if environmental conditions are conducive to environmentally safe and effective herbicide treatment. Baseline data will be collected on pre-treatment for comparison to post-treatment impacts and treatment efficacy. Treatment protocols will be modified accordingly if necessary to reduce environmental impacts.

Project Area

The project area includes 307 possible treatment sites, averaging between one and two miles in length, within Contra Costa, Merced, Solano, Fresno, Sacramento, Stanislaus, Madera, San Joaquin, and Yolo counties. The action area includes the Sacramento River, between the City of Sacramento and the confluence of the Sacramento and San Joaquin Rivers at Sherman Island, waterways of the Sacramento/San Joaquin Delta, the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolomne, Merced, and San Joaquin Rivers up to certain dams, and the Kings River to Mendota (Attachment A).

Control Methods

The control methods proposed for the WHCP treatment sites are the aquatic herbicides Weedar® 64, a dimethylamine salt formulation of 2,4-Dichlorophenoxyacetic acid (over 97 percent treatment area) and Rodeo®, a formulation of glyphosate. Reward®, a formulation of diquat dibromide, is included in the WHCP as a control agent, but is not expected to be used due to the high cost of monitoring.

The primary control method of the WHCP has been the water-soluble, systemic herbicide Weedar® 64, accounting for 99 percent of chemical use in previous application years. The active ingredient in this phenoxy herbicide is 2,4-Dichlorophenoxyacetic acid dimethylamine salt. Weedar® 64 is absorbed through the leaves of the plant and within four to six hours progresses through the plant in the phloem. The herbicide mimics plant regulating hormones (auxins) leading to abnormal growth patterns and death. Plant metabolism is affected through modification of enzyme activity, respiration, nucleic acid synthesis, protein synthesis, cell division, and congestion of the phloem blocking food transport. The half-life in natural water is two to four weeks; 2,4-D degrades to nontoxic metabolites and ultimately to simple carbon compounds (e.g., CO_2). Weedar® 64 has been approved for use in California water bodies that are quiescent or slow moving. Weedar® 64 is toxic to aquatic invertebrates and non-target plants; it may adversely affect aquatic invertebrates and non-target plants by drift or direct application. Weedar® 64 can result in oxygen depletion due to decomposition of dead plants, resulting in fish suffocation.

Rodeo® is a non-selective, slow-acting systemic herbicide, expected to be used in 3.0 percent of chemical applications. The active ingredient is glyphosate isopropylamine salt, which moves through the plant from foliage to the root system. Glyphosate prevents the synthesis of certain amino acids essential for the plant's survival. The enzymes that glyphosate inhibits are not present in animals, so the toxicity of glyphosate to animals is low. Animals obtain the amino acids that glyphosate inhibits production of, through their diet. Rodeo® is highly soluble, and can be applied in all bodies of fresh and brackish water, but should be monitored to avoid adverse impact to agricultural crops and nontarget plant species. Rodeo® can result in oxygen depletion or loss due to decomposition of dead plants, resulting in fish suffocation.

Reward® (diquat) is a non selective fast acting contact herbicide that is rapidly absorbed by aquatic vegetation. Reward® controls weeds by destroying cellular membranes and disrupting photosynthesis. Diquat has high water solubility, but rapidly and tightly binds to organic particles in water, rendering it biologically unavailable. Diquat is degraded by sunlight, and by microorganisms to nontoxic metabolites and simple carbon molecules (e.g., CO_2). Reward® can result in oxygen depletion or loss due to decomposition of dead plants, resulting in fish suffocation.

In addition to the chemical controls above, 3 adjuvants would be used in application of the controls: (1) Placement® , a deposition and retention agent that reduces evaporation and drift of chemicals while increasing coverage and adherence on the target area; (2) R-11® Spreader-Activator, a combined spreader-activator for increasing the efficiency of agricultural chemicals, is used where quick wetting and uniform coverage of herbicide is required. R-11® increases absorption and translocation, as well as inhibits rust and corrosion in equipment. (3) Agri-Dex® Nonionic improves pesticide application by modifying the wetting and deposition characteristics of the spray solution, resulting in a more even and uniform spray deposit.

The adjuvants act as control agents to reduce chemical drift and spray of non-target areas and increase adhesion of the herbicide to the water hyacinth leaves. None are known to be carcinogenic or harmful to the aquatic environment if label recommendations are followed.

III. STATUS OF THE SPECIES/CRITICAL HABITAT

Sacramento River Winter-run Chinook Salmon ESU and Critical Habitat

The Sacramento River winter-run chinook salmon (*Oncorhynchus tshawytscha*)(winter-run chinook salmon) was determined by NMFS to be a unique run of chinook salmon, endemic to the Central Valley of California. The State of California listed winter-run chinook salmon as endangered in 1989 under the California State Endangered Species Act (CESA). NMFS listed winter-run chinook salmon as threatened (54 FR 10260) under emergency provisions of the ESA in August 1989 and the species was formally listed as threatened in November 1990 (55 FR 46515). On June 19, 1992, NMFS proposed that the winter-run chinook salmon be reclassified as an endangered species pursuant to the ESA (57 FR 27416). NMFS finalized its proposed rule and re-classified the winter-run as an endangered species under the ESA on January 4, 1994 (59 FR 440).

On June 16, 1993 (58 FR 33212), NMFS designated critical habitat for the winter-run chinook salmon as the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay to the Golden Gate Bridge north of the San Francisco/Oakland Bay Bridge. In the areas westward from Chipps Island, including San Francisco Bay to the Golden Gate Bridge north of the San Francisco/Oakland Bay Bridge, this designation includes the estuarine water column and essential foraging habitat and food resources utilized by Sacramento River winter-run chinook salmon as part of their juvenile emigration or adult spawning migration.

There is only one unique population of winter-run chinook salmon, the Sacramento River winter-run, within California. Prior to construction of Shasta and Keswick Dams in 1945 and 1950, respectively, winter-run salmon were reported to spawn in the upper reaches of the Little Sacramento, McCloud, and lower Pit Rivers and may have numbered over 200,000 (Moyle et al.1989; Rectenwald 1989). Construction of the dams blocked access to all of the winter-run chinook salmon's historic spawning grounds.

The first winter-run chinook salmon migrants appear in the Sacramento-San Joaquin Delta during the early winter months (Skinner 1972). On the upper Sacramento River, the first upstream migrants appear during December (Vogel and Marine 1991). Due to the lack of fish passage facilities at Keswick Dam, adults tend to migrate to and hold in deep pools between Red Bluff Diversion Dam (RBDD) and Keswick before initiating spawning activities. The upstream migration of winter-run chinook salmon typically peaks during the month of March, but may vary with river flow, water-year type, and operation of RBDD.

Winter-run chinook salmon spawning primarily occurs between RBDD and Keswick Dam from mid-April to mid-August with peak activity occurring in May and June (Vogel and Marine 1991).

The only known self-sustaining population of winter-run chinook outside the Sacramento drainage occurred in the Calaveras River (NMFS 1997). Several dozen to several hundred adults, spawned below New Hogan Dam. The run was extirpated by the mid-80s, partially due to low flows in the Calaveras River, drought and irrigation diversions.

Most winter-run chinook salmon spawners are three years old. They spawn in gravel between 1.9 cm to 10.2 cm in diameter with no more than 5 percent fine sediment composition. Once spawning is completed, adult winter-run chinook salmon die. The eggs hatch after an incubation period of about 40-60 days depending on ambient water temperatures. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 40°F and 56°F. Mortality of eggs and pre-emergent fry commences at 57.5°F and reaches 100 percent at 62°F (Boles et al. 1988). Other potential sources of mortality during the incubation period include redd dewatering, insufficient oxygenation, physical disturbance, and water-borne contaminants.

Pre-emergent fry remain in the redd and absorb the yolk stored in their yolk-sac as they grow into fry. This period of larval incubation lasts approximately 2 to 4 weeks depending on water temperatures. Emergence of the fry from the gravel begins during late June and continues through September. The fry seek out shallow nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow from 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure.

The emigration of juvenile winter-run chinook salmon from the upper Sacramento River is dependent on streamflow conditions and water-year type. Once fry have emerged, storm events may cause en masse emigration pulses. This emigration past Red Bluff may occur as early as late July or August, generally peaks in September, and can continue until mid-March or April in drier years (Vogel and Marine 1991). Data combined from trawling, seining and State and Federal water project fish salvage records in the Delta show that winter-run chinook salmon outmigrants occur from October to early May in the Sacramento-San Joaquin Delta (DFG 1993). Emigration from the Delta might begin to occur as early as late-December and continue through June. Smolts enter the ocean at an average fork length of approximately 118 mm. The period of residency in the Sacramento River and Delta for Sacramento River winter-run chinook salmon is between five and nine months.

Winter-run chinook salmon are very susceptible to extinction because the species is limited to a single, isolated population without a source of immigration from subpopulations (NMFS 1997). The winter-run chinook have a lower fecundity than most other chinook populations and therefore have a lower reproductive potential average of 3,353 eggs per female, vs. Central Valley fall-run chinook at 5,498 eggs per female, Columbia River chinook salmon at 5,032-5,453 eggs per female, and Alaskan chinook populations averaging 5,000 eggs per female) (Fisher 1994; Healey and Heard 1984).

Central Valley Spring-run Chinook Salmon ESU and Critical Habitat

The Central Valley spring-run chinook salmon (*Oncorhynchus tshawytscha*)(spring-run chinook salmon) was determined by NMFS to be a unique evolutionarily significant unit (ESU), endemic to the Central Valley of California. The State of California listed the spring-run chinook salmon as threatened species under the California State Endangered Species Act February 1999, followed by federal listing as a threatened species under the ESA (September 1999). In February 2000, NMFS designated critical habitat for the spring-run chinook salmon as all river reaches accessible to listed chinook salmon in the Sacramento River and its tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge (50 CFR Part 226).

Adult Central Valley spring-run chinook salmon migrate between March and September, peaking in May through June, and spawn from late August through early October, peaking in September (Yoshiyama et al. 1998). Between 56 to 87 percent of adult spring-run chinook salmon enter freshwater to spawn are three years of age (Calkins et al. 1940, Fisher 1994). Spring-run chinook salmon in the Sacramento River exhibit an ocean-type life history, emigrating to the ocean as fry, subyearlings, and yearlings. Juvenile spring-run chinook salmon may spend several months resting and feeding in the Delta and Estuary for several months prior to entering the ocean (Kjelson et al. 1981).

Central Valley spring-run chinook salmon run timing enables fish to gain access to the upper reaches of river systems prior to the onset of prohibitively high water temperatures and low flows that inhibit access to these areas during the fall. Fish hold over throughout the summer in these cool upper reaches until reaching sexual maturity and subsequently spawn between August and October (Yoshiyama et al. 1998).

Historically, spring-run chinook salmon were abundant in the Sacramento River system and constituted the dominant run in the San Joaquin River Basin (Reynolds et al. 1993), occupying the upper and middle reaches (450-1,600 m in elevation) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit Rivers. Smaller sustaining populations were found throughout most other tributaries with sufficient cold-water flow to maintain spring-run adults through the summer prior to spawning (Stone 1874, Rutter 1904, Clark 1929, Meyers 1998).

Clark (1929) estimated that there were historically 6,000 stream miles of salmonid habitat in the Sacramento-San Joaquin River Basin, but by 1928 only 510 miles remained. The elimination of access to spawning and rearing habitat resulting from the construction of impassable dams has extirpated spring-run chinook salmon from the San Joaquin River Basin, historically supported the greatest numbers of spring-run chinook salmon. Construction of impassible dams has also curtailed access to suitable spawning habitat in the upper Sacramento and Feather Rivers.

The remaining streams believed to sustain populations of wild spring-run chinook salmon are Mill, Deer, and Butte Creeks (tributaries of the Sacramento River). These remaining populations are relatively small and exhibit a sharply declining trend. Demographic and genetic risks of extirpation due to small population size are thus considered to be high. Spring-run chinook salmon unable to access historical spawning and rearing habitats in the Sacramento and San Joaquin River Basins are restricted to spawning in the mainstem tributaries of the Sacramento River. This limited spawning habitat and corridors used for migration and rearing are substantially marred by elevated water temperatures, agricultural and municipal diversions and returns, restricted and regulated flows, entrainment of migrating fish into unscreened or poorly screened diversions, and the poor quality and quantity of remaining habitat.

Central Valley Steelhead ESU and Central Valley Steelhead Critical Habitat

The Central Valley steelhead (*Oncorhynchus mykiss*)(steelhead) was determined by NMFS to be an ESU, endemic to the Central Valley of California. On August 9, 1996, NMFS issued a proposed rule to list this ESU as endangered under the federal Endangered Species Act (61 FR 155). On March 19, 1998, the Central Valley steelhead ESU was listed as threatened (50 CFR Part 227), and critical habitat was subsequently designated on February 16, 2000 (50 CFR Part 226).

Critical habitat is designated to include all river reaches accessible to listed steelhead in the Sacramento and San Joaquin Rivers and their tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence and areas above specific dams or longstanding, naturally impassable barriers.

Historically, steelhead spawned and reared in most of the accessible upstream reaches of Central Valley rivers, and their perennial tributaries. It is likely that steelhead were also present in the upper San Joaquin River drainage. Steelhead generally migrated far into tributaries and headwater streams, where cool, well-oxygenated water was available year round. In the Central Valley, steelhead are now restricted to the upper Sacramento River downstream of Keswick Reservoir, the lower reaches of large tributaries downstream of impassable dams, small perennial tributaries of the Sacramento River mainstem and large tributaries, and the Sacramento-San Joaquin Delta and San Francisco Bay system. Few records are available regarding the occurrence of steelhead in the San Joaquin River system. In the Mokelumne River, steelhead are currently found below Camanche Dam.

Historical records indicate that adult steelhead enter the mainstem Sacramento River in July, peak in abundance in the fall, and continue migrating through February or March (McEwan and Jackson 1996). Migration in the lower Mokelumne River occurs from August to March, peaking in December; spawning occurs from January through April. Unlike Pacific salmon, most steelhead do not die after spawning and a small portion survive to become repeat spawners.

During spawning, the female steelhead digs a redd (i.e., gravel nest) in which she deposits her eggs, which are then fertilized by the male steelhead. Egg incubation time in the gravel is determined by water temperature and varies from approximately 19 days at an average water temperature of 60 ° F to approximately 80 days at an average temperature of 40° F.

Steelhead fry usually emerge from the gravel 2-8 weeks after hatching (Barnhart 1986, Reynolds et al. 1993); emergence usually takes place between February and May, but sometimes extends into June. Newly emerged steelhead fry move to shallow, protected areas along streambanks and move to faster, deeper areas of the river as they grow into the juvenile life stage. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates. Under optimal conditions, juvenile steelhead may rear in the lower Mokelumne River throughout the year (California Department of Fish and Game 1991). Small numbers of yearling and older juvenile steelhead and/or rainbow trout have been identified at Woodbridge Dam in recent years during annual monitoring of out migrating chinook salmon (January-July). Young-of-the-year have also been observed from April through July (Natural Resource Scientists 1998b). As juvenile steelhead begin their downstream migration, they undergo a physiological adaptation called smoltification that prepares them for ocean residence. Juvenile steelhead migrate before smolting.

Salmonid Spawning Migrations in the Delta

Chinook salmon and steelhead are present in the Delta throughout the year as juveniles migrate out to sea, or adults return to natal streams or sites of hatchery release. The start and duration of emigration is dependent upon water year type, precipitation, accretion in the Sacramento River, and water flows. Distinct emigration pulses coincide with high precipitation, increased turbidity, and storm events (Hood 1990, Pickard et al.1982).

Juvenile winter-run chinook emigrate from the Delta to the ocean from mid-December or January through June. Peak emigration of Sacramento River winter-run chinook through the Delta generally occurs from January through April, but the range may extend from September up to June (Schaffter 1980, Messersmith 1966, CDFG 1989, 1993, USFWS 1992, 1993, 1994). Adult Sacramento River winter-run chinook salmon leave the ocean and migrate through the Sacramento-San Joaquin Delta to the upper Sacramento River from December through June. (Van Woert 1958, Hallock et al.1957).

Spring-run chinook fry and fingerlings can enter the Delta as early as January and as late as June; their length of residency within the Delta is unknown but probably lessens as the season progresses into the late spring months (DFG 1998). Spring-run chinook salmon adults are estimated to leave the ocean and enter the Sacramento River from March to July (Myers et al. 1998). This run timing is well adapted for gaining access to the upper reaches of river systems, 1,500 to 5,200 feet in elevation, prior to the onset of high water temperatures and low flows that would inhibit access to these areas during the fall.

Hallock et al. (1961) found that juvenile steelhead in the Sacramento Basin migrated downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall. Steelhead smolts show up at the Tracy and Banks pumping plants between December and June. Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954; Hallock et al. 1961). The timing of upstream migration is generally correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures.

IV. ENVIRONMENTAL BASELINE

Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta is a complex system of tidally-influenced, interconnected sloughs and channels. The hydrologic complexity is increased further by freshwater inputs to the Delta from several rivers and various sloughs. One-half million pounds of over 30 different herbicides are applied annually on agricultural lands in the Delta, and an additional 5 million pounds are applied upstream in three other watersheds: the Sacramento River, San Joaquin River, and French Camp Slough (Kuivila et al.1999). Herbicides enter the Delta waters from these external (upstream) and from local (Delta) inputs.

Delta Water Quality

Increased water temperatures, insufficient dissolved oxygen, and contaminants have degraded the aquatic habitat quality of rearing and migrating salmonids. Discharges from industrial and agricultural sources have led to increased water temperatures and contaminant levels. Water temperatures typically exceed 60 or 66 degrees Fahrenheit from April through September. Contaminants such as mercury from historic goldmining and industrial & municipal discharges may be well above criteria levels designed to protect beneficial uses in the Delta. Dissolved oxygen (DO) levels are affected by municipal, industrial, and agricultural discharges. Salmonids function normally at DO levels of 7.75 mg/L and may exhibit distress symptoms at 6.0 mg/L (Reiser and Bjornn 1979). Low dissolved oxygen levels impair metabolic rates, growth, swimming ability, and the overall survival of young salmonids.

Sediment Quality

The level of contamination in the Bay-Delta Estuary today is high enough to "moderately" impair the health of the ecosystem overall. Sites in the lower South Bay, the Petaluma River mouth, and San Pablo Bay are more contaminated than other sites. The Bay's Regional Monitoring Program indicate that the contaminants of greatest concern are: mercury, polychlorinated biphenyls (PCBs), diazinon and chlorpyrifos (two pesticides). Also of concern are: copper, nickel, zinc, DDT, chlordane, dieldrin, selenium, dioxins and polyaromatic hydrocarbons (PAHs). Mercury, PCBs, DDT, and PAHs can bioaccumulate in the tissues of salmonids and their prey. In addition, mercury, DDT, and chlordane may biomagnify, or increase contaminant concentration tissue loads, as the food chain progresses to top level participants such as salmonids. Presence of these chemicals may also cause localized depletions of prey abundance around areas of high concentration.

Water Operations

The Sacramento River Basin provides approximately 80 percent of the water flowing into the Delta (DWR 1993). With the completion of upstream reservoir storage projects, the Sacramento River, San Joaquin River, and Delta waterways are now highly regulated systems, such that the current seasonal distribution of flows differs from historical patterns. Only 3-4 percent of the Bay-Delta's historic wetlands remain intact today. The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Reservoir storage capacity in the Sacramento-San Joaquin system now totals 30 million acre-feet. The California State Water Project and the Federal Central Valley Project export over 5.5 million acre-feet of water annually from the Delta to central and southern California.

To a great extent, streamflow volume and runoff patterns regulate the quality and quantity of habitat available to juvenile salmonids. Salmon are highly adapted to seasonal changes in flow. Increased stream flows in the fall and winter stimulate juvenile salmonid downstream migration, improve rearing habitat, and improve smolt survival to the ocean. Over the last few years an increasing trend has been noted in the size of the winter-run chinook salmon run. This increase has been attributed to a number of factors, including favorable environmental conditions, implementation of temperature controls on water released from storage, modified operations of the Red Bluff Diversion Dam, and screening of select diversions. However, increasing trends have not been noted for the remaining ESUs that may be more greatly influenced by changes in natural flow in the Delta waterways from CVP/SWP pumping in the south Delta. These conditions have adversely affected Central Valley salmonids, including the spring-run chinook salmon, through reduced survival of juvenile fish.

Juvenile salmon migrate downstream from their upper river spawning and nursery grounds to lower river reaches and the Delta prior to entering the ocean as smolts. Historically, the tidal marshes of the Delta provided a highly productive estuarine environment for juvenile anadromous salmonids. During the course of their downstream migration, juvenile salmonids utilize the Delta's estuarine habitat for seasonal rearing, and as a migration corridor to the sea. Since the 1850's, reclamation of Delta islands for agricultural purposes has caused the cumulative loss of 94 percent of the Delta's tidal marshes (Monroe and Kelly 1992).

Once in the complex configuration of waterways in the central and southern Delta, fish are subjected to a variety of adverse conditions that decrease their chances for survival. Lower survival rates are expected due to the longer migration route, where fish are exposed to increased predation, higher water temperatures, unscreened agricultural diversions, poor water quality, reduced availability of food, and entrainment at the CVP/SWP export facilities. Through reduced Delta outflow and decreases in net westerly flow, diversion operations are expected to degrade chinook salmon rearing habitat in the Delta, degrade conditions for natural smolt out-migration stimulus and seaward orientation, and generally reduce smolt survival. During dry and critical water years, diversions have an even greater potential for adversely affecting channel hydrodynamics and reducing winter-run chinook salmon, spring-run chinook salmon, and steelhead trout survival already strained by low flows, poor water quality, and high CVP/SWP entrainment rates.

In addition to the degradation and loss of estuarine habitat, downstream migrant juvenile salmon in the Delta are currently subject to adverse conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmon are adversely affected by: (1) water diversion from the mainstem Sacramento River into the Central Delta via the manmade Delta Cross Channel, Georgiana Slough, and Three-mile Slough; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; and (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay. In addition, salmonids are exposed to increased water temperatures from late spring through early fall in the lower Sacramento and San Joaquin River reaches and the Delta. These temperature increases are primarily caused by the loss of riparian shading and thermal inputs from municipal, industrial, and agricultural discharges.

Diversion into the Central and South Delta

Juvenile salmon emigrating from spawning and rearing areas in the Sacramento River may be diverted into the interior Delta through the manmade Delta Cross Channel, Georgiana Slough, or Three-mile Slough. Fisheries investigations by Schaffter (1980) and Vogel et al. (1988) using winter-run chinook salmon juveniles suggests that the number of salmon diverted into the central and South Delta are proportion to flow into the central Delta at the Delta Cross Channel.

Studies conducted using fall-run chinook salmon smolts have demonstrated substantially higher mortality rates for those fish passing into the interior Delta (FWS 1990 and FWS 1992). The increased mortality rates reflect increased susceptibility to predation, delays in migration, exposure to increased water temperatures, and increased susceptibility to entrainment losses at the CVP/SWP export pumps and other water diversion locations within the Delta.

Reverse Flow: Channel hydrodynamics in the lower San Joaquin River and other southern Delta waterways are altered by CVP/SWP water export operations in the south Delta. CVP/SWP pumping can change the net flow in these channels from a westward direction to an eastward direction, particularly during periods of drought and high pumping rates. When present, these 'reverse' flows move the net flow of water east up the San Joaquin River and then south towards the CVP/SWP export facilities, via Old and Middle Rivers. In general, the magnitude of reverse flow increases with the rate of export pumping. Although the mechanism is not well understood, juvenile salmon frequently pass with the net flow of water into a complex network of channels leading to the CVP/SWP water export facilities in the South Delta. Indirect losses of juvenile salmon are thought to occur in these southern Delta channels through predation, disorientation, and delayed out-migration. Direct losses to predation and entrainment are known to occur in Clifton Court Forebay and at the CVP/SWP pumping plants.

Entrainment at CVP/SWP and Clifton Court Forebay: The CVP and SWP Delta pumping plants presently have maximum capacities of 4,600 cfs and 10,300 cfs, respectively. However, the State's existing USACE permit generally restricts the SWP's level of pumping by limiting the monthly maximum average inflow into Clifton Court Forebay to 6,680 cfs. Both projects operate fish collection facilities within the intake channels of their canals using a louver system which resembles venetian blinds and acts as a behavioral barrier. Although the slots are wide enough for fish to enter, approximately 75 percent of the chinook salmon encountering the louvers sense the turbulence and move along the face of the louvers to enter the bypass system. The remaining 25 percent are lost to the pumping plant and canal. Additional losses occur inside the fish screening facilities from predation to striped bass and other predators. Significant handling and trucking losses also occur during the process used to transport salvaged fish to a release site in the western Delta.

Current Operations Under the Bay-Delta Accord and 1995 WQCP

Significant actions to protect beneficial uses in the Delta were initiated by a three-year agreement between the Federal government, State of California, water users, and environmental interests in the Bay-Delta Accord of December 15, 1994 (Accord). Through the Accord and the 1995 WQCP, water quality objectives for the protection of fish and wildlife have been established for the following parameters: dissolved oxygen, salinity, Delta outflow, river flows, export limits, and Delta Cross Channel gate operation. An "operations" group (Water Operations Management Team) coordinates CVP/SWP projects operations, using current biological and hydrological information for the management of water quality, endangered species, and the Central Valley Project Improvement Act. Water quality objectives and criteria established by the Accord are based on historical operations of the CVP/SWP and the life history needs of the fish species affected by Delta water operations. The combined effect of these various criteria seems to have improved the environmental baseline of the Delta to a level which provides adequate protection for the conservation of listed species and critical habitat.

Small scale restoration projects are being undertaken in many locations throughout the Delta, including restoration of Decker, Twitchell, and Bradford Islands. But paramount to these efforts is the implementation of CALFED, a long-term restoration and management plan for the Bay-Delta estuary. This effort to balanced the water needs of all parties has brought together the private stakeholders, the public, and state and federal agencies. Through its implementation, CALFED seeks to restore ecological health to the Bay-Delta estuary and throughout the entire Sacramento River-San Joaquin River watershed, improve the quality and supply of water to the state, and protect the sustainability of the water supply. The goal of CALFED's Ecological Restoration Program (ERP) "is to improve aquatic and terrestrial habitats and natural processes to support stable, self-sustainable populations of diverse and valuable plant and animal species, and includes recovery of species listed under the State and Federal Endangered Species Acts" (CALFED 2000). Examples of activities to be implemented include large-scale restoration projects on Clear Creek, Deer Creek, and the San Joaquin River, removal of select dams, purchase of additional upstream flows, protection and restoration of the natural meander corridor to the Sacramento River, and improvement of water quality throughout the watershed.

V. EFFECTS OF THE ACTION

A. Direct Effects of Application on Salmonids

USDA-ARS and DBW water hyacinth control operations in 2001 may adversely affect the winter-run and spring-run chinook salmon and steelhead, and diminish some of the fisheries habitat benefits gained in the Bay-Delta Accord. Juvenile salmonids may be adversely affected through reduction in oxygen levels from decomposition of dead plants and/or localized and temporary exposure to pesticides. It is important to note that the dense mats of water hyacinth would also result in localized depletions of dissolved oxygen, particularly at night, due to plant respiration. Indirect impacts to juvenile salmonids include a decrease in abundance of invertebrate prey and the removal of native submerged aquatic vegetation used for rearing, cover and forage. The WHCP is not expected to directly or indirectly affect adult salmonids, as adults migrate through the Delta using open channels, and are not expected to utilize aquatic vegetation, including water hyacinth, for cover.

The proposed period for WHCP treatment is from April through mid-December, 2001. This treatment period would overlap 3 months (50 percent) of juvenile adult chinook migration and 5.5 months (61 percent) of winter-run chinook juvenile emigration; most of the spring-run adult migration (80 percent) and juvenile emigration (60 percent); and 8.5 months (77 percent) of the steelhead migration in the Delta. During out-migration, the winter-run juveniles are at sub-yearling stage (age 0); spring-run juveniles are at yearling stage (age 1) and steelhead smolts are post-yearlings (age 1.5 - 2).

Direct toxicity and Environmental Fate of Herbicides

Because the waterhyacinth is a floating aquatic macrophyte, and the pesticides are applied by spraying the floating portion of the plant, the entire amount of pesticide applied does not enter the water column. A conservative estimate of the amount of pesticide entering the water column is 20 percent of the amount applied to the floating portion (Lars Anderson, personal communication).

The estimated environmental concentration of Weedar® 64 at the application rate used in the WHCP (4 lbs. per acre) ranges between 0.294 mg/L and 0.049 mg/L, with complete mixing, at water depths of one and six feet, respectively. The 96 hour LC50 for 2,4-D to rainbow trout ranges between >100 mg/L (Johnson and Finley, 1980) and 250 mg/L (Alexander et al., 1985). Assuming the worst case scenario (i.e., using the highest estimated environmental concentration and the lowest LC50) the concentration of 2,4-D achieved by the WHCP is 340 times lower than the lowest LC50 for rainbow trout. The 96 hour LC50 for 2,4-D to chinook salmon is >100 mg/L (Johnson and Finley, 1980), over 340 times the highest estimated environmental concentration. Furthermore, the concentration of 2,4-D in the water column is expected to diminish rapidly after application through dilution. Weedar® 64 is readily degraded in aquatic environments. Rates of breakdown increase with increased nutrients, sediment load, and dissolved organic carbon. Under oxygenated conditions, the half-life of 2,4-D is 1 week to several weeks (Howard, 1991). The environmental fate characteristics of 2,4-D and the application rate used in the WHCP indicate that the concentrations of 2,4-D achieved in Delta waters are not acutely or chronically toxic to listed salmonids.

The estimated environmental concentration of Rodeo® at the application rate used in the WHCP (10.8 lbs. per acre) ranges between 0.794 mg/L and 0.132 mg/L, with complete mixing, at water depths of one and six feet, respectively. There have been many acute and sublethal toxicity studies conducted on salmonid species for the active ingredient in Rodeo® herbicide, glyphosate. The 96 hour LC50s (calculated as glyphosate) for rainbow trout and chinook salmon exposed to Rodeo® ranged from 130 mg/L to 210 mg/L and 140 mg/L to 290 mg/L respectively (Mitchell et al., 1987). Wan et al. (1989) found that the toxicity of glyphosate to five species of salmonid fishes (coho salmon, chum salmon, chinook salmon, pink salmon, and rainbow trout) decreased with increasing water hardness. For rainbow trout, the 96 hour LC50s ranged from 10 mg/L to 197 mg/L in soft and hard water, respectively. The 96 hour LC50s for chinook salmon followed the same pattern, ranging from 19 mg/L in soft water to 211 mg/L in hard water (Wan et al., 1989). A study by Folmar et al., (1979) estimated the 96 hour LC50 for technical grade glyphosate to rainbow trout to be 140 mg/L. In addition to lethality, Folmar et al., (1979) investigated the effects of glyphosate on reproductive and behavioral endpoints. No changes in fecundity or gonadosomatic index were observed in adult rainbow trout exposed to 2 mg/L of the glyphosate isopropylamine salt for 12 hours. Rainbow trout did not avoid water containing up to 10 mg/L of the glyphosate isopropylamine salt. The results of a four hour exposure of coho salmon to three formulations of a glyphosate herbicide suggest that the threshold concentrations causing acute physiological stress (i.e., increased oxygen consumption, plasma glucose, plasma lactate, hematocrit, and leukocrit) exceeded the 96 hour LC50 value (Janz et al., 1991). Rainbow trout exposed for two months at concentrations of up to100 µg/L of Vision (a glyphosate formulation) exhibited no significant effects in foraging behavior, growth (length and weight), liver tumors, or gill legions (Morgan and Kiceniuk, 1992). Assuming the worst case scenario (i.e., using the highest estimated environmental concentration and the lowest LC50s), the concentration of glyphosate achieved by the WHCP is between 12.6 and 24 times lower than the lowest LC50s for rainbow trout and chinook salmon, respectively. Furthermore, the concentration of glyphosate is expected to decrease rapidly after application in Delta waters through dilution and rapid binding of glyphosate to organic and mineral particulate matter (U.S. Department of Agriculture, 1984). Glyphosate is broken down primarily by microorganisms, and has a half-life in water of 12 days to 10 weeks (U.S. Environmental Protection Agency, 1992).

The estimated environmental concentration of Reward® at the application rate used in the WHCP (2.8 lbs. per acre) ranges between 0.206 mg/L and 0.034 mg/L, with complete mixing, at water depths of one and six feet, respectively. The 96 hour LC50s for rainbow trout exposed to diquat range from 11.2 mg/L (Gilderhus, 1967) to 21 mg/L (Worthing and Hance, 1991). The 8 hour LC50 for diquat dibromide is 12.3 mg/L in rainbow trout and 28.5 mg/L in chinook salmon (Pimental, 1971). Assuming the worst case scenario (i.e., using the highest estimated environmental concentration and the lowest LC50s), the concentration of diquat (Reward®) achieved by the WHCP is between 54 and 138 times lower than the lowest LC50s for rainbow trout and chinook salmon, respectively. The concentration of diquat in Delta waters, achieved by the application rate used in the WHCP, is expected to decrease rapidly through dilution and rapid binding of diquat to particulate matter. Studies on the erosion of diquat-treated soils near bodies of water indicate that diquat dibromide stays bound to soil particles, remaining biologically inactive in surface waters such as lakes, rivers, and ponds (Gillett, 1970). When diquat dibromide is applied to open waters, it disappears rapidly because it binds to suspended particles in the water (Gillett, 1970). Diquat dibromide's half-life is less than 48 hours in the water column, and may be up to 160 days in sediments due to its low bioavailability (Gillett, 1970; Tucker, 1980).

Bioaccumulation of Herbicides

The high water solubility of Weedar® 64 indicates that the active ingredient (2,4-D) is not likely to bioaccumulate in fish tissues, or undergo maternal transfer into developing ovary tissue and associated eggs. Bluegills and channel catfish absorbed only 0.5 percent of radiolabeled 2,4-D during exposure to 2 mg/L in aquaria. The amount of 2,4-D absorbed was maximal after 24 hours of exposure and did not change significantly after 7 days of exposure. Bluegills administered 2,4-D via intraperitoneal injection excreted 90 percent of the dose within 6 hours of treatment (Sikka et al, 1977). Rainbow trout injected with 2,4-D at 0.1 mg/kg excreted 2,4-D via the urine with an elimination half-life of 2.4 hours (Carpenter and Eaton, 1983).

There is very low potential for glyphosate (Rodeo®) to accumulate in the tissues of aquatic invertebrates and other aquatic organisms due to its high water solubility, and strong binding to suspended organic and mineral matter (Monsanto Company, 1985).

There is little or no bioconcentration of diquat dibromide in fish (U.S. National Library of Medicine, 1995). A study on the disposition and toxicokinetics of diquat dibromide in channel catfish estimated the elimination half-life for diquat to be 35.8 hours (Schultz et al, 1995), indicating rapid elimination, and little potential for bioaccumulation.

Dissolved Oxygen

Previous testing of dissolved oxygen (D.O.) levels under floating water hyacinth disclosed low measurements on average of 5 parts per million (ppm). Fish subjected to extended oxygen concentrations below 5 ppm are usually compromised in their growth and survival (Piper et al.1982). The lethal D.O. concentration for most fish is 0 - 3 ppm. NMFS expects that fish and invertebrates will generally avoid areas with large mats of water hyacinth vegetation due to their oxygen deficit. Weedar® 64 acts quickly on water hyacinth, generating tracts of dead vegetation, subsequently lowering dissolved oxygen in treated areas. Based on previous WHCP monitoring measurements, D.O. levels increase over time in areas where water hyacinth has been eradicated.

In general, NMFS expects the lowered DO levels after treatment operations to have insignificant or undetectable effects on emigrating salmonids. As mentioned previously, areas beneath dense concentrations of water hyacinth are likely to have low DO levels, which salmonids are likely to avoid. In areas with lesser concentrations of water hyacinth or open flowing channels, salmonids should be able to avoid the localized DO depletion. This localized depletion may also be short-lived due to tidal flushing or typical river flows mixing oxygenated water into the area.

Removal of Native Submerged Aquatic Vegetation

Native submerged aquatic vegetation may be crowded out by the shading presence of water hyacinth, or could be exposed to the control chemical treatment for water hyacinth. NMFS expects that the benefit of water hyacinth removal offsets any temporary loss of native aquatic vegetation, by providing areas which native vegetation can re-colonize. However, during periods when juvenile salmonids are present, treated areas will not provide cover vegetation or food sources. Treatment procedures could magnify this impact as adjacent acres may have a less than 48-hr. time interval before being treated, resulting in even larger areas devoid of aquatic vegetation. NMFS anticipates that these localized effects will not reduce survival of juveniles emigrating or rearing in the project area as untreated areas will be available for cover and prey species production.

Decrease in Abundance of Invertebrate Prey

The chemicals proposed for use, when applied at label rates, are not known to be toxic to aquatic invertebrate prey items for salmon and steelhead. Areas of low water exchange or low DO, may reflect a decreased number and diversity of aquatic invertebrates which could temporarily affect prey availability for salmonids. As discussed above, these areas are expected to be either avoided by salmonids or re-colonized and re-oxygenated by river and tidal flows, resulting in minimal or undetectable impacts on salmonids.

B. Monitoring

The DBW, with assistance from USDA and CDFA , has been monitoring pre-treatment and post-treatment levels of 2,4-D, Diquat, and Glyphosate since the inception of the WHCP. Historic sampling by DBW, USDA, and CDFA, since 1983, have shown levels of 2,4-D well below allowable State criteria. There have been no recorded fish kills resulting from activities associated with the WHCP since the start of the program. The DBW has been monitoring three fixed locations along with random site location sampling since initiating the WHCP.

In general, the increased monitoring program will include a daily log with site specifics (e.g. location, wind, chemicals used, location of listed species/species habitat), dissolved oxygen levels, pH, and pre-treatment and post-treatment levels of chemical residues.

C. Water Quality

Potential water quality impacts from WHCP include increased water temperatures and decreased dissolved oxygen (DO) levels. During the summer months, the Delta often has water quality conditions that are not suitable for salmonid rearing and migratory behaviors.

Chemical treatments that cause local dissolved oxygen levels to drop below 6.0 mg/L may also cause sublethal physiological impacts to emigrating salmonids. Reiser and Bjornn (1979) found that salmonids exhibit various distress symptoms at 6.0 mg/L. Low dissolved oxygen levels impair metabolic rates, growth, swimming ability, and the overall survival of young salmonids. DBW proposes to prohibit chemical treatment when DO is below 6.0 mg/L. Additionally, DBW proposes to prohibit chemical treatment that will cause a DO drop in the receiving water to below 5.0 mg/L. Localized DO drops to 5.0 mg/L may adversely affect rearing and emigrating juveniles if the drop affects the entire channel cross-section. Impacts to salmonids will be minor as effects are temporary in nature or affect only a portion of the channel, thereby allowing for avoidance of decreased DO areas.

D. Summary of Effects

Based on the foregoing analysis, NMFS anticipates that application of Weedar®64, Rodeo®, or Reward® to the waters of the Delta and its tributaries during 2001 in an effort to control water hyacinth will not result in direct toxic effects to listed salmonids, including death or injury. Application of these herbicides is also not expected to result in bioaccumulation within the tissues of listed salmonids or any of the potential negative consequences of such bioaccumulation. Decreased levels of DO, prey species, and rearing habitat in localized areas are expected to be short-term and may result in minimal levels of harassment or harm of individual salmonids present in treatment areas. Overall these effects are not expected to reduce the numbers, reproduction or distribution of the listed species to a degree that would reduce appreciably their likelihood of survival and recovery. In addition, these effects of the water hyacinth control program are not expected to alter or destroy the functioning of critical habitat within the action area.

VI. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." Future Federal actions are not considered in this Opinion because they require separate consultations pursuant to section 7 of the ESA.

Ongoing impacts identified in the Environmental Baseline section of this Opinion are expected to continue at current levels. Beyond these effects, NMFS is unaware of any future non-Federal activities within the action area which may adversely affect listed salmonids or their critical habitat.

VII. CONCLUSION

Based on the best available scientific and commercial information, the current status of Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon, and Central Valley steelhead, the environmental baseline and the effects of the proposed action, it is NMFS's biological opinion that the proposed water hyacinth control program in 2001 is not likely to jeopardize the continued existence of the winter-run chinook salmon, spring-run chinook salmon, or steelhead trout, or result in the destruction or adverse modification of their critical habitat.

VIII. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS further defines harm to include any act which actually kills, or injures fish or wildlife and emphasizes that such acts may include significant habitat modification or degradation that significantly impairs essential behavioral patterns, including breeding, spawning, rearing, migration, feeding or sheltering. Incidental take is defined as take of a listed animal species that results from, but is not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7 (b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, and the proposed action may incidentally take individuals of a listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Under the terms and conditions of section 7(o)(2) and 7(b)(4), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of the Incidental Take Statement.

The measures described below are non-discretionary. They must be implemented by the USDA-ARS so that they become binding conditions of any grant or permit issued to the DBW, as appropriate, for the exemption in section 7(o)(2) to apply. The USDA-ARS has a continuing duty to regulate the activity covered in this Incidental Take Statement. If the USDA-ARS: (1)

fails to assume and implement the terms and conditions of the Incidental Take Statement, and/or (2) fails to require the DBW to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, USDA-ARS and DBW must report the progress of the action and its impact on the species to NMFS as specified in this Incidental Take Statement (50 CFR §402.14(i)(3)).

This incidental take statement is applicable to the operations of the Water Hyacinth Control Program project as described in the biological assessment submitted on February 9, 2001, and the proposed operations matrix from the Water Board to DBW.

A. Amount or Extent of Take

The NMFS anticipates that Water Hyacinth Control Program (WHCP) operations will result in take of listed salmonids. This will primarily be in the form of harm to salmonids by impairing essential behavior patterns as a result of reductions in the quality or quantity of their habitat. In addition, NMFS anticipates that some juveniles may be killed, injured, or harassed during the chemical application, and boat operation during the treatment process.

The take of listed salmonids will be difficult to detect because finding a dead or injured salmonid is unlikely as the species occurs in habitat that makes such detection difficult. The impacts of DBW operations will result in changes to the quality and quantity of salmonid habitat. These changes in the quantity and quality of salmonid habitat are expected to correspond to injury to or reductions in survival of salmonids by interfering with essential behaviors such as rearing, feeding, migrating, and sheltering. Because the expected impacts to salmonid habitat correspond with these impaired behavior patterns, NMFS is describing the amount or extent of take anticipated from the proposed action in terms of limitations on habitat impacts. The NMFS expects that physical habitat impacts will be consistent with the project description in terms of location, scope, and compliance with proposed minimization and mitigation measures, compliant with the terms and conditions of this incidental take statement, and within the expected effects of DBW operations as described in this Opinion. Adverse effects to, and incidental take of, listed salmonids are primarily expected during the June 15th through November time period.

Anticipated incidental take will be exceeded if DBW operations are not in compliance with the project description or the terms and conditions of this incidental take statement, or if effects of DBW operations are exceeded or different than the expected effects described in this Opinion.

For example, NMFS anticipates that DBW operations in 2001 will decrease the amount of oxygen and available habitat in the Sacramento/San Joaquin Delta. This decrease in oxygen, when salmonids are present, is expected to result in reduced feeding and rearing success, or reduced survival of juveniles drawn into the complex maze of waterways in the Delta.

Discharges of 2,4-D and glyphosate chemical residue are expected to decrease availability of shallow water habitat, increase shallow water temperatures and decrease dissolved oxygen (DO) levels. Increased temperatures and reduced DO levels are expected to result in sub-lethal physiological stress leading to reduced fitness and survival, termination of smoltification, and delays in migration. DBW operations are expected to result in DO level changes to no less than 5.0 mg/L and temperature increases of no more than four degrees (or two degrees, depending on ambient water temperatures) in the receiving waters. Therefore, changes in DO to less than 5.0 mg/L or temperature increases of more than two or four degrees, as appropriate, would exceed the anticipated levels of incidental take.

Changes in instream habitat around shallow areas and navigation channels, critical habitat for Central Valley steelhead and Central Valley spring-run chinook salmon, are expected to reduce rearing and feeding opportunities for juvenile salmonids migrating through the area, resulting in reduced fitness and survival rates.

Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of winter-run chinook salmon, spring-run chinook salmon, or steelhead trout taken caused by DBW.

1. Measures shall be taken to reduce the impact of DBW water hyacinth control program boating operations on designated critical habitat of winter-run chinook salmon, spring-run chinook salmon and steelhead trout.

2. Measures shall be taken to reduce degradation of Delta habitat during water hyacinth control and maintenance activities.

3. Measures shall be taken to reduce impacts to juvenile chinook salmon and steelhead trout from chemical control treatment and/or monitoring activities.

4. Measures shall be taken to monitor DBW water hyacinth control operations and Delta hydrologic conditions.

5. Measures shall be taken to adaptively management DBW water hyacinth control operations from season to season.

The USDA-ARS is responsible for DBW compliance with the following non-discretionary terms and conditions that implement the reasonable and prudent measures described above:

1. **Measures shall be taken to reduce the impact of DBW water hyacinth control program boating operations on designated critical habitat of winter-run chinook salmon, spring-run chinook salmon and steelhead trout.**

Terms and conditions:

A. USDA-ARS and DBW shall comply with the receiving water limitations of the NPDES permit issued for the WHCP in regards to oils, greases, waxes, floating material, or suspended material.

B. The USDA-ARS and DBW shall ensure that any mixing of chemicals, or disinfecting of any equipment shall be done on land in order to avoid possible contamination of Delta waters.

C. The USDA-ARS shall ensure that DBW annually submits a log record to NMFS Southwest Region that documents compliance with measures 1A - 1B above.

2. **Measures shall be taken to reduce degradation of Delta habitat during water hyacinth control and maintenance activities.**

Terms and conditions:

A. USDA-ARS and DBW shall ensure compliance with the receiving water limitations and monitoring provisions of the NPDES permit issued for the WHCP.

B. Chemical constituents are not to exceed the following concentrations:

2,4-D	20 ug/L
Diquat	0.5 ug/L
Glyphosate	700 ug/L

C. Ambient pH shall not fall below 6.5, exceed 8.5, or change by more than 0.5 units.

D. Turbidity shall be measured pre-treatment and post-treatment, to assess the extent of turbidity attributed to control operations and refine future operation protocols.

3. **Measures shall be taken to reduce impacts to juvenile chinook salmon and steelhead trout from chemical control treatment and/or monitoring activities.**

Terms and conditions:

A. Current real-time monitoring indicate a late Delta juvenile migration for the 2001 season. The Delta Cross Channel is also subject to openings on holidays and weekends throughout the "closed" season. Chemical controls for the water hyacinth program in the Delta shall therefore not be applied before June 15, 2001.

B. Chemical controls for the water hyacinth program shall not be applied after October 15, 2001.

C. Any winter-run chinook salmon, spring-run chinook salmon, and steelhead trout mortalities found at treatment sites shall be placed in labeled whirl-pak bags and promptly frozen. Labels shall include the date, time, and location of capture, including near shore habitat type and water stage, and the fork length of the fish. NMFS, Sacramento Field Office, shall be notified as soon as soon as possible of any chinook salmon or steelhead mortalities.

D. An annual report of DBW operations shall include:

   i. a description of the total number of winter-run chinook salmon, spring-run chinook salmon, or steelhead trout taken, the manner of take, and the dates and locations of take, the condition of winter-run chinook salmon, spring-run chinook salmon, or steelhead trout taken, the disposition of winter-run chinook salmon, spring-run chinook salmon, or steelhead trout taken in the event of mortality, and a brief narrative of the circumstances surrounding injuries or mortalities; and this report shall be submitted to the addresses given below.

E. DBW staff must follow Federal law and use herbicide products consistent with labeling pertaining to application windows, to allow adequate time between treatments on water hyacinth:

   i. Weedar® 64: restricted entry interval (REI) is 48 hours; buffer strips must be a minimum of 100 feet wide, and delay treatment of the strips for 4 to 5 weeks or until dead vegetation has decomposed.

   ii. Rodeo®: REI is 7 days; complete plant necrosis occurs within 60 - 90 days.

   iii. Reward®: REI is 14 days; treat only 1/3 to ½ of the water body area at one time.

F. Fish passage shall not be blocked within treatment areas. Protocols shall be followed to ensure that WHCP operations do not inhibit passage of fish in each area slated for treatment, and these will be submitted to NMFS prior to the treatment season.

G. The DBW will provide a copy of each weekly Notices of Intent (NOI) to Dr. Christopher Tatara, NMFS toxicologist, NMFS Regulatory Support Team, 777 Sonoma Avenue, Room 325, Santa Rosa, CA 95404-6515, by the Friday prior to the treatment week. This notification will include the sites scheduled for treatment and a contact person for those sites.

H. Dr. Christopher Tatara will be the appointed NMFS representative on the Water Hyacinth Task Force (Task Force), and provide technical guidance to the Task Force along with carrying out the duties of a Task Force member.

4. Measures shall be taken to monitor DBW water hyacinth control operations and Delta hydrologic conditions.

Terms and conditions:

A. The USDA-ARS shall ensure that DBW follows a comprehensive monitoring plan designed to collect project operational information. This monitoring plan shall be submitted to NMFS Southwest Region for review and approval upon its immediate completion and prior to its implementation. The results of this monitoring program will be used to determine if the DBW project is affecting winter-run chinook salmon, spring-run chinook salmon, or steelhead trout to an extent not previously considered.

B. The USDA-ARS, in coordination with DBW, shall provide weekly monitoring reports of hydrologic conditions and control chemical discharges to Dr. Christopher Tatara, NMFS-Santa Rosa. These reports shall include information on the following parameters:

  i. Pre-treatment and post-treatment measurements on chemical residue, intertidal vegetation, pH, and turbidity levels.

  ii. Daily receiving water temperatures and dissolved oxygen conditions and resultant changes in those conditions resulting from DBW discharges.

  iii. Pre-treatment and post-treatment conditions of habitat to assess the effects of chemical drift on downstream habitat.

C. The USDA-ARS, in coordination with DBW, shall summarize the above weekly reports into an annual report of the DBW project operations, monitoring measurements and Delta hydrological conditions for the previous treatment year for submission to NMFS by December 30 of each year.

D. All weekly and annual reports shall be submitted by mail or fax to:

Regional Administrator
Southwest Region, NMFS
501 West Ocean Boulevard, Suite 4200
Long Beach, California, 90802
Fax: (562) 980-4027

Mr. Mike Aceituno
NMFS, Sacramento Field Office
650 Capitol Mall, Suite 6070
Sacramento, California, 95814
Fax: (916) 498-6697

Dr. Christopher Tatara
NMFS, Santa Rosa Field Office
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95404
Fax: (707) 578-3435

5. Measures shall be taken to adaptively manage DBW water hyacinth control operations from season to season.

A. As part of the WHCP Task Force, the NMFS representative will be active in guiding decisions on prioritizing treatment sites in regards to the presence of salmonids.

B. USDA-ARS will explore CALFED partnership programs to help control water hyacinth in the Delta, including a revegetation program with native Delta plants.

C. USDA-ARS will continue to research and develop non-chemical controls for water hyacinth, including exploring ways of refining previous biological control and mechanical control experiments

IX. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These "conservation recommendations" include discretionary measures that the USDA-ARS can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, NMFS provides the following conservation recommendations that would reduce or avoid adverse impacts on the Central Valley spring-run chinook salmon ESU:

1. The USDA-ARS should encourage alternate non-chemical controls of water aquatic hyacinth and other non-native invasive vegetation in the Sacramento/San Joaquin Delta and its tributaries.

2. The USDA-ARS should support, through research and other means, studies which evaluate juvenile salmonid rearing and migratory behavior in the Sacramento/San Joaquin Delta, including the effects of various chemical control operations and non-point source chemical and nutrient input into the Delta on juvenile survival and behavior.

X. REINITIATION OF CONSULTATION

Reinitiation of formal consultation is required if there is discretionary Federal involvement or control over the action and if (1) the amount of extent of taking specified in any incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the actions subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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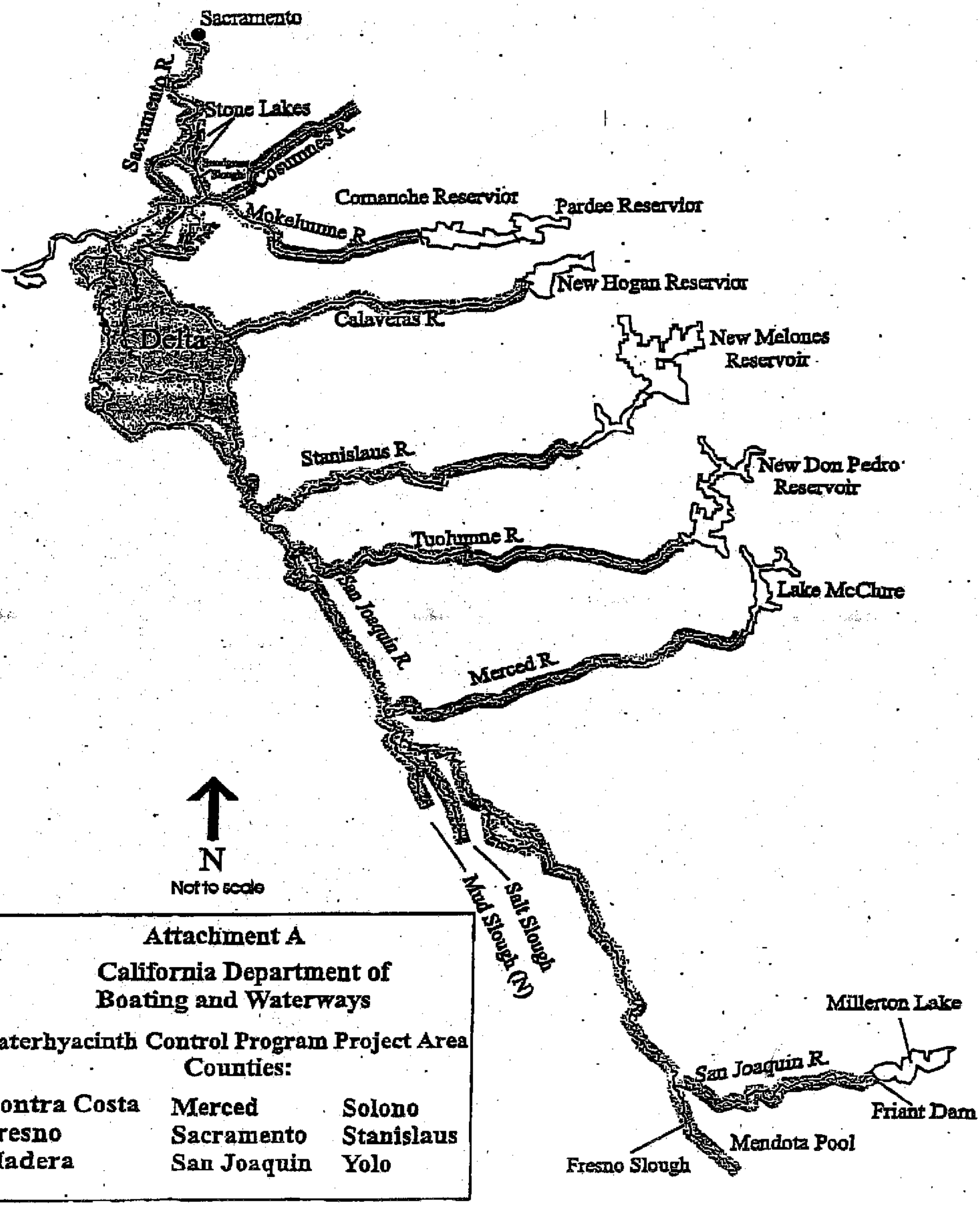

Attachment A

California Department of Boating and Waterways

Waterhyacinth Control Program Project Area

Counties:

Contra Costa
Fresno
Madera
Merced
Sacramento
San Joaquin
Solono
Stanislaus
Yolo

Attachment B.

Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth new mandates for the National Marine Fisheries Service (NMFS), regional fishery management councils, and federal action agencies to identify and protect important marine and anadromous fish habitat. The Councils, with assistance from NMFS, are required to delineate "essential fish habitat" (EFH) in fishery management plans (FMPs) or FMP amendments for all managed species. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NMFS' conservation recommendations. In addition, NMFS is required to comment on any state agency activities that would impact EFH. Although the concept of EFH is similar to that of "Critical Habitat" under the Endangered Species Act, measures recommended to protect EFH are advisory, not proscriptive.

The Pacific Fisheries Management Council has delineated EFH for Pacific Coast salmon (PFMC 1999). Species within the action area of the preceding biological opinion which require EFH consultation are chinook salmon (Oncorhynchus tshawytscha). The U.S. Department of Agriculture, Agricultural Research Service (USDA-ARS), in cooperation with the State of California Department of Boating and Waterways (DBW), must provide a detailed response in writing describing the measures proposed by State of California Boating and Waterways for avoiding, mitigating, or offsetting the impacts of the project on EFH.

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific salmon fishery is proposed as waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (Pacific Fisheries Management Council 1999).

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, "waters" includes aquatic areas and their associated physical , chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle. For the Sacramento-San Joaquin Delta, the aquatic areas that may be identified as EFH for salmon are within the hydrologic unit map numbered 18040003 (titled San Joaquin Delta).

Historically, the Sacramento-San Joaquin Delta, has served as a migratory route for immigrating adult winter, spring, and fall-run chinook salmon (*Oncorhynchus tshawytscha*) to their spawning habitat, and for rearing and emigration of juveniles returning to the ocean (Yoshiyama et al. 1996). Within the Central Valley of California, populations of winter and spring-run chinook salmon have declined significantly as a result of habitat degradation due to dams, water diversions, and placer mining, as well as past and present land-use practices. The fall-run has been reduced, however to a lesser extent than the winter-run and spring-runs (Myers 1998). Recent estimates find that fall-run chinook have declined between 85 percent to 90 percent (Rich and Loudermilk 1991; USFWS 1995) of the population levels which existed in the 1940's. Fall-run chinook spawning population estimates from the Stanislaus, Tuolumne and Merced Rivers from 1974 to 1991 show both rising and descending trends lasting for several years (Kano 1996, 1998). Factors limiting salmon populations include low instream flows, high water temperature, reversed flows in the Delta (drawing juveniles into large diversion pumps), loss of fish into unscreened agricultural diversion, predation (especially by warm-water fish species), and lack of rearing habitat (Kondolf et al., 1996a, 1996b). In addition to direct losses caused by the entrainment or entrapment of fish at diversions, withdrawals of water affect both the total volume of water available to salmon and their prey, as well as the seasonal distribution of flows. Consequently, migration may be altered, changes to sediment and large woody debris transport and storage, altered flow and temperature regimes, pollution, and water level fluctuations may result (Dettman et al. 1987; CACSST 1988).

LIFE HISTORY AND HABITAT REQUIREMENTS

General life history information for chinook salmon is summarized below. Further detailed information on chinook salmon ESUs are available in the NMFS status review of chinook salmon from Washington, Idaho, Oregon, and California (Myers et al. 1998), and the NMFS proposed rule for listing several ESUs of chinook salmon (NMFS 1998).

Central Valley fall-run chinook enter the Sacramento and San Joaquin Rivers from July through April and spawn from October through December (USFWS 1998) with spawning occurring from October through December. Peak spawning occurs in October and November (Reynolds et al. 1993). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 6 inches, usually 1-3 feet to 10-15 feet. Preferred spawning substrate is clean loose gravel, Gravels are unsuitable for spawning when cemented with clay or fines, or when sediments settle out onto redds reducing intergravel percolation (NMFS 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds et al. 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and estuary (Kjelson et al. 1982). The remainder of fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade and protect juveniles and smolts from predation. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

In contrast, the majority of fry carried downstream soon after emergence are believed to reside in the Delta and estuary for several months before entering the ocean (Healey 1980, 1982; Kjelson et al. 1982). Principal foods of chinook while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as *Daphnia,* flys, gnats, mosquitoes or copepods (Kjelson et al. 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates. Whether entering the Delta or estuary as a fry or juvenile, fall-run chinook depend on passage through the Sacramento-San Joaquin Delta for access to the ocean.

II. PROPOSED ACTION.

The proposed action is described in Part II of the preceding Biological Opinion for the Water Hyacinth Control Program in 2001.

III. EFFECTS OF THE PROJECT ACTION

The Sacramento-San Joaquin Delta is of vital importance to the migration of adult and juvenile chinook salmon. In addition, the majority of the fall-run chinook salmon rely on the Delta and estuary for rearing that will prepare them for entry and survival in the ocean. As such, it functions as a portion of the habitat necessary to support a sustainable population. The presence and operation of DBW's Water Hyacinth Control Program can interrupt the EFH habitat functions by reducing the quantity and quality of rearing, feeding, migration and sheltering habitat.

It is anticipated that DBW operations will adversely impact the zooplankton prey base immediately after chemical application. These impacts may result in reduced feeding and rearing success, and impede juvenile migration. Water quality may be affected by increasing temperatures and chemical pollutants, and decreasing dissolved oxygen levels. These actions are expected to reduce rearing and feeding opportunities for juvenile fall-run chinook salmon by removing or otherwise destroying rearing habitat and increasing pollution input from boats. Lastly, the monitoring of delta smelt may result in the incidental capture of fall-run chinook salmon.

Water Hyacinth Control Program will result in long-term control of the water hyacinth and ultimately opening up rearing habitat and migration routes for the fall-run chinook salmon.

IV. CONCLUSION

Upon review of the effects of the DBW Water Hyacinth Control Program, NMFS believes that the operation of the Water Hyacinth Control Program may adversely affect EFH of fall-run chinook salmon in the project area of the Sacramento-San Joaquin Delta.

V. EFH CONSERVATION RECOMMENDATIONS

NMFS recommends that Reasonable and Prudent Measures Numbers 1, 2, 3, and 4, and their respective Terms and Conditions listed in the Incidental Take Statement prepared for the Central Valley spring-run chinook salmon ESU in the preceding Biological Opinion be adopted as EFH Conservation Recommendations. In addition, three additional EFH Conservation Recommendations are provided below. These recommendations are provided as advisory measures.

1. The USDA-ARS and DBW should report annually to NMFS on the amount of herbicide applied onto each treated region of the Delta and habitat islands, as well as the estimated acreage of treated water hyacinth into the Delta.

2. The USDA-ARS and DBW should monitor the treated areas and implement adequate control measures to minimize areas of decreased oxygen into the Delta during water hyacinth chemical control operations.

3. The USDA-ARS and DBW should report annually on the progress and success of the restoration of the treated acres of shallow water habitat, and its benefits to fall-run chinook salmon.

VI. U.S. DEPARTMENT OF AGRICULTURE STATUTORY REQUIREMENTS

The Magnuson-Stevens Act and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the MSFCMA require federal action agencies to provide a written response to EFH Conservation Recommendations within 30 days of its receipt. A preliminary response is acceptable if final action cannot be completed within 30 days. Your final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH Conservation Recommendations, the USDA-ARS must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

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