STATE OF CALIFORNIA—THE RESOURCES AGENCY PETE WILSON, *Governor*

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
AN FRANCISCO, CA 94105-2219
OICE AND TDD (415) 904-5200

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Energy and Ocean Resources Unit
Staff: SMH & JJL–SF
Staff Report: August 22, 1997
Hearing Date: September 9, 1997
Commission Action:
Commission Vote:

Authorization for SONGS Marine Fish Hatchery Memorandum of Agreement

I. Staff Recommendation

The staff recommends that the Commission authorize the Executive Director to sign the attached Memorandum of Agreement (MOA) for the State of California's Ocean Resource Enhancement and Hatchery Program between the Commission, the California Department of Fish and Game (DFG), and the Ocean Resources Enhancement Advisory Panel. The draft MOA is attached as Exhibit A.

The MOA implements Condition C, Section 3.0 of the San Onofre Nuclear Generating Station (SONGS) Coastal Development Permit 6-81-330A (formerly 183-73), as amended on April 9, 1997. Condition C requires the permittee (Southern California Edison Company) to transfer $3.6 million (plus accrued interest) to DFG for the mariculture/marine fish hatchery program operated under its Ocean Resource Enhancement and Hatchery Program (OREHP). The purpose of the permit condition is to compensate in part for losses to the kelp bed community that the Coastal Commission found to be caused by the operation of SONGS Units 2 and 3. The MOA establishes DFG's agreement to spend the monies on mariculture/marine fish hatcheries and the process by which a joint panel will oversee the expenditure of the monies.

The permittee has met the initial step for Condition C, Section 3.0, by establishing an interest-bearing account in the amount of $3.6 million. Following execution of the MOA, the Executive Director will direct the permittee to transfer these monies, plus accrued interest, to DFG's OREHP account, thus fulfilling the remainder of the permittee's obligation for Section 3.0 of Condition C. Under the terms of the MOA, the funds will then be expended by DFG for the OREHP, specifically: (1) repayment of the debt for construction of the pilot hatchery at Agua Hedionda Lagoon in Carlsbad; (2) the cost of additional equipment and resources needed to achieve full operating capacity of the hatchery (i.e., "hatchery build-out"); and (3) hatchery operating expenses for approximately eight years. In addition, funds may be used to cover administrative overhead, provided such expenses do not exceed 5% of hatchery expenditures.

Expenditure of the permittee monies as directed by the MOA meets the intent of Condition C. In approving the permit amendment in April 1997, the Commission found that funding a mariculture/marine fish hatchery program will provide compensation for kelp bed resources not replaced by the artificial mitigation reef. The Commission also found that while marine fish hatcheries have not yet been

demonstrated to enhance fish stocks, recent results from the pilot hatchery in Carlsbad are promising, and that this technique has the potential for substantially enhancing coastal fish populations, including those utilizing kelp beds. (Adopted Findings and Conditions, May 14, 1997)

The staff has worked closely with DFG to prepare the draft MOA contained in Exhibit A. Should any significant change to the language in the MOA be necessary, the staff will bring the matter back to the Commission for further authorization.

II Motion and Resolution

Commission authorization for executing the draft MOA requires the following motion:

> I hereby move that the Commission authorize the Executive Director to sign the Memorandum of Agreement for the Ocean Resource Enhancement and Hatchery Program as recommended by the staff.

The staff recommends a **"yes"** vote and adoption of the following resolution:

> The Commission hereby determines that the draft Memorandum of Agreement that is set forth in this staff recommendation, dated August 22, 1997, carries out the intent of Condition C, Section 3.0 of Permit 6-81-330A (formerly 183-73) by providing an appropriate mechanism for the permittee to meet its obligation to transfer $3.6 million (plus accrued interest) to the Department of Fish and Game to implement its marine fish hatchery program.

EXHIBIT A:

Draft Memorandum of Agreement and Attachments

Memorandum of Agreement
for the
State of California's
Ocean Resources Enhancement and Hatchery Program
between the
California Coastal Commission
California Department of Fish and Game
Ocean Resources Enhancement Advisory Panel

This Memorandum of Agreement (Agreement or MOA) is entered into between the California Coastal Commission (Coastal Commission), California Department of Fish and Game (DFG), and Ocean Resource Enhancement Advisory Panel (OREAP), also referred to as the Parties.

The Parties agree as follows:

1.0 BACKGROUND AND PURPOSE

On April 9, 1997, the Coastal Commission amended Coastal Development Permit 6-81-330-A (formerly 183-73) (the Permit) for the San Onofre Nuclear Generating Station (SONGS) to require Southern California Edison Company (SCE), as majority owner and operating agent, to provide $3.6 million (plus accrued interest) for the mariculture/marine fish hatchery program operated by the State of California through the Ocean Resource Enhancement and Hatchery Program (OREHP). These funds are in addition to the $1.2 million previously provided by SCE in 1994 as required by the March 1993 amendment to the Permit. The purpose of this new funding requirement is to compensate in part for losses to the kelp bed community that the Coastal Commission found to be caused by the operation of SONGS Units 2 and 3.

Since 1993, Hubbs-Sea World Research Institute (HSWRI), pursuant to a contract with DFG, has constructed a pilot production hatchery at Agua Hedionda Lagoon, located in Carlsbad. The current facility consists of the main hatchery building and a series of eight raceways. Within the hatchery are pools to hold 200 broodstock, incubators to hold eggs and larval fish, and tanks to grow the fish to three inches, at which time they are transferred to the pen grow-out facilities. The raceways are used for holding fish before their transfer to the grow-out facilities.

The hatchery has been operating at limited capacity for over two years. To bring the facility to full production, additional equipment is needed to: enhance water quality and flow; better control environmental conditions within the hatchery and raceway system; expand and enhance food production and distribution to the fish; facilitate coded wire tagging of juvenile white seabass; and increase reliability of the tagging

and recovery process. In addition, four cage systems, to be placed in Agua Hedionda Lagoon or along the open coast, are needed to assure adequate grow-out capability.

HSWRI will continue to operate the hatchery under contract to DFG. HSWRI is responsible for all hatchery operations, including bringing the facility to full production. When the hatchery is operating at full capacity, production should reach 400,000 juvenile white seabass per year. Reaching full hatchery production is expected occur within a year of receiving the $3.6 million.

The purpose of this Agreement is to ensure that the monies SCE is required to provide by Condition C of the Permit are spent on mariculture/marine fish hatcheries under OREHP consistent with the intent of Condition C of the Permit. The pertinent section of Condition C, Section 3.0, Funding Requirement for Mariculture/Fish Hatchery Program, is attached as Exhibit 1.

2.0 PARTIES TO THE MOA

The Parties to this Agreement are:

(1) the California Department of Fish and Game, which is the principal state agency responsible for the establishment and control of fishery management programs, including the California Ocean Resources Enhancement and Hatchery Program (OREHP);

(2) the Ocean Resources Enhancement Advisory Panel established by the Legislature to assist the DFG in establishing policy and direction for OREHP; and

(3) the California Coastal Commission, which is a state coastal management and regulatory agency with authority over the development and use of the California coast and coastal waters.

3.0 CONTINUATION OF April 6, 1994 MOA

The Memorandum of Agreement for the State of California's Experimental Marine Fish Enhancement Hatchery between the Parties and SCE, effective April 6, 1994 (the 1994 MOA), established terms for expenditure of the $1.2 million previously provided by SCE and for DFG funding of a genetic quality assurance program and evaluation program. The provisions of the 1994 MOA remain in effect. A copy of the 1994 MOA is attached as Exhibit 2.

4.0 FUNDING

Upon receipt of the $3.6 million plus accrued interest provided by SCE in accordance with the Permit, DFG shall deposit the monies into its interest-bearing OREHP dedicated account and assign the monies a separate Program Cost Account code (the Fund). The Fund shall be held in accord with all applicable State statutes, regulations, and administrative requirements.

The Fund shall be expended only for the purposes described in section 5, unless those purposes are modified in writing and agreed to by all Parties to this Agreement.

5.0 PROJECT DESCRIPTION

Monies from the Fund shall be spent on the HSWRI hatchery program at Agua Hedionda Lagoon as further described in the Comprehensive Hatchery Plan and SONGS Budget, incorporated herein and attached as Appendix A. The three primary components for expenditure are: (1) repayment of the debt for the hatchery construction; (2) cost of additional equipment and resources needed to achieve full operating capacity of the hatchery, i.e., "hatchery build-out"; and (3) hatchery operating expenses for approximately eight years. In addition, funds may be used to cover administrative overhead, which shall not exceed 5% of expenditures.

The identified costs of these components are estimates and are not intended to commit an exact dollar amount to that component.

5.1 Hatchery Construction Debt Repayment

Initial construction of the experimental marine fish hatchery for white seabass, completed during the spring of 1997, resulted in a construction debt of $593,760. The Fund will be used to retire the debt.

5.2 Hatchery Build-Out

Approximately $816,800 from the Fund will be used for the planned build-out of the hatchery. The build-out will:

(1) upgrade the raw seawater delivery system to increase flow, improve physical water quality and decrease pathogens;

(2) increase food production (plankton) for larval fish;

(3) increase broodstock holding capabilities;

(4) secure an emergency power supply (generator);

(5) expand data logging and computer capability for increased monitoring of fish health;

(6) increase coded-wire tagging and fish counting ability;

(7) expand vacuum degassing system;

(8) increase hatchery capability to grow-out fish to release size; and

(9) increase fish transporting capability.

5.3 Hatchery Operating Expenses

The remaining funds (approximately $2,189,440 plus all accrued interest) shall be used for hatchery operating expenses, including genetic evaluation, experimental augmentation, and fish hatchery personnel, as described in Appendix B, incorporated herein and attached hereto.

6.0 PLANNING AND OVERSIGHT

The Joint Panel formed pursuant to section 4.1 of the 1994 MOA shall have the planning and oversight responsibilities for the projects set forth in section 5 of this Agreement. The responsibilities and procedures shall be as follows:

6.1 Responsibilities

The Joint Panel shall have the following general oversight responsibilities to ensure development of this hatchery and grow-out facilities: (1) develop and oversee the evaluation and genetic quality assurance programs, (2) develop Requests for Proposals (RFPs) or contracts to conduct the programs, consistent with requirements of State law and all relevant provisions of this Agreement, (3) make recommendations for contractor selections to the OREAP and Director of DFG, (4) make recommendations for development of contract terms, and (5) oversee and evaluate contractor performance in carrying out the evaluation and genetic quality assurance programs.

6.2 Procedures

The Joint Panel shall select its chairperson from among its members, and shall make decisions by a majority vote of all panel members entitled to vote. The Joint Panel shall meet as often as necessary, but at least twice a year.

7.0 ENVIRONMENTAL QUALITY

Permits issued by the Coastal Commission, in connection with the hatchery project, may require careful monitoring of the hatchery and grow-out facilities to ensure they are not causing significant environmental degradation. The Joint Panel shall review the potential causes of environmental degradation from the hatchery and grow-out facilities, and develop a monitoring program to be implemented by the fish hatchery operator and grow-out facility operators. In addition, the Joint Panel shall make recommendations to DFG and OREAP as to whether additional applied ecological studies should be conducted to ensure adequate monitoring, or to develop methods to reduce or eliminate the potential causes of degradation.

In carrying out the projects set forth in section 5 of this Agreement, the hatchery contractor must satisfy the waste discharge requirements of the appropriate Regional Water Quality Control Board, adhere to the standards set forth in the Hatchery Plan, and comply with the requirements of the Joint Panel with respect to the evaluation program, the genetic quality assurance program, and the environmental monitoring program, implemented pursuant to the requirements of the 1994 MOA. Managers of the grow-out facilities must comply with the requirements of the Joint Panel with

respect to the evaluation program, the genetic quality assurance program, and the environmental monitoring program, and follow the Grow-Out Facility Procedures Manual contained in the 1994 MOA.

If, after consulting with the Joint Panel, the Executive Director of the Coastal Commission determines that the operation of the hatchery or of a particular grow-out facility is causing significant degradation of the environment, the Executive Director may recommend to the Coastal Commission, and the Coastal Commission may require, that operation of the facility be modified, or halted to abate the degradation. The Parties agree to take whatever action is necessary and appropriate to enforce the Coastal Commission decisions.

8.0 CONTRACTING PROCEDURES

8.1 Requests for Proposals

The Joint Panel shall develop Requests for Proposals (RFPs) according to the requirements of the State Administrative Manual (SAM) Sections 1200-1290 and 8752, as applicable, and DFG contract procedures. These procedures will be provided to the Joint Panel by DFG.

8.2 Selection of Contractors

The Director of DFG shall select contractors in accordance with the requirements of SAM Sections 1200-1290 and 8752, as applicable. Contractors are subject to the competitive bid requirements of SAM unless otherwise exempted. The Director of DFG shall be guided by the Joint Panel's recommendation and advice in selecting contractors. If the Director of DFG does not select a contractor recommended by the Joint Panel, the Director of DFG shall provide the Joint Panel with a written explanation of the reason for the different selection. The Parties agree that these contracts will be let by the DFG Director pursuant to SAM and the Public Contracts Code.

8.3 Preparation of Contracts

The DFG shall prepare contracts according to SAM Sections 1200-1290 and 8752. All contracts are subject to approval by the Department of General Services, unless otherwise exempted by State law.

8.4 Change of Contractors

If the project is not terminated, but the Joint Panel determines that a new operations contractor is required, sections 8.1 to 8.3 shall apply to the new operations contractor.

9.0 FINANCIAL RECORDS AND ACCOUNTING

The DFG, OREAP, and their contractors must follow Generally-Accepted Accounting Procedures (GAAP), and must maintain financial management, accounting systems, and procedures which provide for (1) accurate, current and complete disclosure of all financial activity related to the Fund, (2) effective control over, and accountability for

all monies, property and other assets related to the Fund, (3) comparison of the Fund's actual outlays and budgeted amounts, and (4) accounting records for the Fund supported by source documentation. Semi-annual financial reports showing current and cumulative financial activity of the Fund must be provided to the Joint Panel. All records pertaining to the Fund must be available at any time for examination by the Joint Panel.

The DFG, OREAP, and their contractors shall retain all pertinent books, documents and papers, including financial transactions and supporting documents, and policies and procedures for the general accounting system, internal controls, and management practices for a period of three years following the date(s) of all final payment(s) from the Fund.

Any of the Parties can request that an audit be conducted at its own expense by an independent, certified public accountant. Copies of the audit report(s) shall be provided to all Parties to this Agreement.

10.0 RIGHTS IN DATA

All data, including, but not limited to, reports, drawings, blueprints, technical information, financial information, and contracts, resulting from the implementation of the Agreement shall be the joint property of all Parties to this MOA. Notwithstanding the foregoing, any Party to the Agreement, or to a contract prepared thereunder, may use the data for its own purposes, including publication, provided a statement is included with each publication of the data that the views expressed are those of the individual party alone, and not of the other Parties.

11.0 DISPUTE RESOLUTION

A failure on the part of any of the Parties to carry out the terms of the Agreement shall result in the following process. First, the party that believes another party is failing to carry out the terms of the Agreement shall present the problem to the joint Panel for resolution. If the Joint Panel cannot resolve the issue to the satisfaction of the Party, the Party may bring the issue to the Executive Director of the Coastal Commission and the Deputy Director for Fisheries of the DFG, who shall jointly try to resolve the problem. If the Executive Director of the Coastal Commission and the Deputy Director for Fisheries of the DFG cannot resolve the issue, the matter shall be referred to the Secretary for Resources for resolution.

12.0 MODIFICATION

This Agreement may be amended only in a writing executed by all of the Parties.

13.0 TERMINATION

13.1 Initial Term

This Agreement shall be effective upon execution by all Parties, and shall continue in effect until December 31, 2002, unless sooner terminated or extended as provided herein.

13.2 Extension

If the Legislature extends the OREHP beyond December 31, 2002, this Agreement is automatically extended for the period of time determined by DFG to be necessary to fully expend the Fund for the purposes set forth herein, provided, however, that no extension shall be effective beyond the date that the Legislature has extended the OREHP.

13.3 Early Termination

13.3.a Mutual Agreement. This Agreement may be terminated at any time by written mutual agreement of all the Parties.

13.3.b Failure of Legislative Authority. In the event that the Legislature fails to extend Article 8 of Chapter 5 of Division 6 of the Fish and Game Code, which provides for the OREHP, DFG, upon notice to the other Parties, may withdraw from this Agreement as of the effective date of such repeal. The Agreement then shall terminate as to all other Parties, 30 days after DFG's withdrawal.

13.3.c Other Events Justifying Early Termination. Any Party may effect the termination of this Agreement upon 30 days notice, if the operation of the hatchery ceases for any of the following reasons:

(a) The operator loses the right to occupy the land upon which the hatchery is built;

(b) The operator ceases to exist as a non-profit entity, and another entity does not qualify to assume management and operation of the hatchery;

(c) The operation of the hatchery becomes impossible or impractical due to the occurrence of some event of *force majeure*.

13.3.d Disposition of Assets. Upon termination of the MOA, the disposition of the hatchery building and raceways will be the responsibility of the operations contractor. Equipment purchased by the operations contractor pursuant to this Agreement shall be retained by that contractor. Disposition of the hatchery fish will be the responsibility of DFG or its agent. Unexpended monies from the Fund shall be transferred to DFG or other entity designated by the Executive Director of the Coastal Commission and approved by the Coastal Commission for the sole purpose of funding activities that mitigate losses to the San Onofre kelp bed community.

14.0 DESIGNATION OF PARTY REPRESENTATIVES

For purposes of this Agreement, each of the representatives listed below may exercise all the rights and discharge all the obligations of the represented Party, to the extent otherwise permitted by law.

Coastal Commission:	Executive Director
DFG:	Deputy Director for Fisheries
OREAP:	Panel Chairman

The designated representatives listed above may delegate any of the responsibilities or authority specified in this Agreement to other members of their respective staffs. However, no Party shall assign any of its responsibility or authority to any other person or entity, without the consent of all other Parties.

IN WITNESS WHEREOF, the Parties have executed this Memorandum of Agreement to this effect as of the date last signed below.

CALIFORNIA COASTAL COMMISSION

By: _____ _____
Peter M. Douglas — Date
Executive Director

CALIFORNIA DEPARTMENT OF FISH AND GAME

By: _____ _____
Jacqueline E. Schafer
Director

OCEAN RESOURCES ENHANCEMENT ADVISORY PANEL

By: _____ _____
Robert C. Fletcher — Date
Panel Chairman

Appendices

A. Hatchery Plan and Budget
B. Hatchery Operating Expenses

Exhibits

1. Coastal Commission Permit Condition C, Section 3.0, Permit No. 6-81-330-A, adopted April 9, 1997
2. April 6, 1994 MOA

COMPREHENSIVE HATCHERY PLAN (CHP) FOR THE ENHANCEMENT OF WHITE SEABASS (*Atractoscion nobilis*): Including Techniques for Culturing, Transporting, Tagging, Releasing, and Bioeconomic Modeling

Compiled By
California Department of Fish and Game
Marine Resources Department

Contributions From
Hubbs-Sea World Research Institute
and
San Diego State University

COMPREHENSIVE HATCHERY PLAN (CHP) FOR THE ENHANCEMENT OF WHITE SEABASS (*Atractoscion nobilis*)

COMPREHENSIVE HATCHERY PLAN (CHP) FOR THE ENHANCEMENT OF WHITE SEABASS (*Atractoscion nobilis*)

INTRODUCTION

In early April of 1994 representatives of the California Department of Fish and Game (CDFG), California Coastal Commission (CCC), Ocean Resources Enhancement Advisory Panel (OREAP) and Southern California Edison (SCE) signed a Memorandum of Agreement (MOA) that made $1.2 million available to build an experimental marine hatchery. Funding for the marine hatchery is part of a larger mitigation settlement between SCE and the CCC to compensate for fish lost by entrainment and thermal shock from the operation of SCE's San Onofre Nuclear Generating Station (SONGS). The hatchery is meant to augment the Ocean Resources Enhancement and Hatchery Program (OREHP); a program designed to evaluate the feasibility of enhancing depleted marine fish stocks through the release of hatchery reared juveniles. The MOA mandates the compilation and content of this Comprehensive Hatchery Plan (CHP), and this plan has been written to comply with the outline that appears in the MOA (Appendix A).

GOALS AND OBJECTIVES

The goal of the marine fish hatchery is to develop culture techniques for depleted marine fish species and produce offspring for use in the Ocean Resources Enhancement and Hatchery Program. The primary goal of OREHP is to evaluate the economic and ecological feasibility of releasing hatchery-reared fish to restore depleted, endemic, marine fish populations to a higher, sustainable level. Achievement of these goals will occur through completion of the following objectives:

1) Develop and implement hatchery operation methods that provide a supply of healthy and vigorous fish;

2) Quantify contributions to the standing stock in definitive terms;

3) Conduct the enhancement program in a manner that will avoid any significant environmental impacts resulting from operation of either the hatchery or pen rearing facilities;

4) Maintain and assess a brood stock management plan that results in progeny being released that have genotypic diversity very similar to that of the wild population.

5) Continue to develop, evaluate, and refine hatchery operations to maximize the potential for achieving the goal of the program.

DEFINING THE SUCCESS OF MARINE ENHANCEMENT

Although enhancement has proven to be an effective fisheries management tool for freshwater and anadromous fish species, the feasibility of successfully enhancing a truly marine species is a current issue of debate. Accidental and intentional introductions of exotic marine fishes have occurred worldwide. Although exotic species may have an ecological advantage in areas where they do not naturally occur, the success of these introductions indicates that the life history of marine fish species with planktonic eggs and larvae does not prevent the escape of a few individuals from forming a large naturally sustainable population.

There are many ongoing marine enhancement programs located in both temperate and tropical waters worldwide. Unfortunately, most of these programs have not been conducted in a

manner conducive to evaluating success. In many cases the hatchery fish were not tagged making it impossible to track the survival of the hatchery fish and their impact on the wild population. As a result, subsequent population changes cannot be attributed to the enhancement effort. One notable exception is a striped mullet (*Mugil cephalis*) enhancement project in Hilo, Hawaii. The release of tagged hatchery produced juvenile mullet resulted in a dramatic increase in the mullet catch, where approximately 40% of the mullet landed in 1991 originated from the hatchery (Oceanic Institute 1993).

Since 1984, the California Department of Fish and Game, as part of OREHP, has contracted for research to evaluate the feasibility of culturing and releasing juvenile marine fish, with the goal of enhancing depleted wild stocks in southern California. These studies have been conducted jointly by the Hubbs-Sea World Research Institute (H-SWRI), San Diego State University (SDSU), Occidental College, Los Angeles County Natural History Museum, Scripps Institution of Oceanography, University of California Davis, and California State University Northridge. As research progressed, white seabass (*Atractoscion nobilis*) was selected as the first species for experimental population enhancement. The white seabass was chosen because it is a species of great value to both commercial and sport fishers, and landings of this species have declined to a fraction of historic levels. The exact cause of population decline of white seabass is not known. Naturally, overfishing, loss of habitat and climate change are logical causes of population decline, but the degree each these factors affected white seabass is unknown. Fisheries data show a significant decline in white seabass catch prior to major development of the California coast, suggesting that fishing pressure alone contributes to stock reduction. This is an important point since enhancement would not be effective if stock decline was attributed to habitat loss and habitat restoration was not a part of the enhancement plan. The recent ban of commercial gill netting in most of southern California state waters may contribute to the potential success of OREHP.

The Ocean Resources Enhancement and Hatchery Program has designed an enhancement plan that includes tagging every individual white seabass that is released into the wild. Releasing

only tagged fish allows an accurate evaluation of the program's progress. Optimally, any enhancement program strives to restore the wild population to some predetermined optimum biomass level; once the target biomass is reached fish releases would cease and the population would be self sustaining at the new higher level. This strategy requires accurate estimates of the virgin spawning biomass, the current depleted spawning biomass level and a method of monitoring changes in the biomass of the species in question. Unfortunately these types of data are not available for white seabass. The available fisheries data is confused by changes in fishing regulations and landings of white seabass caught in Mexican waters. The life history and behavior of this species also makes field studies very difficult and expensive.

Ragen (1990) estimated the pre-fishery biomass of the California white seabass population using records of the heaviest white seabass caught each year (1884-1940) by the Avalon Tuna Club membership. By assuming that the heaviest fish caught each year is an indication of the size structure of the population, and that size structure reflects fishing pressure, Ragen estimated the pre-fishery biomass to be between 14.98 and 22.97 million kg. This translates to 1.51 to 2.64 million fish. Although Ragen's model requires multiple assumptions that are impossible to verify (mortality, stability, recruitment etc.), it is the best "guess" available. MacCall (National Marine Fisheries Service-Tiburon; pers. comm.) estimates the current white seabass population to be around 100,000 fish by using the average annual commercial landing of 5,000 fish and a fishing mortality of 5% (educated guess). Jacobson (pers. comm.) recommends an enhancement target of 50-60% of the pre-fishery biomass, based on Clark (1991). If we use 2 million fish as the pre-fishery stock level, 100,000 as the current stock size, and 1 million (50% of pre-fishery estimate) as the enhancement target, then a 10-fold increase in the number of white seabass is necessary before the enhancement effort should cease.

Rather than monitoring the absolute biomass of white seabass, which is an impossible task at this time, success of the OREHP should be measured by monitoring relative changes in the number of fish landed by the fishery and/or the catch rate. Since the major portion of the

commercial gill net fishery has been terminated as of 1994 it is necessary to use Commercial Passenger Fishing Vessel log book data to track changes in sport fish landings. Beginning this year CDFG has implemented a new log book system that will allow more accurate accounting of white seabass landings and catch per unit effort (CPUE). Although increases in landings and CPUE are not necessarily linear to increases in stock size (due to increased fishing pressure as stock size increases), they are the best available relative indicators of stock size at this time. When landings and/or CPUE reaches a level 10 times their 1994 level white seabass releases from this hatchery should cease. At this time landings and/or CPUE should be tracked to determine if the new, larger white seabass population is self sustaining. Two possibilities exist if the white seabass population significantly declines after releases cease: management of the resource is inadequate, or the population has been artificially enhanced. If studies prove the population to be artificially enhanced and incapable of naturally sustaining itself at the new higher level, the cost to benefit ratio must be critically examined to determine if further enhancement is feasible.

Clearly it is difficult to measure the success of OREHP given the available data; fisheries biologists in all sectors should be encouraged to conduct basic life history studies of white seabass. As part of the enhancemet project OREHP has a responsibility to see that some of these studies are conducted (MOA discusses process for which this will occur). As more data become available, from fishery independent as well as fishery dependent methods, it will be necessary to re-evaluate how the success of OREHP is defined. The CCC is studying this program as a possible model for future mitigation settlements; it may view a lower level of restoration, relative to the actual level of resource losses at SONGS, as a mitigation success.

CULTURE PROTOCOLS

The hatchery will be operated as an Animal Research Center as defined and regulated by United States Department of Agriculture (USDA) standards. Animal husbandry methods are

reviewed annually according to the standards established by the Guide for the Care and Use of Laboratory Animals (U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, 1985).

Brood Stock Management

Collection. White seabass brood fish are obtained from a variety of sources. The primary source is through the skippers of commercial sport fishing vessels who carry special permits authorized by CDFG to maintain and transport sub-legal (1-2 kg) white seabass caught by their patrons. These fish generally require two years before they are fully acclimated to the hatchery environment and are capable of spawning. Other sources of brood fish have included local public aquariums, the Southwest Fisheries Center of the National Marine Fisheries Service, and cooperative collecting trips organized by OREHP staff.

The number of brood fish at the existing Mission Bay experimental hatchery has been increased since 1992 and continues to grow. At the time of this writing, there are 33 wild-caught adult white seabass brood fish, with an average weight of approximately 18 kg and average age of approximately 13 years. In addition to these brood fish, 70 sub-adult white seabass (454-847 mm TL) are being held until they mature and can be added to the spawning population within the hatchery. Wild white seabass will be collected for brood stock until an appropriate spawning population size is attained, as determined by the genetic assessment.

Holding system. Mature brood fish will be maintained in four separate holding systems, capable of supporting approximately 50 adult brood fish each. These systems each consist of a 45 m^3 fiberglass pool, with a viewing window in one side. Each pool and filtration system is completely enclosed in a separate, well insulated room, which excludes ambient light and facilitates control of water temperature. The diel cycle is simulated using floodlights controlled by a 24-hour timer. Two 15-watt "moonlights" powered by a 12 VDC battery system provide a small amount of

light throughout the night.

Water quality in each system is maintained by recirculating seawater through two sub-sand and gravel filters. Water overflows from the holding pool into a 500μm mesh nylon egg trap suspended in a sump. Water is then pumped from the sump through the sand filters and back into the pool. The flow rate of 2-5 L/sec allows complete turnover in 1.5-3.5 hrs. Water used to supplement evaporative loss from the system is supplied at a rate of approximately 0.13 L/sec. Temperature is maintained by adding seawater that has been either heated or chilled by a titanium heat exchanger. An additional five ton heat exchange system is used to increase the cooling capacity during the summer months.

Health and nutrition. White seabass brood fish are fed a diet of fresh frozen mackerel, squid, anchovies, and other small fish. Brood fish are fed twice per week at a ration of roughly 1% of their body weight per week. Vitamin and lecithin supplements are added to the diet weekly. All food handling is conducted in accordance with USDA standards for research facilities holding live vertebrate organisms.

Genetic diversity considerations. Beyond the technical aspects of maintaining brood fish is the concern that genetic variability of the wild population could be diminished by releasing large numbers of hatchery fish. Diminishing genetic variability due to selective breeding and survival within the hatchery is an important consideration. These concerns are driven largely by observations made of some adverse interactions between wild and hatchery populations of salmonids. However, because the white seabass is a completely marine species and is phylogentically distant from salmonid species, it has a very different reproductive strategy. Specific problems with using observations of anadromous salmonids to set realistic conservation guidelines for white seabass include:

Homing ability: Because salmon home so precisely to spawn, sub-populations can be greatly

differentiated and adapted to a local drainage or environment (Ricker 1972; Quinn 1982). Most marine fish, including white seabass, do not home as precisely and do not have as genetically differentiated sub-populations (Gyllensten 1985; Utter and Ryman 1993).

Larval and egg dispersal: Salmon do not have a planktonic egg and larval stage, and offspring remain in the watershed in which they are born. White seabass eggs and larvae are planktonic for an estimated 40 days, and are capable of wide transport by currents along the California coast, thereby providing a mechanism to break down sub-population structure. Waples (1987) reported that the genetic structure of populations of 10 inshore marine fish species from the Southern California Bight were correlated with egg and larval dispersal; eight of these 10 species studied by Waples had little population differentiation.

Complex life history. Because salmon have an anadromous life history and strictly defined migration patterns, which appear to be genetically controlled (Ricker 1972; Bams 1976), the addition of exotic genes from conspecifics coding for other migration patterns can disrupt the fine tuning necessary for salmon to migrate to their natal streams or to migrate to the sea at the appropriate times of the year (Bams 1976). White seabass do not have as complex a life history and spawn over a longer seasonal period, April to July (Vojkovich and Reed 1983).

Although the study of genetic resources described for salmonids has greatly advanced the field of applied population genetics and has provided an efficient tool for the management of valuable salmon populations, using anadromous salmonids as a general model for the conservation and utilization of genetic resources of many marine species should be done cautiously.

Studies funded by OREHP and conducted by researchers at the University of California Davis (UCD) have addressed both the genetic structure of the wild population and how to minimize the impact of hatchery reared fish. A survey of the natural population of white seabass from the

southern California Bight (Bartley and Kent 1990) revealed no stable population sub-structuring in the area. The study evaluated 22 enzyme systems representing 33 distinct loci in 13 different samples that varied spatially and temporally ($\sum N=510$ fish). Average heterozygosity values ranged from 0.033 to 0.064, genetic identity was greater than 99% in all pair-wise comparisons and only 3% of the genetic variation was attributed to between sample differences. Gene flow was estimated to be approximately nine migrants per generation and therefore sufficient to homogenize the genetic structure of the population. The study detected no consistent geographic, clinal or temporal component to the observed genetic variation in wild southern California populations of white seabass. These results are consistent with genetic studies on other pelagic marine fishes (Gyllensten 1985; Ramsey and Wakeman 1987; Waples 1987; Graves et al., 1992; King and Pate 1992). In highly mobile species such as white seabass (Vojkovich and Reed 1983), gene flow among localities is apparently sufficient to homogenize the genetic structure. However, since several gene loci possessed rare alleles (frequency < 2%) that contributed to genetic diversity, the hatchery enhancement program should strive to conserve this allelic diversity.

Bartley and Kent (1990) also compared the same enzyme systems across six different groups of hatchery fish ($\sum N=212$ fish) spawned over three years. The results indicate that while the genetic variability of fish within a single spawn group may be less than that of the wild population, the cumulative variability of all groups released can approximate the level of genetic variability observed in the wild population.

The results of this study have been used to determine how many brood fish should be used as an effective population size to minimize any selection effects. This technique of applying extensive field observations of a wild population's genetic structure and reproductive behavior to the operational protocols of an enhancement hatchery have been developed for white seabass and summarized in Bartley et al. (in review).

In order to have the rare alleles present in the fish produced at the OREHP hatchery, it will

be necessary to collect enough brood stock so that rare alleles will be sampled. Binomial sampling theory describes the probability of collecting an allele of frequency p as

$$N = \frac{\ln(1-\alpha)/\ln(1-p)}{2} \qquad (1)$$

where N is the number of fish required and α is the confidence level. Therefore to be 95% certain of collecting brood stock that possess rare alleles (2% frequency), a minimum of approximately 74 brood fish is needed.

OREHP will use white seabass captured from wild populations off the southern California coast as its source of brood stock. These fish represent the wild genotypes and therefore, represent a low genetic risk to the wild population (Waples 1991). Prior to stocking the brood pools, the sex of each fish will be determined and each fish will be individually identified using a Passive Integrated Transponder (PIT) tag. A biopsy will also be performed on each brood fish. Samples taken during the biopsy will include muscle and fin tissue that will be subjected to analysis of allozymes. The inadvertent use of hatchery-reared and released fish as brood stock will be strictly avoided through tagging of progeny produced in the hatchery.

Although no stable population substructure was revealed among the samples evaluated by Bartley and Kent (1990), it is recognized that extensive sampling of fish from offshore islands and lower Baja California will be necessary to complete the genetic description of white seabass. Until this description is completed, transfers of white seabass will be minimized within their natural range by using brood fish collected from the southern California coast. Adults from southern Baja California or from north of Point Conception will not be utilized for stocking the southern California coastal areas.

After accounting for the presence of rare alleles by using a minimum number of founders for

the brood stock population, Bartley et al. (in review) evaluated the impact of using 74 fish on other measures of genetic diversity. Founding population size effects on heterozygosity and allelic diversity of the brood stock can be mathematically represented.

The proportion of the original heterozygosity (H') of the source population that will be represented in a founding population of size N is expressed as:

$$H' = 1 - \frac{1}{(2 * N)} \qquad (2)$$

Therefore, a founding population of 74 fish will represent 99% of the heterozygosity of the source population. However, allelic diversity is more sensitive to small population size than heterozygosity (Allendorf and Ryman 1987). Allelic diversity in a founding population is given by:

$$n' = n - \sum (1 - P_j)^{2N} \qquad (3)$$

where n' is the effective number of alleles remaining after establishing a population with N founders, n is the original number of alleles, and P_j is the allele frequency. For a simplified two allele model with various allele frequencies in the source or wild population, over 93% of the allelic diversity due to rare alleles (2% in this example) will be conserved if the effective size of the founding population exceeds 50 fish. Theoretically at least, the strategy of utilizing 74 fish as brood stock appears to be sound and will conserve over 90% of the natural genetic variability in the region, as measured by heterozygosity and allelic diversity.

Effective population size (N_e) is one of the primary determinants of genetic diversity. In

order to avoid problems associated with founding hatchery populations from a restricted genetic base, as has occurred in tilapia transplanted to Asia (Eknath et al. 1993), the effective number of brood stock will be maximized for the OREHP white seabass project. To satisfy the genetic conservation goal of the program, an N_e of 74 fish is required.

Effective population size is influenced by sex ratio, and variance in reproductive output and is usually lower than actual population size (N). Bartley et al. (1992), using linkage disequilibrium data from allozyme genotypes, showed that the effective population size of a mass spawning group of white seabass brood stock was about 50% of the actual population size. Therefore, using the conservation goals stated above, the OREHP brood stock management plan should consist of approximately 150 brood fish (2 x 74=148). The sex ratio of these brood fish should be 1:1. Deviations will necessitate that more brood stock are maintained according to the expression,

$$N_e = \frac{4N_m * N_f}{(N_m + N_f)} \qquad (4)$$

where m and f are the numbers of males and females, respectively. A schedule for annually rotating 20% of the male brood fish among breeding pools should increase the diversity in progeny by increasing the number of different matings per brood stock. The rotation schedule assumes that a total of 200 brood fish (1:1 sex ratio), or 33% more than the effective founder population size described above, are maintained in the hatchery with at least 5% being replaced per year. However, in light of the fact that we do not fully understand the reproductive behavior of white seabass in culture, it will be necessary to monitor the effective population size and diversity of the progeny produced by this rotation schedule. If, for example, one brood fish becomes dominant in its holding pool and makes a disproportionately high reproductive contribution to that pool's progeny, this situation should become apparent in a reduction in N_e. It is expected that a precise rotation schedule will be empirically refined.

Although the survival of juveniles in the hatchery is high, natural mortality of these fish once released into the wild is unknown. Therefore, the progeny will be physically marked and genetically characterized. The physical marker currently employed to tag fish prior to release is the binary coded wire tag (CWT's). In addition to this physical tag, genetic variability of the progeny groups can be determined from allozyme analysis as described by Bartley and Kent (1990). More discriminating analyses, such as DNA fingerprinting or other molecular techniques capable of identifying parents of individual offspring are being investigated by OREHP researchers (K. Jones, California State University Northridge, pers. comm.). Coded wire tags will help quickly assess the migratory and recruitment patterns of first generation hatchery fish and will prevent utilization of hatchery produced fish as subsequent brood stock. The genetic characterization will serve two functions: 1) it will allow the effective population size of the brood stock to be assessed and 2) it will allow the genetic marking programs to be evaluated, specifically to assess the introgression of hatchery fish into wild populations. The two types of data provided by physical and genetic tags are complimentary and necessary for long term evaluation.

Currently, there is no plan to breed a genetic marker into the hatchery stock of white seabass, even though candidate allozyme markers have been identified at LDH, MPI, and AAT gene loci (Bartley and Kent 1990). These allozyme markers are presumed to be selectively neutral and would not adversely affect the viability of the progeny groups. However, molecular analysis of brood stock may provide means to identify hatchery fish without specific breeding programs (Doyle 1993).

There is the possibility that certain brood stock fish will adapt more readily to the hatchery environment and may become over-represented in the progeny groups. Conversely, certain brood stock may become reproductively senescent over the course of the enhancement effort. Genetic monitoring of the progeny groups should help to detect these conditions and will facilitate the replacement or infusion of brood fish.

Only through systematic monitoring of the enhanced (natural and hatchery) populations can the effectiveness of the enhancement program be evaluated. Monitoring will be done in conjunction with commercial or sportfishing operations or as part of public or privately funded research projects. Several state observer programs in the southern California Bight Region as well as local sport and commercial fishermen have demonstrated their support by assisting in the sampling of white seabass.

Induction of spawning. Spawning is induced in the environmentally controlled pools by manipulating water temperature and photoperiod to simulate spring ocean conditions. No hormone injection or special handling of white seabass is required to induce spawning. To acclimate the individual brood groups to these conditions, brood fish are held at temperatures of approximately 14°C and day lengths of 10 hours for 3-4 months to mimic winter, or non-reproductive, conditions. Temperature and photoperiod are then slowly increased to 17-20°C and 14 hour days, respectively. These conditions are maintained for 6 months, after which the transition is again made to the winter conditions. The cycle takes about a year to complete.

The spawning seasons of the environmentally controlled pools are offset to provide a constant supply of eggs. On the day of a spawn, the abdomens of females containing hydrating oocytes become distended. Spawning generally occurs in the early evening. Spawning has been observed on only a few occasions, but most spawns are believed to involve one female and several males.

Egg Production

Egg collection and enumeration. Spawning generally occurs in the early evening and the eggs are collected the following morning. Therefore, the first 12 hours of incubation usually occurs inside the brood stock pool or the egg collection net. Due to their buoyancy at full salinity (35 ppt), white seabass eggs float and are easily skimmed from the surface with a fine mesh net (<800 μm). The eggs are then concentrated in a container with approximately 5.0 L of seawater and then poured

into a clear 4.0 L graduated cylinder. After allowing the eggs to settle for 3-5 minutes, the number of eggs is estimated using a conversion ratio of 500 eggs per ml. Viable, undamaged eggs are concentrated at the very top of the graduated cylinder due to their buoyancy, while non-viable eggs settle to the bottom. The numbers of eggs in both the viable and non-viable aliquots are determined for the entire spawn.

Historical production levels. Since 1984 over 790 million eggs have been produced during 624 spawning events in our hatchery. The number of eggs collected from a single spawning event is variable, ranging from as few as 25,000 to as many as nine million. This variability may be attributed to several factors, the most obvious being the number of females that contribute to a particular event. The multimodal frequency distributions of numbers of eggs spawned suggest that spawning events resulting in greater than 1.6 million eggs involve more than one female. Based on this estimate, group spawning occurs in about 7% of all spawning events in the system.

Historically, the percentage of viable (fertile) eggs has been high in the environmentally controlled pools, with the majority of spawns having viability of more than 70-80%. Under ambient temperature conditions, viability is much less. This reduced viability is most likely caused by diel temperature spikes. It may also be caused by the smaller volume of the egg traps used in the ambient temperature system compared to those in the environmentally controlled pools. There is no evident trend in egg viability relative to spawning season or age of the brood stock.

Although it has been reported that white seabass are multiple or batch spawners, the interval between spawns for an individual female is not known. Time lagged autocorrelations of an annual spawning cycle for pools B1 and B3 suggest that there is a 15-20 day periodicity between spawns from a single female. Considering the total number of spawning events each year, and that 2-3 females contribute to large spawning events, it is estimated that each female spawns about 4-5 times during each season. The spawning season for a group as a whole generally lasts 6 months, with the largest spawning events occurring during the middle of the season.

Batch fecundity is the number of eggs released by one female at a single time, and is estimated by dividing the total number of eggs produced each spawning season by the sum of the estimated number of females contributing to each event. The average estimated batch fecundity in previous years ranged from 0.76 to 1.5 million and varied as a function of mean female body weight. Annual egg production is also a function of female weight and is estimated by dividing the total number of eggs collected by the estimated total female biomass in the pool during that year. During the past eight years, annual egg production averaged 393,000 eggs/kg body weight (SD=179,000; n=15).

Egg Incubation

After removal from the egg traps, the eggs are disinfected for one hour in 100 ppm formalin, and then transferred into 1.89 m^3 (500 gal) cone bottom incubator pools. The pools (2.1 m x 1.4 m in diameter), are stocked at approximately 200-300 eggs/L. The water temperature in the incubators is adjusted to match that of the brood stock tank. Water is exchanged continuously by flow-through at rates of 25-50 L/min and is adjusted periodically to maintain high water quality. Detritus is removed from the bottom of the incubator once per day. This procedure involves scrubbing the interior, then creating a vortex water current, and finally siphoning or flushing the concentrated debris. Water temperature in the incubator system is maintained at approximately 18.0°C, with variations of ±1°C due to temperature changes in the ambient seawater supply.

The center outflow standpipe is covered with a 335 µm mesh screen to prevent the escapement of larvae and food. Eggs are maintained in this system through hatching at day two, and up to 20 days post-hatching. Inflation of the swim bladder is visible by day 4-6. Complete absorption of yolk and first feeding by the larvae occur between day 2 and 5 post hatching. Following yolk sac absorption, larval white seabass are fed *Artemia* nauplii that have been enriched overnight with Super Selco and sterilized using a fresh water bath. Selco is a liquid self-emulsifying concentrate, especially designed for the nutritional enrichment of *Artemia*. Feeding occurs four

times per day using an automated distribution system.

Larval and Post Larval Culture (0-60 days)

Following the 16 day period in the incubator system, white seabass larvae are transferred to circular larval rearing pools. These pools are 3.6 m in diameter and contain a water volume of 8.0 m^3. Larvae are stocked directly from incubators into a single pool without mixing spawn groups. As a result stocking densities range from 10-50 larvae/L according to mortality rates incurred in the incubator system.

Water quality is maintained by continuous flow-through at rates of 50-100 L/min. Incoming water is directed through a desaturation tower before entering the pool. The pools are equipped with an overflow screen (with air-collar), and skimmers to remove surface film. Siphoning of detritus from the bottom of the pools is conducted 2-4 times daily. Water temperature in the larval system is maintained at approximately 18°C, with variations of ± 1°C due primarily to temperature changes in the ambient seawater supply.

Artemia nauplii or rotifers are provided to each culture pool through an automated distribution system. In addition to distributing the food, the system automatically allows for enhancement of the live food, and subsequent rinsing to remove detrital bacteria and metabolites, prior to its distribution. Zooplankton are enhanced with commercially available Super Selco, an emulsion of fatty acids, phospholipids, and vitamins. This automated procedure provides the larvae with healthy, nutritious and clean zooplankton on a programmed schedule, with minimum supervision by a technician.

Weaning from live prey to a commercially available pellet diet is initiated at an age of 30-40 days, and is generally complete by an age of 70-80 days. This process involves several feeding

steps, using frozen foods as an intermediate diet. The frozen food generally consists of one or more of the following; adult *Artemia*, Euphausiids or chopped squid. Pellets are introduced in combination with the frozen food when the fish are 50-60 days old. The ratio of frozen food to pellets is slowly reduced (normally over 20-34 days) until the fish are feeding to satiation on pellets only.

In the past, harvest densities of 1.0-4.3 post-larvae/L (PL/L) have been attained in these larval culture systems. Production estimates for design and modeling purposes currently use a value of 1.5 PL/L. Continued refinement of culture techniques will substantially increase production.

Juvenile Fish Culture (60 days to release size)

Once the juvenile white seabass are weaned from live food onto pellets (age 70-80 days), they will be removed from the larval pools and then transferred to raceway pools or transported to pen rearing facilities. Juvenile white seabass will be held in these systems until the appropriate time, as determined by controlled release experiments designed specifically to identify the optimal size of fish at release, the optimal release sites and seasons, and any interactive effects.

Raceway culture. Raceways have been used to rear juveniles as large as 140 mm TL. These pools are 2.4 x 7.3 m, and are maintained at a volume of 12.5 m^3. Raceways are located outside of the main culture building under an enclosure of shade cloth attached to a steel support frame. The enclosure reduces the amount of light entering the pool and also prevents night herons and other predators from entering. Weaned juveniles are stocked directly from larval pools into the raceways without mixing fish from different spawn groups. As a result, stocking densities vary according to mortality rates incurred in the larval system. The highest stocking density of juveniles recorded was approximately 3.9 g/L (2.8 fish/L).

Grading of size classes is conducted once per month to reduce cannibalism and a count of

the total number of animals is made. The current grading procedure involves sorting animals by hand and assigning each fish to one of two size classes. The larger fish are separated within the same raceway using a sturdy plastic mesh divider.

Water quality is maintained by continuous flow-through at rates of 100-200 L/min. Incoming water is directed through a desaturation tower before entering the raceway. Siphoning of detritus from the bottom of the pools is conducted twice daily. Water temperature in the raceways has been regulated to some degree in the past, but the increased size of raceways at the new hatchery make this impractical.

Commercially available semi-moist, sinking pellets are provided to the fish in each culture pool through an automatic fish feeding system connected to a timing controller. Feeding occurs throughout the daylight hours. The rate of feeding is variable and depends on the biomass of fish in the raceway system as well as the water temperature. Fish are fed 2.5-3.5% of their body weight per day.

The new hatchery will use eight raceways (15.2 x 2.4 m) in the same manner as the smaller raceways described above. Although the majority of fish will be transported to pen rearing facilities, raceway culture will be used to handle surplus production and for experimental purposes.

Floating pen culture. Information regarding the methods for culturing white seabass in pen systems is provided in detail in a separate document entitled "Procedures Manual for Grow-Out Facilities".

TAGGING PROTOCOLS AND DATABASE MANAGEMENT

Tagging and Equipment

Coded wire tags (CWTs) are used to mark cultured fish prior to release. The CWTs are inserted into fish using a model MKIV tagging machine manufactured by Northwest Marine Technology (NMT). The CWT is a stainless steel wire etched with four binary coded data fields. Different CWT formats are available and several have been used in the past. Standard tags are 1.1 mm long, 0.25 mm in diameter, and batch coded with a total of 4,096 codes for each of 64 agency codes. Half length tags are 0.5 mm long, 0.25 mm in diameter, and batch coded with a total of 32,768 codes for each of 16 agency codes. Half length tags are generally used when fish size (< 2.0 g) cannot accommodate a larger tag. Replicate tags are similar to standard tags except they have an embedded replicate number from 1 to 7 (we use 4 replicates), which can be used to increase the power of statistical analyses. To assist reading this format, certain codes are not used, leaving the data capacity at 1,024 codes for each of 64 agency codes (NMT product guide).

The tags are magnetized and injected into the cheek muscle of each fish, and allow identification of fish by spawn group. The tag site is located below the posterior edge of the left eye, with the tag oriented parallel to the muscle fibers. Following insertion of the CWT, each fish is passed through a quality control device that effectively separates tagged fish from untagged fish. This procedure ensures that 100% of fish are tagged prior to release or transfer.

CWTs have been used successfully to mark small juveniles of an increasingly wide variety of fish, including salmon and steelhead (Shaul & Clark 1988; Johnson 1988), striped bass (Dunning et al. 1988), red drum (Bumguardner et al. 1988), largemouth bass (Crumpton, 1985; Williamson, 1987), herring (Krieger, 1982) and mullet (Leber, 1993). The advantages of the coded wire tagging system are many, including 1) ease of application on a large scale, 2) long-term tag retention, longevity and readability 3) relatively non-invasive application, 4) precise reading of code with no

subjective interpretation, and 5) non-visible method eliminating the bias of selective return.

The coded wire tagging technique has been used with positive results by OREHP since 1990. As many as 800 fish can be tagged per hour by an experienced operator. Each batch of fish released is marked with a different code. This tagging system enables a precise identification of the release group to which recaptured fish belong. With this information more accurate estimates of growth can be made and patterns of migration can be identified.

Experiments have been conducted to determine the effects of fish size, tag size and operator experience on both short and long-term tag retention. Our experiences and those of others, indicate that the majority of tag loss occurs within the first 1-2 weeks. Initial tag loss can generally be attributed to improper depth or angle of needle penetration. When this occurs, the tag is pushed out of the epidermis as the tissue heals instead of being encased within the muscle fibers. Tag retention generally increased with fish size and, to a small degree, with operator experience. Long-term tag retention rates (>300 days) by white seabass reared in pen systems were high (>90%). White seabass are tagged approximately one month prior to release. At the time of release, 100 fish are subsampled and checked for tag retention. This percentage is then applied to the total number of fish released and represents the number of released fish that can be identified as hatchery-reared in subsequent field surveys.

Database Management

The database containing mark, release and recapture information is designed as a relational database using dBase IV software by Borland. Two electronic database files are used to store this information. The "Release File" contains variables that code for the following information; 1) tag number, 2) spawn identification, 3) spawn date, 4) date of release, 5) number released, 6) mean length for the group, 7) age at release, 8) age at last measure, and 9) release site, including latitude and longitude. This file is updated immediately after a group of fish is released.

The "Recapture File" contains variables that code for the following information; 1) tag number, 2) date of capture, 3) site of capture, including latitude and longitude when available, 4) collection number, 5) TL, 6) SL, and 7) wet weight. This file is updated immediately after a fish is recaptured and its tag code identified.

The relation between the two files is established by the tag code number. After the necessary recapture information is entered, the computer searches the "Release File" for a matching code. Once the code is found, a printout is automatically generated (**Appendix B**), which includes historical information for each fish regarding the release, recapture information as entered, and also calculated information such as the number of days at since its release and its growth rate. Additional historical information can be obtained by linking the spawn identification field of these files to the "Culture File", which contains all of the information related to hatchery and pen-rearing operations for each release batch.

TRANSPORTING FISH

White seabass have been transported to release sites and cage systems using several different types of vehicles in combination with separate or attached transport tanks. Depending on the number of fish being transported, either a 0.95 or 2.6 m^3 (250 or 700 gal) transport tank has been used. The fish are starved for 24 hours prior to shipment and the tanks are stocked at a maximum density of 20-30 g/L. Water in the system is static, with no filtration employed. Constant aeration is supplied by a 12 VDC blower, and direct oxygenation is accomplished using compressed oxygen. Water in the transport tank is treated with Fritzguard to protect the ectodermal mucous layer and to maintain an appropriate electrolyte balance.

The type and size of transport vehicle employed is dependent on the size of the load and often on the characteristics of the unloading site. The size and shape of the transport tanks allow them to be loaded easily into a pickup truck, flatbed truck or boat. Upon arriving at the release site, the water

temperature of transport tank and receiving body of water are checked. If water temperatures are significantly different (>2.0° C) between these water sources, water is pumped from the embayment into the transport tank to reduce this difference. Fish are flushed from the tank into the receiving body of water using a 7.6 cm diameter flexible hose. The length of the hose or joined hoses has varied from 7.6-53.3 m depending on the site.

This protocol has been proven to maintain the fish in generally good condition during and after transport. Mortality rates during shipment have never exceeded 1%. Short-term mortality (within one week) caused by the stress associated with the transfer is also low (<5%).

RELEASING FISH

The methods used to design an efficient release program must consider how, when and where the fish will be released. When developing appropriate procedures, those parameters that may effect the health and survival of released fish must be identified and weighed against any additional costs incurred.

The methods used to release fish ("How") are substantially more complex than merely determining the method of transport as described above. Strong consideration must be given to other controllable parameters such as the size of fish at release, and the density of each release relative to the release habitat. The seasonal timing of release ("When") must also be determined in order to maximize the survival of released fish and optimize the overall efficiency of the program. The need to identify appropriate habitats and sites to release fish ("Where") is addressed briefly in the MOA. Information regarding the distribution of juvenile white seabass is already available (Thomas, 1968; Kent and Ford, 1990; Kent et al., 1991, 1992; Leet et al., 1992), and prerelease baseline information on the relative abundance of white seabass in different embayments is also being collected (Kent et al., 1992). Additional studies may be required to determine if these same habitats are optimal for

releases of hatchery-reared whites seabass.

The importance of identifying these factors and any interactive effects is well recognized. However, this information can only be obtained through controlled release experiments using adequate numbers of fish. These experiments will be conducted in the initial phase of the expanded program. Until these parameters can be evaluated, releases will be conducted on a small scale in areas adjacent to the culture facilities that are known to support juvenile white seabass.

HATCHERY PERFORMANCE STANDARDS

The results of the culture research and ecological studies have been adapted into a bioeconomic model developed in cooperation with the University of California at Davis (Botsford and Hobbs, 1988). Evaluation of the culture protocol using this model will remain an on-going process.

The bioeconomic model provides a standard method for evaluating new culture techniques, and for estimating the culture costs needed to produce fish of various sizes for release. These culture cost estimates are then used in models describing post-release survival, benefit to cost, and yield-to-the-fishery.

In order to identify performance standards for the expanded enhancement program, it will be necessary to identify the appropriate "benefit" parameters in the cost to benefit analyses, as well as a minimum acceptable ratio. Currently, the benefit of the program is measured according to an anticipated commercial yield and associated ex-vessel price. The model does not consider the contribution to the sport fishing industry and its economic impact. However, it can be adapted to perform this function, assuming that adequate data are available on the per weight value of fish caught by recreational anglers.

As new growth and survival data are assimilated, the bioeconomic model will be updated to track the performance of the program. These analyses will be available for review by the OREAP and the Joint Panel.

Culture Model

Catch per unit effort (CPUE) data obtained from field studies are used to improve both the bioeconomic and mortality models. Hatchery-reared white seabass which have been recaptured 26 months after release have provided data on growth during the post-release period. These data, when combined with aging studies of young white seabass obtained from the wild, have allowed us to better estimate the pattern of growth and subsequently the theoretical pattern of mortality for the first two years. Using the assumption that fish exhibit an instantaneous mortality rate inversely proportional to their weight (Ricker, 1976; Mathews and Buckley, 1976), we developed a mathematical model for post-release survival relative to the size of release up to an age of one year. This model is based on mortality estimates reported for sockeye salmon of similar size and age (Furnell and Brett, 1986). An optimal size at release is then derived by weighing the cost to culture to a specific release size by the anticipated survival to one year. The theoretical survival model estimates that fish should be held to an optimal release size of 165 mm SL (age = 235 days).

Yield-to-the-Fishery Model

Once estimates of the number of hatchery-released white seabass surviving to one year are known, it is possible to predict the impact of hatchery releases on the natural population and to fishery yields. This is accomplished by using known growth parameters and various intensities of fishing mortality. The experimental production hatchery has been scaled to produce approximately one million post larval fish (30 mm SL) that will eventually result in over 450,000 individuals available to be released at the predicted optimal size each year. This annual total is apportioned temporally among five crops (i.e. approximately 90,000 fish per crop). Of the seabass released, we

estimate that over 332,000 will survive to one year, which is the value used to initiate the yield-to-the-fishery model.

The model uses a set rate of fishing mortality of 50% per year (Botsford and Hobbs, 1988), various growth parameters, and the specific culture parameters listed in **Appendix C**. Based on these parameters, it is predicted that 525 metric tons of white seabass will be contributed to the standing stock from a single year of releases. Using a fishing yield of 50% per year, this represents a cumulative yield to the fishery of 927 metric tons. If the yield from hatchery releases is tracked over 20 years of hatchery operation, it is estimated that the contribution to the standing stock will reach an equilibrium value of over 2,941 metric tons per release after 10 years. Similarly, the fishery yield is expected to reach an equilibrium value of 185 metric tons per release. If an ex-vessel price of $4.40/kg and an annual operating budget of $330,000 are used as input parameters, the benefit to cost model predicts an equilibrium yield of over $817,000 per crop from the fishery. This translates into a benefit to cost ratio of 8 to 1.

ENHANCEMENT OBJECTIVES

The level at which "enhancement" is achieved can only be subjectively defined. Several methods can be employed to provide a quantitative interpretation of the success of the program. Among these methods is the determination of a **benefit-to-cost ratio**, which is an economic measure of the value of the fish returned weighed against the cost to provide those fish. The **percent of the catch**, can also be used as an evaluation tool. This value is the calculated percentage of the total catch resulting from enhancement. A third approach employs the **relative abundance of fish** as weighed against the historic catch records for both recreational and commercial fisheries. For strictly mitigation purposes, the **percent of compensation** of standing crop lost might be viewed as an appropriate endpoint for successful enhancement. This method would require that a ratio of lost biomass to hatchery-supplemented biomass be established prior to releases (e.g. a ratio of 1:1 would represent 100% compensation). Successful enhancement would be achieved when this ratio was

met.

It should be noted that these methodologies are not mutually exclusive and that a combination of these approaches might be appropriate. This is especially true when one considers that the agencies involved may have different enhancement objectives or endpoint goals. Thus, it is important that the methods to be employed and variables to be measured be established "a-priori". A carefully planned assessment strategy and cooperative recovery effort will ensure that valid results are available for interpretation by these agencies and by the scientific community at large.

BUDGET AND SCHEDULE FOR HATCHERY CONSTRUCTION

Appendix D is a cost schedule summarized by major expense area for planning, designing, permitting and constructing the hatchery facility. As of this date, this estimate totals just under $1.5 million. Approximately 80% of these funds will be provided by the owners of SONGS as directed by the CCC. The remainder of the costs will be covered by cash, in-kind and materials contributions to H-SWRI.

Appendix E is a time line for completion of the hatchery construction and subsequent commencement of operations. After permitting is complete and the winter grading moratorium for the coastal zone has ended, grading can begin in April of 1994, with construction being completed by the end of September 1994. Hatchery operations will be immediately transferred to the new facility upon completion of its construction.

PROCEDURE FOR REVISION OF PROTOCOLS

This CHP may be modified subject to annual review by the OREAP and the Joint Panel, employing the process outlined in the MOA between the CDFG and the CCC.

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APPENDICES

APPENDIX A: Comprehensive Hatchery Plan Outline from Memorandum of Agreement

The DFG shall develop a comprehensive hatchery plan and submit it for approval to the Joint Panel and the Executive Director of the Coastal Commission. The plan shall address the objectives set forth below:

(1) The Hatchery Plan will describe the methods for producing white seabass, including answers to the following questions:

   a. How will the broodstock be collected and maintained?

   b. How will eggs be produced?

   c. How will larvae be cultured?

   d. How will post settlement offspring be maintained?

(2) The Hatchery Plan will describe the methods for tagging all fish that are to be released, and how a tag database will be maintained.

(3) The Hatchery Plan will describe the procedures for the grow-out and release of the fish.

(4) The Hatchery Plan will describe the methods for transporting fish from the hatchery to the grow out facilities and from grown out facilities to release sites, if different.

(5) The Hatchery Plan shall provide standards for measuring the success of the hatchery. This will include a bioeconomic model.

(6) The Hatchery Plan will provide an enhancement objective, i.e., what biomass or catch will be considered the endpoint for restoration of the fish population.

(7) The Hatchery Plan will provide a budget and schedule for hatchery construction.

APPENDIX B - SAMPLE OUTPUT FROM RECAPTURE DATABASE

********** GROWTH REPORT FOR RECAPTURED WHITE SEABASS **********

HISTORICAL INFORMATION		RECAPTURE INFORMATION	
TAG NUMBER	30/06/19	COLLECTION DATE	09/16/91
		COLLECTION SITE	ROSE CREEK
SPAWN DATE	10/27/90	COLLECTION NUMBER	1223
RELEASE DATE	02/14/91		
RELEASE SITE	ATLANTIS	TL 385 mm	SL 322 mm
		WT 591 g	
		CURRENT AGE	324 days
		PERIOD AT LIBERTY	214 days

********* GROWTH INFORMATION *********

GROWTH IN THE WILD	223	mm
GROWTH RATE IN THE WILD	1.04	mm/day
GROWTH RATE SINCE HATCHED	1.00	mm/day

APPENDIX C - CULTURE PARAMETERS

NOTE*			INPUT PARAMETERS FOR HATCHERY MO		
DENSITY AND YIELD VALUES					
	Yield per unit volume		1.50	per Liter	
	Larval culture volume		128,000	liters	
	Annual PL production		960,000		
	Crops per year		5		
	Life of hatchery		15	years	
GROWTH EQUATIONS					
PERIOD	FUNCTION	EQUATION	R2	UNITS	SOURCE
25-120 days	Laird-Gompertz	SL = .202*exp(6.64*(1-exp(-.0273*age)))	0.95	age = days; SL = mm	Donohoe, 1990
120 days - 4 yrs	Von Bertalanffy	TL = 769.4*(1-exp(-.422*(age + 0.0584)))		age = yrs; TL = mm	OREHP
4-15 yrs	Von Bertalanffy	TL = 1465.3882*(1-exp(-.1280*(age + .2805)))	0.99	age = yrs; TL = mm	Thomas, 1968
MORPHOMETRIC EQUATIONS					
60-365 days		Wt = (exp(2.79*ln(SL)-3.058))	0.99	Wt = mg; SL = mm	Orhun, 1989
1-15 yrs	power	Wt = 1.5491E-5*(TL^2.92167)		Wt = kg; TL = mm	Thomas, 1968
0-15yrs	linear	TL = 1.183(SL) + 3.608	0.99	TL = mm; SL = mm	OREHP
MORTALITY ESTIMATES					
PERIOD	DESCRIPTION	EQUATION	COEFF	UNITS	SOURCE
60-120 days	Pool/raceway	mortality = exp(-.0098*t)	0.0098		OREHP
120-365	Pen	mortality = exp(-.0017*t)	0.0017		UAVC
60-365	Combined model	%surviving = 8.9395*age^(-.535)	-0.535		OREHP
12-60 mths	Natural	%surviving = 2.791*age^-.413	-0.413	age = months	OREHP
		%surviving = 116.7*age^-.413		age = yrs	
>60 mths	Natural	mortality = exp(-.13*t)	-0.13		Maccall
>60 mths	Fishing	50%	-0.6931		Botsford
MONETARY VALUES					
	Exvessel price		$2.00	per lb	

APPENDIX D - HATCHERY BUDGET

HUBBS - SEA WORLD RESEARCH INSTITUTE

LR HUBBARD FISH HATCHERY

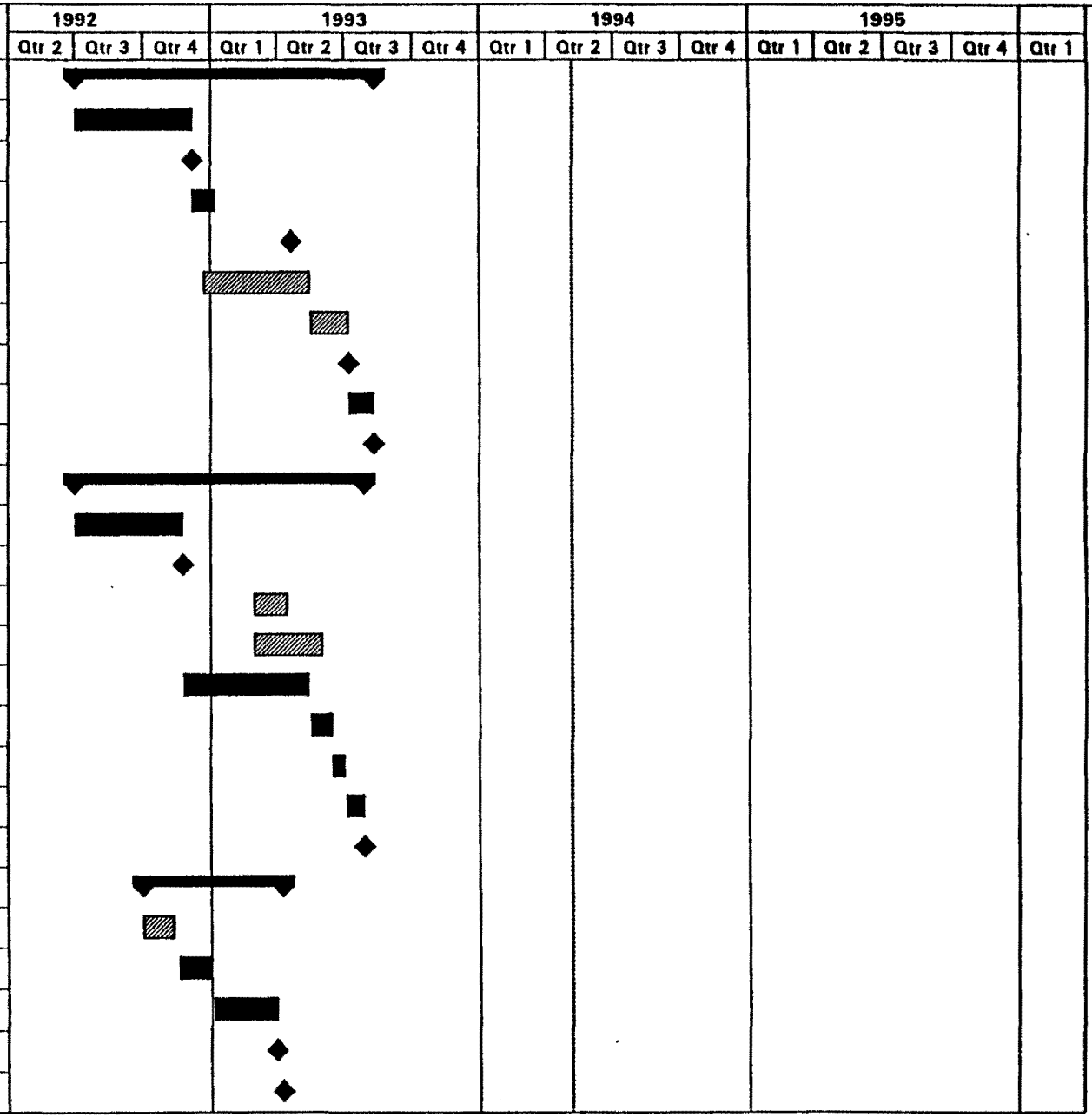
CARLSBAD, CALIFORNIA
PRELIMINARY COST ESTIMATE
Prepared by
Highland Partnership, Inc.
Estimate date: April 15, 1994

DESCRIPTION	REVISED BUDGET AMOUNT	ASF 19,700 SF COST
GENERAL REQUIREMENTS	$107,676	$5.47
SITEWORK	455,684	23.13
CONCRETE	254,842	12.94
MASONRY	33,390	1.69
METAL COATINGS	0	0.00
STRUCT. STEEL & MISC.	16,616	0.84
METAL FABRICATIONS	0	0.00
RAILING AND HANDRAILS	0	0.00
ROUGH CARPENTRY	2,400	0.12
FINISH CRPTY & CSWK	48,462	2.46
INSULATION	1,008	0.05
GRAVEL & MEMB. ROOFING	0	0.00
FLASHING & SHEET METAL	2,955	0.15
SKYLIGHT STRUCTURES	30,495	1.55
SEALANTS	1,970	0.10
DOOR FRAMES	1,680	0.09
WOOD DOORS	0	0.00
SPECIAL DOORS	0	0.00
ACCESS DOORS	380	0.02
OVERHEAD COILING DOORS	0	0.00
ENTRANCE / STOREFRONTS	21,640	1.10
METAL DOORS	3,640	0.18
FINISH HARDWARE	6,625	0.34
GLASS & GLAZING	1,650	0.08
DRYWALL / PLASTER	13,833	0.70
CERAMIC TILE	0	0.00
ACOUSTICAL CEILING / DRYWALL CLG	2,630	0.13
RESILIENT FLOORING & CARPET	25,411	1.29
PAINTING AND WALL COVERING	5,642	0.29
TOILET PARTITIONS	0	0.00
TOILET ACCESSORIES	1,500	0.08
SIGNAGE / EXHIBITS	0	0.00
FIRE EXTINGUISHERS	600	0.03
EQUIPMENT /	500	0.03
FURNISHINGS	5,300	0.27
SPEC CONSTRUCTION	182,243	9.25
CONVEYING SYSTEMS	0	0.00
PLUMBING	43,695	2.22
FIRE SPRINKLERS	4,800	0.24
HVAC	19,700	1.00
ELECTRICAL	72,548	3.68
INSURANCE	7,000	0.36
TESTING & INSPECTION	19,560	0.99
CONTINGENCY	38,065	1.93
ARCHITECTURAL / ENGINEERING	76,870	3.90
INDIRECT COST	19,300	0.98
PERMITS & FEES	64,950	3.30
DESIGN BUILDER / CONTRACTOR FEE	0	0.00
TOTAL	$1,487,584	$75.51

APPENDIX E - HATCHERY SCHEDULE

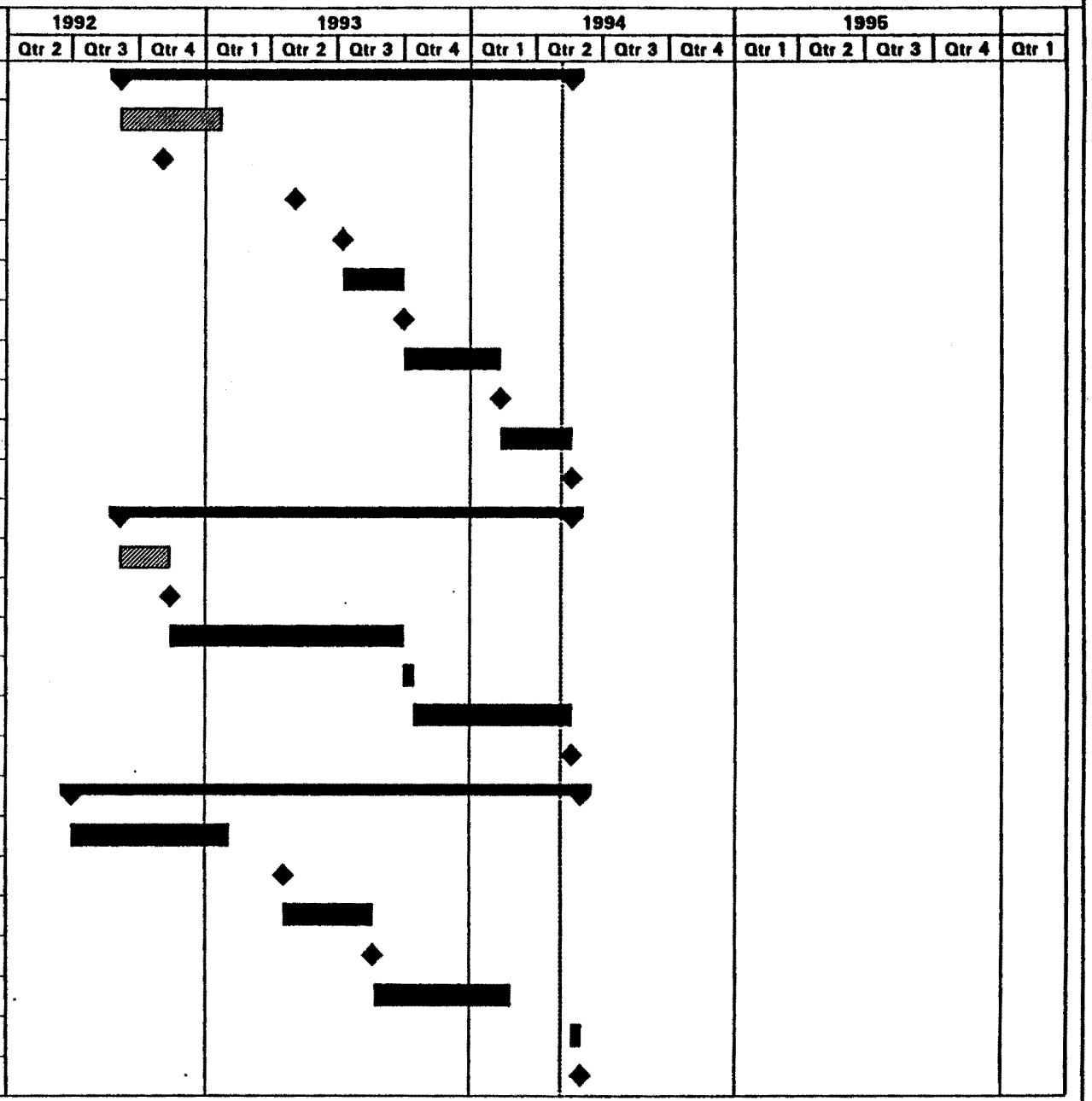
Hatchery Planning, Permitting and Construction Schedule (Revised; 5/4/94)

ID	Name
1	CONDITIONAL USE PERMIT
2	Plan Preparation
3	Submittal to Carlsbad (First)
4	30 Day Completeness Review
5	Submittal to Carlsbad (Second)
6	Processing/Review/Revision
7	Planning Commission Review
8	Planning Comm. Determination
9	Appeal Review
10	Appeal Determination
11	NEGATIVE DECLARATION
12	Prepare EIA Form
13	Submittal to Carlsbad
14	Cultural Resources Report
15	Hillside Development Permit
16	Environ. Review/Determination
17	Public Review
18	Consider Comments
19	Record of Decision/CC Approval
20	File Notice of Determination
21	SITE LICENSE AGREEMENT
22	Review by USWRI
23	Review by SDG&E
24	Consider Comments
25	Deemed Complete
26	Signed



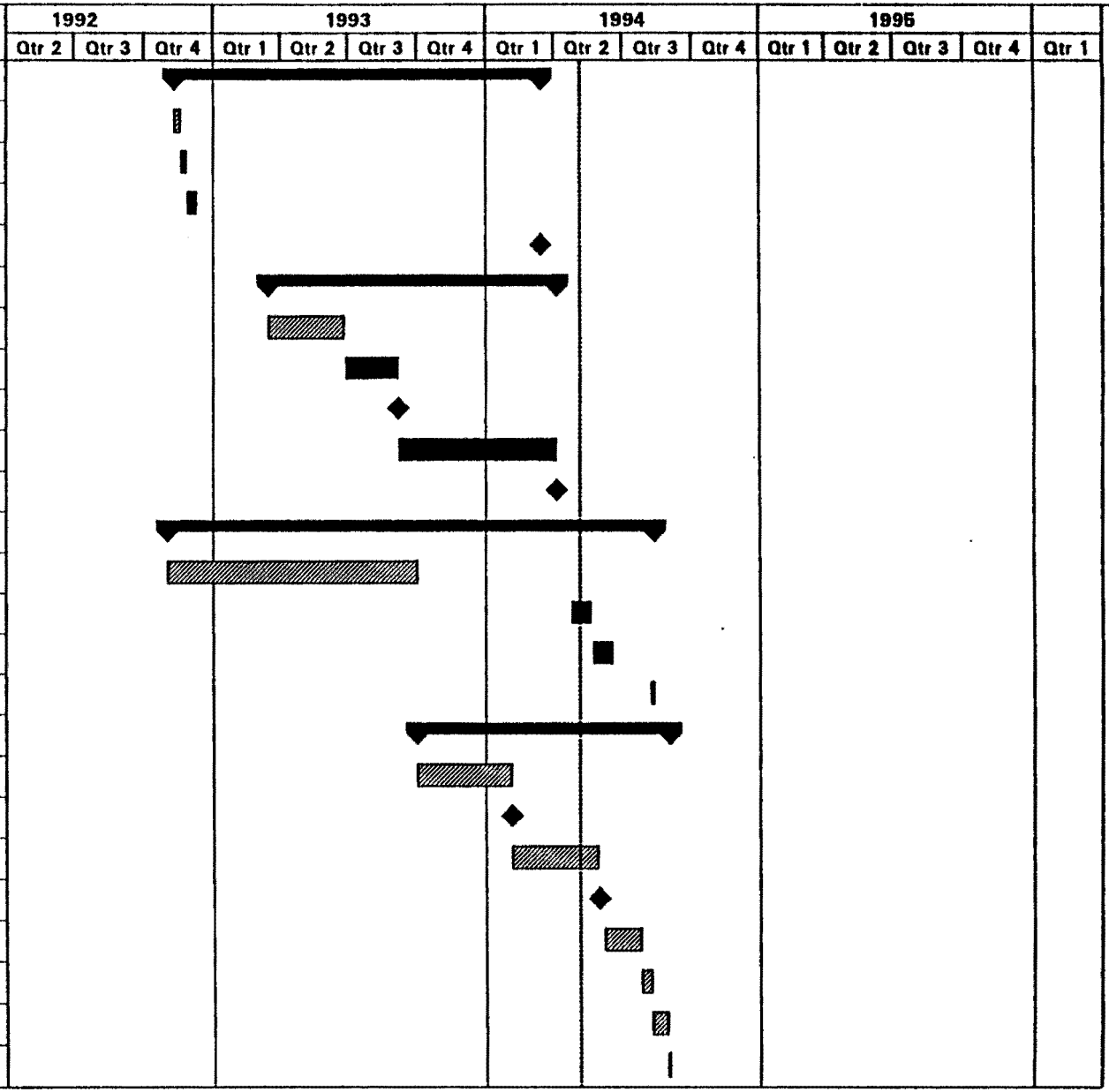
Hatchery Planning, Permitting and Construction Schedule (Revised; 5/4/94)

ID	Name
27	COASTAL DEVELOPMENT PERMIT
28	Prepare Permit App.
29	1st Informal Meeting with Staff
30	2nd Informal Meeting with Staff
31	Submit Coastal Application
32	Staff Review of Application
33	Deemed Complete
34	Processing
35	Coastal Hearing
36	Conditions of Approval Period
37	Issue Permit
38	RWQCB NPDES PERMIT
39	Prepare Application
40	Submit Application
41	Staff Review of Application
42	Deemed Complete
43	Processing
44	Issue Permit
45	404 PERMIT (Army Corps of Engineers)
46	Prepare Application
47	Submit Application
48	Staff Review of Application
49	Deemed Complete
50	Processing
51	Review of Coastal Permit
52	Issue Permit



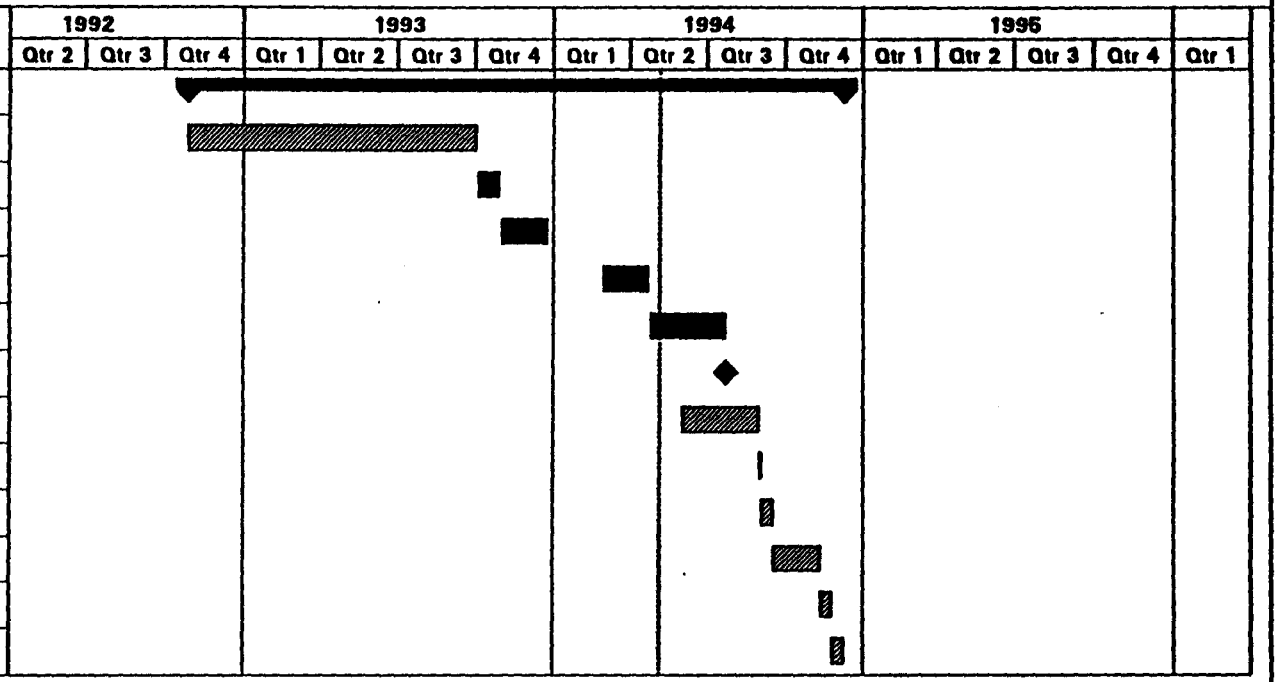
Hatchery Planning, Permitting and Construction Schedule (Revised; 5/4/94)

ID	Name
53	GEOTECHNICAL REPORT
54	Draft Report
55	Review Report
56	Finalize Report
57	Update
58	MEMORANDUM OF AGREEMENT
59	Draft MOU prepared (CCC)
60	CDF&G, OREHAP, SCE Review
61	OREHAP Approval
62	Final review by counsel
63	Signing of MOA
64	PRE-CONSTRUCTION SERVICES
65	Cost Estimate (Preliminary)
66	Cost Estimate (Final)
67	Bid Process
68	Bid Award
69	GRADING/IMPROVEMENTS
70	Preparation
71	Submittal to Carlsbad City
72	Plancheck/Processing/Revision
73	Issuance of Grading Permit
74	Grading of Site/On-site Improv.
75	ConcretePilings
76	Concrete Foundation (SOG)
77	Grading Inspected



Hatchery Planning, Permitting and Construction Schedule (Revised; 5/4/94)

ID	Name
78	BUILDING PLANS/CONSTRUCTION
79	Initial Design Development
80	Select Bldg. Manufacturer
81	Prepare Building Design
82	City Review of Initial Bldg. Plans
83	Plancheck/Processing/Revision
84	Issuance of Building Permit
85	Order/Manufacture Building
86	Building Available for Delivery
87	Erect Building w/ Ext. Improve.
88	Interior Improvements
89	FF&E Installation
90	Move-in/Operational Start-up



SONGS Enhancement of Hatchery Program

Description		
Equipment Purchased		
Intake pump system	$	23,597
Backwash control system	$	3,384
Fume Hood Hood (installed)	$	12,000
Chiller Compressors (installed)	$	28,128
Lab Benches	$	13,455
Raceway shade covers	$	10,000
Walk-in freezer	$	11,374
Refrigerator	$	535
Panasonic	$	692
Vacuum pump	$	1,165
Sea Water Filters	$	36,000
Filters valves	$	22,841
10 autofeeders	$	3,103
14 round tanks, 10 cone tanks	$	46,028
B&G in-line pump	$	950
Pressure washer	$	5,256
Larval pool plumbing	$	313
Autofeeder timer	$	266
Broodstock egg collecting nets	$	528
8 cone & 6 flat bottom tanks	$	7,166
Lumber	$	1,568
sea water gauges	$	509
saturometer	$	6,013
seawater temp controls	$	4,023
3 blowers, valves & clamps	$	7,779
Desaturator media, hose, tubing	$	1,531
Larval tank plumbing	$	5,917
Straps, washers, nuts	$	26
seawater system seals	$	828
Broodstock temp controls	$	11,949
Pipe pigging components	$	4,173
Pool plumbing	$	1,527
Computer	$	4,141
Automated control hardware	$	17,384
Printer	$	805
SW system components	$	5,972

Larval pool plumbing	$	141
BW control system components	$	9,735
Pigging system components	$	1,964
16 feeders, filter bags, controllers	$	1,336
22 flow meters	$	1,093
Fish counter/scanner uni	$	8,474
6 temp controls	$	1,302
4 broodstock tanks	$	37,664
2 Pentium computers/modem	$	4,658
12 Hayward electric actuators	$	8,601
2 microscopes	$	9,660
Transport trailer	$	20,750
Transport tanks	$	19,500
Filter	$	3,161
SUB-TOTALS:	$	428,965

Description	Qty	Unit	Unit Cost	Extension
Equipment Needed				
Upgrade Pumps to 30 hp w/ variable speed control	1	ls	$ 30,000	$ 30,000
4th 42 sqft seawater filter w/	1	ls	$ 20,000	$ 20,000
Larval Pool Recirculation	4	ls	$ 3,000	$ 12,000
Install Plumbing (Contractors)	1	ls	$ 35,000	$ 35,000
Install Electrical (Contractors)	1	ls	$ 28,000	$ 28,000
Computer, Desktop for data management	4	ea	$ 4,200	$ 16,800
Computer (Laptop and docking)	1	ea	$ 4,500	$ 4,500
Software Development	1	ls	$ 15,000	$ 15,000
Broodstock Biofilters	4	ea	$ 3,200	$ 12,800
Transport truck	1		$ 25,000	$ 25,000
Emergency Power Supply	1	ls	$ 50,000	$ 50,000
Broodstock Holding Systems	3	ea	$ 24,000	$ 72,000
Automated Plankton Harvesters	1	ea	$ 12,500	$ 12,500
Automated Plankton Feeders	5	ea	$ 7,500	$ 37,500
Scales	3	ea	$ 2,500	$ 7,500
WQ Monitoring Equipment	1	ls	$ 36,000	$ 36,000
Oxygen Transport Monitoring	1	ls	$ 5,000	$ 5,000
Egg and Larvae Counter	1	ea	$ 5,000	$ 5,000
Vaki juvenile fish counter	1	ea	$ 5,200	$ 5,200
Forklift	1	ea	$ 25,000	$ 25,000
Feed Storage Shed	1	ea	$ 8,000	$ 8,000
Tagging Machines/Systems	3	ea	$ 26,000	$ 78,000
Tagging and Sorting Table	1	ea	$ 2,000	$ 2,000
CWT Detector Wands	10	ea	$ 6,500	$ 65,000
Vacuum Degassing system	1	ea	$ 14,000	$ 14,000
Cage Systems (30K/batch)	4	ea	$ 40,000	$ 160,000
HVAC System	1	ls	$ 35,000	$ 35,000
				$ 816,800
Operating Expenses				
Genetics Evaluation	8	yrs	$ 80,000	$ 640,000
Experimental Augmentation	8	yrs	$ 78,080	$ 624,640
Ass't. Cage Technicians (2; w/ FB's	8	yrs	$ 68,000	$ 544,000
Hatchery Facility Mgr (w/ FB's)	8	yrs	$ 47,600	$ 380,800
				$ 2,189,440

INCOME		
Contributions		
FYE 6/30/93	$	18,350
FYE 6/30/94	$	74,504
FYE 6/30/95	$	66,823
FYE 6/30/96	$	87,412
FY to 1/31/97	$	72,613
	$	319,702
SONGS Mitigation Funds	$	1,202,500
Pledges		
Northwest Tournament	$	13,255
American Sportfishing Assoc.	$	25,000
National Fish and Wildlife Found.	$	5,112
	$	43,367
CDF&G Equipment Funds	$	250,000
TOTAL INCOME:	$	1,815,569
EXPENSES		
FYE 6/30/93	$	23,091
FYE 6/30/94	$	100,089
FYE 6/30/95	$	1,554,034
FYE 6/30/96	$	320,597
Existing Equipment	$	428,965
EXPENSES TO DATE:	$	2,426,776
HSWRI Deficit	$	(432,242)
CDFG Deficit	$	(161,518)
BALANCE TO DATE:	$	**(593,760)**
Needed Equipment	$	816,800
Operations	$	2,189,440
ADDITIONAL EXPENSES:	$	3,006,240
FUNDING NEEDED:	$	**3,600,000**

1997 DRAFT MOA – APPENDIX B

Hatchery Operating Expenses

Genetic Evaluation ($640,000)

Funds from SONGS mitigation/compensation will be used to supplement existing OREHP programs looking at the genetic make-up of the wild stock, broodfish, and progeny. First priority is completing a genetic study to determine if there is one reproducing stock or several substocks. Up to $100,000 per year for two years will be earmarked for collection of specimens, geno-typing and data analysis. Continued typing of new broodfish will cost $10,000 per year for the life of the program. Finally, geno-typing 50 spawns per year to determine parentage will cost at least $100,000 per annum. With interest, and assuming all the money for stock analysis is spent, the genetic funding should last in excess of five years given that OREHP will also contribute $50,000 per year.

Experimental Augmentation ($624,640)

The OREHP is deeply involved in developing techniques to hatch, grow, transport, and release white seabass. Unfortunately, due to funding short-falls, experiments to increase the efficiency of each of these operations has prevented adequate studies. SONGS money would be used to better understand the spawning process and how OREHP can control the environment to produce viable eggs. To determine the most efficient way to grow fish, packing density and feeding experiments would be expanded to include all stages of life, not just post larval fish as OREHP is concentrating on presently. Transporting large numbers of juvenile fish has presented problems. OREHP needs to examine the current system and conduct experiments to determine the best regime for moving fish. Finally, more experimental work is required to determine the best release location. Are at sea releases the best or does simply releasing the fish at the grow-out site produce the highest return rate? The anticipated experiments would take place over the next five years and cost up to $624,640.

Hatchery Facility Manager ($380,800)

Currently, there is a project manager which oversees all of HSWRI operations associated with OREHP. Part of the individual's job involves managing the hatchery. However, as OREHP moves to build-out the hatchery and full production, a dedicated hatchery facility manager is essential to the success of the operation. Money from SONGS would fund a full time hatchery facility manager for eight years.

Research Technicians ($544,000)

Under current conditions, when the hatchery reaches full production, there will not be adequate capacity in the grow-out facilities to release 400,000 fish per year. To off-set this, the hatchery will purchase four open ocean commercial pen-rearing cages and place them in the areas of greatest need. Two full time research technicians will be necessary to maintain the pens. They will also be available to assist the hatchery during tagging operations and the volunteer grow-out facilities when they need additional assistance. Money from SONGS will fund two full time research technicians for eight years.

1997 DRAFT MOA – EXHIBIT 1

Excerpt from Coastal Commission Permit No. 6-81-330-A

Condition C, Section 3.0, adopted April 9, 1997

CONDITION C: KELP REEF MITIGATION

3.0 Funding Requirement for Mariculture/Fish Hatchery Program

No later than June 8, 1997, the permittee shall establish an interest-bearing account (internal or external) in the amount of $3.6 million for a mariculture/marine fish hatchery program operated by the State of California through the Ocean Resource Enhancement and Hatchery Program (OREHP) to compensate for losses to the kelp bed community that are not mitigated by the artificial reef. The California Department of Fish and Game, the Ocean Resources Enhancement Advisory Panel, and the Coastal Commission shall enter into a Memorandum of Agreement to direct the expenditure of these funds, including provisions for continuation of the Joint Panel to oversee including, but not limited to the evaluation and genetic quality assurance of the hatchery program. Within thirty (30) days after the permittee receives written notice from the Executive Director of the establishment of an account with either a private foundation, in the form of a restricted account, or with the OREHP account, neither of which may charge more than 5% in administrative overhead on expenditures, the permittee shall deposit the entire $3.6 million plus accrued interest in said account. Interest shall accrue from the date the permittee establishes its account. Until the permittee deposits the entire $3.6 million plus accrued interest in said account, the permittee shall calculate interest using rates equivalent to the Federal Reserve Bank for 6-month U.S. Government Securities Treasury bills (discount rate). Interest shall be adjusted quarterly in accordance with the current rate and shall be compounded monthly.

Memorandum of Agreement
for the
State of California's
Experimental Marine Fish Enhancement Hatchery
between the

California Coastal Commission

California Department of Fish and Game

Ocean Resources Enhancement Advisory Panel

Southern California Edison Co.

This Memorandum of Agreement (Agreement or MOA) is entered into between the California Coastal Commission (Coastal Commission), Southern California Edison Company (SCE), California Department of Fish and Game (DFG), and Ocean Resources Enhancement Advisory Panel (OREAP), sometimes referred to as the Parties. The Parties agree as follows:

WHEREAS, the Coastal Commission has required SCE to contribute funds toward the capital costs of construction of a marine fish hatchery and toward an evaluation of its effectiveness at increasing the fish stock in the ocean, as a supplemental element to SCE's mitigation program for adverse impacts to fish that the Coastal Commission found to be caused by the operation of the SCE's San Onofre Nuclear Generating Station (SONGS) Units 2 and 3; and

WHEREAS, the Hubbs-Sea World Research Institute (Hubbs) has proposed to construct a hatchery for depleted marine species at Agua Hedionda Lagoon, in the City of Carlsbad, California; and

WHEREAS, the Coastal Commission has made SCE's expenditures of funds for a fish hatchery project contingent upon an agreement among SCE, DFG, Coastal

Commission, and OREAP as to the funding, design, and implementation of evaluation and genetic quality assurance programs for the hatchery project.

Therefore, the Parties agree as follows:

Section 1.0. Parties

1.1. DFG The California Department of Fish and Game is the principal state agency responsible for the establishment and control of fishery management programs. The DFG is the trustee agency with jurisdiction over the conservation, protection, and management of fish, and habitat necessary for biologically sustainable populations of fish species. (Fish and Game Code (Fish & G. Code), sections 1802, 711.7.) The DFG administers the California Ocean Resources Enhancement and Hatchery Program (hereinafter, "OREHP"). The purpose of the OREHP is to support applied research on the artificial propagation, rearing, stocking, and distribution of adversely affected marine fish species that are important to sport and commercial fishing in the ocean waters off California, south of a line extending due west from Point Arguello. (Fish & G. Code, section 6592.)

1.2. OREAP The Ocean Resources Enhancement Advisory Panel is a ten member panel established by the Legislature to assist the DFG in establishing policy and direction for the OREHP.

1.3. Coastal Commission The California Coastal Commission is a state coastal management and regulatory agency with authority over the development and use of the California coast and coastal waters.

1.4. SCE Southern California Edison Company is an investor-owned electric utility serving four million customers in central and southern California.

Section 2.0. Purpose

This Agreement is to give effect to Permit Condition "E" of the March 17, 1993 Resolution of the Coastal Commission concerning SCE's Permit 6-81-330-B (formerly 183-73). A copy of the Coastal Commission's Permit Condition "E" is attached hereto as Exhibit 1. This Agreement also furthers the intent of the OREHP. Notwithstanding any other provision of this Agreement to the contrary, aside from the obligation to deposit funds as required under Section 6.1, this Agreement imposes no other obligations or duties upon SCE.

In entering into this Agreement, the Parties intend to determine if hatchery-reared depleted ocean species can artificially enhance certain stocks of various desirable species, and to ensure that the experimental hatchery program is evaluated in a scientific manner that will determine the viability and effectiveness of the project. This will help both DFG and the Coastal Commission guide future hatchery efforts and possible mitigation applications, and protect the coastal waters from any potential adverse impacts.

Section 3.0. Project Description

3.1. Hatchery Construction This project will fund the construction of an experimental marine fish hatchery for white seabass (See Appendix A). The hatchery will be operated in conjunction with grow-out facilities until the fish are large enough to be released into the marine environment at selected release sites (See Appendix D). The hatchery will be constructed and operated by a non-profit corporation. It is anticipated that volunteer angler and other groups will operate and maintain the grow-out facilities. Other parties may assume these responsibilities should the need arise.

Only white seabass will be reared in the facility. With the exception of culturing experiments, rearing of a different fish species will require an amendment to this Agreement (See Section 11.0) and to the coastal development permit for the hatchery facility.

3.2. Evaluation Program The project will be evaluated scientifically to determine its effectiveness in increasing the stock of white seabass (See Appendix B hereto).

3.3. Genetic Quality Assurance Program A program will be developed and implemented to ensure that the introduction of hatchery-reared fish into the ocean does not degrade the genetic quality of the wild white seabass stock (See Appendix C hereto).

3.4 Name In accordance with Section 6598 of the Fish and Game Code, the hatchery shall be a unit of, and known as the "California Marine Hatchery Institute."

Section 4.0. Planning and Oversight

4.1. Joint Panel; Composition

A joint panel (Joint Panel) shall be formed, consisting of one representative from each of the following entities: the Coastal Commission (appointed by the Executive Director), DFG (appointed by the Director of DFG), OREAP (appointed by the members of OREAP), the National Marine Fisheries Service (NMFS, appointed by the Science and Research Director for the Southwest Region of NMFS), and the University of California (U.C.) (appointed by the U.C. President s Office). The U.C. representative must not also serve on the OREAP or Coastal Commission Scientific Advisory Panel. SCE may participate in the Joint Panel meetings as an observer.

4.2. Responsibilities

The Joint Panel shall have the following general oversight responsibilities to ensure development of the fish hatchery and grow-out facilities:

(1) develop and oversee the evaluation and genetic quality assurance programs;

(2) develop Requests for Proposals (RFPs) or contracts to conduct the programs, consistent with requirements of State law and all relevant provisions of this Agreement;

(3) make recommendations for contractor selections to the OREAP and Director of DFG;

(4) make recommendations for development of contract terms; and

(5) oversee and evaluate contractor performance in carrying out the evaluation and genetic quality assurance programs.

4.3. Procedures The Joint Panel shall select its chairperson from among its members, and shall make decisions by a majority vote of all panel members entitled to vote. The Joint Panel shall meet as often as necessary, but at least twice a year.

Section 5.0. Environmental Quality

Permits issued by the Coastal Commission, in connection with the hatchery project, may require careful monitoring of the hatchery and grow-out facilities to ensure they are not causing significant environmental degradation. The Joint Panel shall review the potential causes of environmental degradation from the hatchery and grow-out facilities, and develop a monitoring program to be implemented by the fish hatchery operator and grow out facility operators. In addition, the Joint Panel shall make

recommendations to DFG and OREAP as to whether additional applied ecological studies should be conducted to ensure adequate monitoring, or to develop methods to reduce or eliminate the potential causes of degradation.

The hatchery contractor must satisfy the waste discharge requirements of the appropriate Regional Water Quality Control Board, adhere to the standards set forth in the Hatchery Plan, and comply with the requirements of the Joint Panel with respect to the evaluation program, the genetic quality assurance program, and the environmental monitoring program. Managers of the grow-out facilities must comply with the requirements of the Joint Panel with respect to the evaluation program, the genetic quality assurance program and the environmental monitoring program, and follow the Grow-Out Facility Procedures Manual described in Appendix A.

If, after consulting with the Joint Panel, the Executive Director of the Coastal Commission determines that the operator of the hatchery or of a particular grow-out facility is causing significant degradation of the environment, the Executive Director may recommend to the Coastal Commission, and the Coastal Commission may require, that operation of the facility be modified, or halted to abate the degradation. The parties agree to take whatever action is necessary and appropriate to enforce the Coastal Commission decisions.

Section 6.0. Funding

6.1 Hatchery Construction At the direction of the Executive Director of the Coastal Commission, within 30 calendar days of the execution of this MOA by all Parties, SCE shall deposit $1.2 million in an interest-bearing escrow account. These funds shall be expended for hatchery construction, only upon authorization of the Executive Director of the Coastal Commission, who shall have the authority to release the funds in phases. The Joint Panel may make recommendations to the Executive Director of the

Coastal Commission as to the appropriate phases in which to release the funds. No funds shall be expended until the following has occurred:

(1) The Executive Director of the Coastal Commission has approved a Comprehensive Hatchery Plan, prepared by DFG (see Appendix A).

(2) The Joint Panel has been formed.

(3) The Coastal Commission has issued a permit for the hatchery construction and all other necessary permits have been secured.

6.2. Evaluation Program DFG and OREAP shall allocate OREHP funds, consistent with the recommendations of the Joint Panel, as explained below, necessary to conduct the evaluation of the experimental marine enhancement hatchery. At DFG's sole discretion, DFG may seek additional revenue for the OREHP to supplement the existing annual budget to provide for enhanced resources for the evaluation programs, beyond the minimum requirements specified below. Subject to the provisions of Section 6.5 below, DFG and OREAP shall allocate a minimum of $170,000 per year for the Evaluation Program (see Appendix B) for the duration of the Evaluation Program (approximately 10 years after the initial releases of fish into the ocean). OREAP and DFG shall dedicate funds for the first year of the Evaluation Program (OREAP shall adopt a resolution declaring that the funds are available for expenditure), prior to the issuance of the permit for construction of the hatchery.

6.3. Genetic Quality Assurance Program DFG and OREAP shall allocate OREHP funds to implement the Genetic Quality Assurance Program (see Appendix C). The Joint Panel shall determine the amount of funding and the duration of the studies. The parties agree that Ocean Hatchery Program funds to be allocated for a Genetic Quality Assurance Program shall be approximately $70,000 annually, unless a majority of the members of OREAP and the DFG Director agree to fund a larger amount upon a specific request, with substantiation, by the Parties. The Parties agree that they shall also develop an allocation schedule for the disbursement of these

funds. Funding for the first year of genetic studies shall have been determined and dedicated by DFG and OREAP, prior to issuance of the permit for construction of the hatchery.

6.4. Grow-Out Facilities The Parties recognize that the success of the program is dependent on experimental grow-out (pen-rearing) facilities. Currently, these facilities are entirely supported by the volunteer efforts of United Anglers of Southern California and various private sport fishing clubs. At DFG's sole discretion, DFG and OREAP may support the grow-out program, to the extent DFG deems feasible, and provided that the Evaluation and Genetic Quality Assurance Programs shall have first priority for the expenditure of funds.

6.5. Selection of Release Sites

The Joint Panel will evaluate existing data, and, if necessary, will develop an RFP to help designate optimum release sites (see Appendix D). The Parties agree that if the Joint Panel determines that adequate information is available, the release sites contract may not have to be let. If the Joint Panel determines that the study is necessary, the study will be funded by the OREHP.

6.6. Conditions on Funding The Parties agree that, pursuant to Fish & G. Code section 6595, the availability of funds from the OREHP is strictly contingent on an annual Legislative appropriation of such funds, and that, absent this appropriation, DFG has no further obligation to make these funds available. DFG agrees to make good faith efforts to have such an appropriation included in the Governor's Budget and the budget approved by the Legislature, each year during the term of this Agreement.

The Evaluation and Genetic Quality Assurance Programs shall have priority over all other programs for the funds that are available from the OREHP.

Section 7.0. Contracting Procedures

7.1. Requests for Proposals The Joint Panel shall develop Requests for Proposals (RFPs) according to the requirements of the State Administrative Manual (SAM) Sections 1200–1290 and 8752, as applicable, and DFG contract procedures. These procedures will be provided to the Joint Panel by DFG. The RFP/Contract(s) for evaluation shall incorporate the evaluation criteria listed in Appendix B. The RFP/Contract(s) for genetic quality assurance shall incorporate the criteria listed in Appendix C.

7.2. Selection of Contractors The Director of DFG shall select contractors in accordance with the requirements of SAM Sections 1200–1290, and 8752, as applicable. Contractors are subject to the competitive bid requirements of SAM unless otherwise exempted. The Director of the DFG shall be guided by the Joint Panel's recommendation and advice in selecting contractors. If the Director of the DFG does not select a contractor recommended by the Joint Panel, the Director of the DFG shall provide the Joint Panel with a written explanation of the reason for the different selection. The Parties agree that these contracts will be let by the DFG Director pursuant to the SAM, and the Public Contracts Code.

7.3. Preparation of Contracts The DFG staff shall prepare contracts according to SAM Sections 1200–1290 and 8752. All contracts are subject to approval by the Department of General Services, unless otherwise exempted by State law.

7.4. Change of Contractors If the project is not terminated, but the Joint Panel determines that a new operations contractor is required, items 7.1 to 7.3 shall apply to the new operations contractor.

Section 8.0. Financial Records and Accounting

Generally-Accepted Accounting Procedures (GAAP), financial management, and accounting systems, and procedures must be maintained by the funding Parties (i.e. DFG and OREAP), and the contractors, which provide for (1) accurate, current and complete disclosure of all financial activity for the marine hatchery program, (2) effective control over, and accountability for all funds, property and other assets related to the program, (3) comparison of actual outlays with budgeted amounts, and (4) accounting records supported by source documentation. Semi-annual financial reports showing current and cumulative financial activity must be provided to the Joint Panel. This work must meet state-approved methods under the SAM. All program records must be available at any time for examination by the Joint Panel.

The funding parties shall retain all pertinent books, documents and papers, including financial transactions and supporting documents, and policies and procedures for the general accounting system, internal controls, and management practices for a period of three years following the date(s) of all final payment(s) under the Agreement.

Any of the parties can request that an audit be conducted at its own expense by an independent, certified public accountant. Copies of the audit report shall be provided to all Parties to this Agreement.

Section 9.0. Rights in Data

All data, including, but not limited to, reports, drawings, blueprints, technical information, financial information, and contracts, resulting from the implementation of the Agreement shall be the joint property of all parties to this MOA. Notwithstanding the foregoing, any Party to the Agreement, or to a contract prepared hereunder, may use the data for its own purposes, including publication, provided a statement is included

with each publication of the data that the views expressed are those of the individual party alone, and not of the other Parties.

Section 10.0. Dispute Resolution

A failure on the part of any of the Parties to carry out the terms of the Agreement shall result in the following process. First, the party that believes another party is failing to carry out the terms of the Agreement shall present the problem to the Joint Panel for resolution. If the Joint Panel cannot resolve the issue to the satisfaction of the Party, the Party may bring the issue to the Executive Director of the Coastal Commission and the Deputy Director for Fisheries of the DFG, who shall jointly try to resolve the problem. If the Executive Director of the Coastal Commission and the Deputy Director for Fisheries of the DFG cannot resolve the issue, the matter shall be referred to the Secretary for Resources for resolution.

Section 11.0. Modification

The Agreement may be amended only in a writing executed by all of the Parties.

Section 12.0. Termination

12.1. Initial Term This Agreement shall be effective upon execution by all Parties, and shall continue in effect until December 31, 2002, unless sooner terminated or extended as provided herein.

12.2. Extension If the Legislature extends the Ocean Hatchery Program beyond December 31, 2002, the Parties agree to extend this Agreement for the period of time determined by the Joint Panel to be necessary to complete the evaluation program (the length of the program is approximately 10 years after initial fish releases) or Genetic Quality Assurance Program, provided, however, that no extension shall be

effective beyond the date that the legislature has extended the Ocean Hatchery Program.

12.3. Early Termination

12.3.1. Mutual Agreement This Agreement may be terminated at any time by written mutual agreement of all the Parties.

12.3.2. Failure of Legislative Authority or Appropriation In the event that the Legislature repeals Article 8 of Chapter 5 of Division 6 of the Fish and Game Code, which provides for the OREHP, DFG, upon notice to the other parties, may withdraw from this Agreement as of the effective date of such repeal. The Agreement then shall terminate as to all other Parties, 30 days after DFG's withdrawal. In the event that the Legislature fails to appropriate funds for the OREHP, DFG may withdraw from this Agreement as of the last day of the fiscal year in which such funds have been appropriated. The Agreement then shall terminate as to all other Parties, 30 days after DFG's withdrawal.

12.3.3. Other Events Justifying Early Termination Any Party may effect the termination of this Agreement, upon 30 days notice, if the operation of the hatchery ceases for any of the following reasons:

(a) The operator loses the right to occupy the land upon which the hatchery is built, or is to be constructed;

(b) The operator ceases to exist as a non-profit entity, and another entity does not qualify to assume management and operation of the hatchery;

(c) The operation of the hatchery becomes impossible or impractical due to the occurrence of some event of force majeure.

12.3.4. Disposition of Assets

Upon termination of the MOA, the disposition of the hatchery building and raceways will be the responsibility of the operations contractor. Disposition of the hatchery fish will be the responsibility of DFG or its agent. Unexpended OREHP funds shall remain in the OREHP account for disposition by DFG. Equipment purchased with OREHP funds shall be declared surplus by the state and appropriate resolution made as determined by DFG. Any equipment purchased by the operations contractor (with non-OREHP funds) shall revert to that contractor.

Section 13.0. Designation of Party Representatives

For purposes of this Agreement, each of the representatives listed below may exercise all the rights and discharge all the obligations of the represented Party, to the extent otherwise permitted by law.

Coastal Commission: Executive Director

SCE: Chief Executive Officer

DFG: Deputy Director for Fisheries

OREAP: Panel Chairman

The designated representatives listed above may delegate any of the responsibilities or authority specified in this Agreement to other members of their respective staffs. However, no Party shall assign any of its responsibility or authority to any other person or entity, without the consent of all other parties.

IN WITNESS WHEREOF, the Parties have executed this Memorandum of Agreement to this effect as of the date last signed below.

CALIFORNIA COASTAL COMMISSION

By: Peter Douglas — 4/1/94

Peter Douglas
Executive Director

Date

CALIFORNIA DEPARTMENT OF FISH AND GAME

By: Boyd Gibbons — 4/6/94

Boyd Gibbons
Director

Date

OCEAN RESOURCES ENHANCEMENT ADVISORY PANEL

By: Robert C Fletcher — 3-28-94

Robert Fletcher
Panel Chairman

Date

SOUTHERN CALIFORNIA EDISON

By: [signature] — 3/31/94

John R. Fielder
~~Vice President~~

Date

APPROVED
BRYANT C. DANNER
Senior Vice President
and General Counsel
By [signature]
Attorney
3/31, 1993

APPENDICES

APPENDIX A: Comprehensive Hatchery Plan

The DFG shall develop a comprehensive hatchery plan and submit it for approval to the Joint Panel and the Executive Director of the Coastal Commission. The plan shall address the objectives set forth below:

(1) The Hatchery Plan will describe the methods for producing white seabass, including answers to the following questions:

   a. How will the broodstock be collected and maintained?

   b. How will eggs be produced?

   c. How will larvae be cultured?

   d. How will post settlement offspring be maintained?

(2) The Hatchery Plan will describe the methods for tagging all fish that are to be released, and how a tag database will be maintained.

(3) The Hatchery Plan will describe the procedures for the grow-out and release of the fish.

(4) The Hatchery Plan will describe the methods for transporting fish from the hatchery to the grow out facilities and from grow out facilities to release sites, if different.

(5) The Hatchery Plan shall provide standards for measuring the success of the hatchery. This will include a bioeconomic model.

(6) The Hatchery Plan will provide an enhancement objective, i.e., what biomass or catch will be considered the endpoint for restoration of the fish population.

(7) The Hatchery Plan will provide a budget and schedule for hatchery construction.

(8) The Hatchery Plan shall be revised after the first year of operation, and biennially thereafter to provide samples for the Genetic Quality Assurance Program when required, and will incorporate any relevant findings and standards from the Genetic Quality Assurance Program, determined appropriate by the Joint Panel.

(9) The OREAP, in consultation with the DFG, shall develop a procedures manual that all grow-out facilities will be required to follow. The manual will standardize the operation of the grow-out facilities. The procedures manual will address the following: (A) application process, (B) site selection, (C) pen design and manufacture, (D) preparation for receiving fish, (E) feeding, (F) monitoring, recognition and treatment of diseases, (G) preparation for release of fish, and (H) record-keeping procedures.

As noted, in Project Description, section 3.1 above, the grow-out facilities will be operated separately from the hatchery by volunteer groups. As the program progresses, there will be a need to update both the Hatchery Plan and the Grow Out Facilities Manual. The Joint Panel will annually determine if these documents need revision. Likewise, the exact amount of funding designated for individual programs may be changed when justified and approved by the Joint Panel. The revision and funding noted above are contingent on availability of DFG resources and legislative appropriation.

Appendix B: Evaluation Program

The evaluation program shall have two stages: (1) the nearshore habitat sampling program for young white seabass (years 1–4), and (2) the ocean sampling program for adult white seabass (years 5–8). The evaluation proposals shall be judged primarily on the ability of each proposal to achieve the criteria for the Nearshore Habitat Sampling Program, and Ocean Sampling Program, as described below:

Nearshore Habitat Sampling Program. This Program monitors fish released nearshore, so that a baseline database may be established for survival of adult fish. Criteria for this program include:

(1) Released fish should be counted accurately and marked, so their source, date of release, place of release, and numbers released can be determined if they are subsequently recaptured.

(2) The field sampling program should include the following tasks:

a. Estimate an index of abundance that is proportional to the absolute numbers of fish present in each habitat sampled.

b. Estimate the fraction of fish that are marked or are wild, soon after release and sometime later, so as to estimate apparent mortality rates or survival, and determine whether these rates vary among habitat, regions, or seasons.

c. Use the information from (a) and (b) to determine, as near as possible, optimal stocking densities and seasons for individual habitat areas, taking into account the possibility that survival may vary among habitats and seasons, and that the release of juvenile fish may saturate habitat areas.

Ocean Sampling Program

(1) Heads of legal-sized white seabass should be collected by the appropriate contractor from anglers and commercial passenger fishing vessels in cooperation with DFG personnel and private parties. The heads will be examined for the presence of tags.

(2) The study should be well publicized to inform the public, and known opponents, about the purpose of the sampling thereby increasing the likelihood of recovering heads of tagged fish.

(3) The data from the ocean sampling program should be used to estimate the contribution of hatchery fish to the catch, and estimate the mortality rate of hatchery fish.

Appendix C: Genetic Quality Assurance Program

The following section contains the objectives of the Genetic Quality Assurance Program. Some of the objectives will be achieved through genetic studies, others address aspects of the hatchery operation. The Joint Panel shall incorporate relevant findings from this program into the Hatchery Plan. As described in Section 4.2, the Joint Panel shall develop an RFP for genetic quality assurance contract(s), evaluate proposals, and recommend a contractor to the Director of the DFG. The genetic quality assurance proposals will be evaluated primarily on the ability of each proposal to achieve the relevant criteria listed below.

(1) Determine the genetic variability and structure of the wild population. The Joint Panel will determine whether the genetics, genetic structure, and genetic variability of white seabass are already adequately known, or whether the existing database should be expanded and more precise techniques developed. If additional studies are needed, they shall include enough individuals and sampling locations and enough loci to characterize the population and monitor changes in the population over time. The first year of studies shall be completed before any substantial releases (>100,000) of hatchery reared fish.

(2) Assure that the hatchery releases protect the existing amount of genetic variability and structure of the wild population.

(a) Determine whether actions are needed to protect the existing amount of genetic variability and structure present in the wild population. This may require, for example, that the minimum effective broodstock size needed to maintain the genetic diversity of white seabass must be determined and maintained.

(b) Assess the impact of the releases on the genetic variability and structure of the wild population. Genotypes of all spawners and an

adequate sample of each batch of their offspring at the time they are released to the wild shall be monitored as a quality assurance measure to document hatchery contributions to the wild stock and to provide data to detect long-term changes in the genetic diversity of the wild population.

(c) If data from B(2) indicate that the hatchery is causing long-term changes in the genetic variability or structure of the wild population, assess whether additional actions are needed to protect genetic variability and structure.

Appendix D: Selection of Release Sites

The Joint Panel will evaluate existing data, and, if necessary, will develop an RFP to help designate optimum release sites. The Parties agree that if the Joint Panel determines that adequate information is available, the release sites contract may not have to be let. If the Joint Panel determines that the study is necessary, the study will be funded by the OREHP.

The study shall be designed to answer the following questions:

(1) What types of habitat do small white seabass (the same size as released fish) use?

(2) Where can white seabass be released with the best chance of survival?

Based on the results of this study, a review of existing information, the results of the genetic quality assurance studies, the Joint Panel will develop a plan for sites for release of depleted ocean species.

EXHIBITS

1) Coastal Commission Permit Condition "E". (See attached).

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200

Energy and Ocean Resources Unit	
Staff:	CP/MM/SH—SF
Staff Report:	March 5, 1993
Hearing Date:	March 17, 1993
Item Number:	16
Commission Action:	Approved
Vote:	9 to 0

ADOPTED COASTAL COMMISSION RESOLUTION TO FURTHER CONDITION SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 AND 3 PERMIT 183–73: MARINE HATCHERY CONDITION (E)

SYNOPSIS

On May 13, 1992, the Coastal Commission voted to add a condition to Permit 183–73, requiring Southern California Edison Company (SCE) to provide $1.2 million for (1) construction of a marine fish hatchery, and (2) an evaluation program to determine the extent to which the hatchery is effective at increasing the stock of fish. The Commission's decision was made on the basis of the staff recommendation, which consistent with Commission practice, became the Commission's findings.

The hatchery requirement serves as a supplemental element to the mitigation package required to address the impacts that the MRC found the San Onofre Nuclear Generating Station Units 2 and 3 to be having on the marine environment. Other elements in the mitigation package include a 300-acre artificial reef, a 150-acre wetland restoration project, and fish behavioral barrier devices at the SONGS Unit 2 and 3 water intakes.

The marine fish hatchery requirement is suited to the unique circumstances of the SONGS Units 2 and 3 impacts and mitigation requirement. The scientific findings on the efficacy of a marine fish hatchery for enhancing a fishery and thus providing mitigation are inconclusive. In its May 13, 1992 decision to require SCE's funding of the hatchery, the Commission found that "because of the status of the science of marine fish hatcheries, a fish hatchery does not provide any guaranteed mitigation." However, the Commission further found that the "the initial results...are promising, (and)...the inclusion of such a requirement would "raise the level of certainty that the impacts (from SONGS) would be compensated."

EXHIBIT NO. 1

An additional level of mitigation assurance is warranted by the uncertainty surrounding the mitigation values that will actually be achieved from the wetland and reef projects, to address the substantial impacts to fish from SONGS. Should it prove to be effective, the hatchery will provide direct environmental benefits to supplement the fisheries benefits of the wetland restoration and reef projects. In addition, the hatchery will provide information on the benefits and problems of future similar projects.

The staff recommends that the Commission adopt the resolution found in Section IV of this staff report (page 5), which adds a new condition to permit 183–73. The condition (1) requires SCE to provide up to $1.2 million toward the construction of a marine fish hatchery, (2) conditions this requirement on the provision of $170,000 in Ocean Resource Enhancement and Hatchery funds to be allocated annually to a monitoring and evaluation program, (3) requires OREHP funds to be allocated to conduct a genetic quality assurance program, and (4) specifies that the Commission, the Department of Fish and Game, the Ocean Resources Enhancement Advisory Panel, and Southern California Edison will jointly oversee the design and implementation of the evaluation program and genetic quality assurance program.

I. BACKGROUND

In 1974, the California Coastal Zone Conservation Commission (CCZCC, now the Coastal Commission) authorized construction of Units 2 and 3 of the San Onofre Nuclear Generating Station. The CCZCC conditioned the approval on the establishment of a committee of scientists to study the effects of the new units on the marine environment and recommend changes to the plant or mitigation measures to address any substantial adverse impacts found. The permit includes a condition that allows the Commission to "further condition the permit accordingly" (Condition B–4 and B–6 of Permit 183–73) in response to the committee's recommendations.

The Marine Review Committee (MRC) studied the impacts of the plant from 1979 to 1988. The MRC found that the plant has a significant adverse impact on the marine environment in two principal ways: (1) as a result of the intake of organisms through the cooling system, the plant has a substantial impact on the standing stock of a number of fish populations in the Southern California Bight and local midwater fish, and (2) as a result of turbidity caused by the discharge plume, the plant adversely affects the kelp community in the San Onofre kelp bed.

On July 16, 1991, in response to the MRC's findings and recommendations, the Commission voted to adopt new permit conditions requiring SCE to mitigate the impacts documented by the MRC by (1) constructing an artificial reef, (2) restoring a wetland, and (3) installing behavioral barrier devices at the plants' water intakes. In addition to imposing these new mitigation requirements, the Commission directed the staff to "explore and bring back to the Commission the possibility of a fish hatchery program for ocean release."

The staff conducted an evaluation of the potential for a marine fish hatchery to serve as an additional requirement, and, on May 13, 1992, presented four options for the Commission's consideration. The Commission voted to select "Option 3": to require SCE to provide funds toward the construction of a hatchery and to fund scientific recapture studies for 5 to 10 years, up to a total of $1.2 million.

In voting to require funding for a fish hatchery, the Commission recognized that a marine hatchery could not serve as stand-alone "mitigation" at this time. Although a number of marine hatcheries are in operation, to date there has been insufficient evaluation of the effectiveness of a fish hatchery in enhancing the stock of marine fish. The Commission added the hatchery funding requirement to the SONGS Units 2 and 3 permit with the idea that if the hatchery proves successful, the benefits to the white seabass fishery will help to ensure that the fisheries impacts of SONGS Units 2

and 3 are adequately mitigated. In addition, the additional funding would help to ensure that an adequate evaluation of the hatchery is conducted. The task now before the Commission is to further specify the details of this new requirement in the form of a new permit condition and findings.

II. SCIENTIFIC ADVISORY PANEL

In developing the details of a new permit condition and findings, the staff sought the advice of the SONGS Mitigation Program Scientific Advisory Panel (SAP). The panel was established by the Commission in the course of its July 16, 1991 action (Condition D), and convened by the Commission's Executive Director. Current membership consists of Dr. Richard Ambrose of the University of California, Los Angeles, Dr. James Bence of the National Marine Fisheries Service (NMFS), and Dr. William Murdoch of the University of California at Santa Barbara. In addition, Dr. Alec MacCall of NMFS participates on the panel in an ad hoc capacity on fisheries issues.

The Scientific Advisory Panel met on July 8, 1992, December 21, 1992, and January 21, 1993 to discuss how to approach the evaluation of the fish hatchery. Steve Crooke from the Department of Fish and Game's Ocean Resources Enhancement and Hatchery Program (OREHP) also participated in the July 8 meeting.

In collaboration with the Commission staff, the Scientific Advisory Panel developed a recommended approach with the goal of "providing scientifically credible evidence that the hatchery is (or is not) enhancing the stock of white seabass, without all the 'bells and whistles' that scientists might like to see in order to understand the details of how the hatchery is working (SAP Report, 9-16-92)." The approach is also designed to yield information that will help optimize hatchery operations to increase the production of catchable fish. Thus, the sampling program becomes a way not only to evaluate but also to improve the effectiveness of the mitigation.

The SAP and staff also recognized the importance of ensuring that hatchery operations do not cause a detrimental effect on the wild fish population. Of particular concern is the potential that the introduction of hatchery-reared fish could decrease the genetic diversity of the wild population. A loss of genetic diversity can reduce the adaptability of a natural population in dealing with changes in environmental conditions such as El Niño, global climate change or human impacts. *As little as a 10% decrease in genetic diversity can increase deformities and mortality and decrease fecundity and growth in fish populations where hatchery fish mix with wild fish* (Allendorf and Ryman, 1987). The hatchery program must

incorporate measures to preserve maximum genetic diversity in the hatchery fish; the SAP and staff have developed a plan to achieve this goal.

The SAP's proposed approach is incorporated into the staff's recommended new condition under Section IV below.

III. DEPARTMENT OF FISH AND GAME

The Department of Fish and Game administers the Ocean Resources Enhancement and Hatchery Program (OREHP), which was created by state legislation in 1983. The purpose of the program is to support research into the artificial propagation, rearing and stocking of marine fin fish species that have high sport and commercial fishing value in California. The program is funded by a tax on fishing licenses, which generates revenues of approximately $500,000 per year.

The program was extended by the state legislature in 1992 for an additional ten years. The legislation also established the Ocean Resources Enhancement Advisory Panel (OREAP) to assist the Director of Fish and Game in establishing policy for the program. The ten member panel is composed of six representatives of the sport and commercial fishing industries, a representative of the commercial aquaculture industry, a representative of DFG, a representative of the University of California, and a representative of the California State University systems. The expenditure of OREHP funds must be approved by both the Director of Fish and Game and a majority of the OREAP.

IV. STAFF RECOMMENDATION

The staff recommends that the Commission adopt the following resolution:

> Pursuant to the provisions of Conditions B–4 and B–6 of Permit 183–73, the Commission hereby adopts the following additional condition to be added to Permit 183–73, for the reasons stated in the Findings and Declarations herein below set forth.

CONDITION E: MARINE FISH HATCHERY

1.0 Provision of Funds

At the direction of the Executive Director of the California Coastal Commission (Executive Director), the permittee shall deposit $1.2 million in an interest bearing account established by the permittee. The funds shall be expended only upon the authorization of the Executive Director. All interest accrued on the funds shall be

added to the program. The Executive Director shall have the authority to release the funds in phases as the construction of the hatchery proceeds.

2.0 Preconditions to Expenditure of Funds

Expenditure of funds for hatchery construction shall be contingent upon the following: (1) execution of an agreement between the California Coastal Commission ("Commission" or "Coastal Commission"), the California Department of Fish and Game (DFG), the Ocean Resources Enhancement Advisory Panel (OREAP), and Southern California Edison Company (SCE) incorporating the terms described below (see 3.0); (2) the Executive Director's approval of a comprehensive hatchery plan, prepared by the DFG (see 3.0(c)); (3) the formation of a "joint panel" for contractor selection (see 3.0(d)); and (4) granting of a coastal development permit and all other necessary permits for the hatchery.

3.0 Memorandum of Agreement

The Department of Fish and Game, the Ocean Resources Enhancement Advisory Panel, the Coastal Commission and Southern California Edison Company shall enter into a Memorandum of Agreement (MOA). The MOA shall include, but not be limited to, the following terms:

a. **Funding for Evaluation.** The OREHP program shall allocate OREHP funds to conduct the necessary evaluation program. The evaluation program is currently estimated to cost approximately $170,000 per year. OREHP shall dedicate, in a manner to be specified in the MOA, **at least** this amount of funding for the evaluation program, adjusted for inflation, for the duration of the evaluation program (10 years after the initial fish releases into the ocean). This funding amount does not include funding for the genetic quality assurance program. The funding for the first year of evaluation shall have been dedicated prior to issuance of the permit for construction of the hatchery. Under no circumstances shall evaluation funds be reduced below this level without the approval of the Joint Panel (see 3.0(d)), in order to augment funding for hatchery operations.

b. **Evaluation and Genetic Quality Assurance Objectives.** The objectives listed in Section 5.0 and Section 6.0 of this report, shall provide the basis for the development of the evaluation and genetic quality assurance programs, respectively.

c. **Comprehensive Hatchery Plan.** The DFG, in consultation with the Commission staff, shall develop a comprehensive hatchery plan and

submit it for approval to the Executive Director of the Coastal Commission. The plan shall include, but not necessarily be limited to: (1) the specifications for the production of white seabass from broodstock to young juveniles, (2) a plan for the grow-out and release of the fish, (3) performance standards for measuring the success of the hatchery, (4) an enhancement objective i.e. what biomass or catch will be considered the endpoint for restoration of the white seabass population, and (5) a budget and schedule for the hatchery construction.

d. **Joint Panel.** A joint panel (Joint Panel) shall be formed, consisting of one representative from each of the following entities: the Coastal Commission, the Department of Fish and Game, and the Ocean Resources Enhancement Advisory Panel. The Joint Panel shall oversee the evaluation and genetic quality assurance of the hatchery. SCE may, but shall not be required to, appoint a fourth member of the panel. Should SCE determine it does not want to participate in the Joint Panel, a fourth qualified person shall be jointly selected by CCC, DFG and OREAP to replace the SCE representative. The Joint Panel shall make decisions based on the consensus of all panel members. Separate contracts shall be let for the evaluation and genetic quality control of the hatchery. The Joint Panel shall develop Request for Proposals (RFPs), recommend contractor selections to the Director of DFG, develop contract terms, and oversee and evaluate contractor performance in carrying out the evaluation and genetic quality assurance programs. The RFP for the evaluation contract shall incorporate the evaluation objectives listed in section 5.0. The RFP for the genetic quality assurance contract shall incorporate the objectives listed in section 6.0. Contractor selection shall be based, in part, on the ability of the contractor's proposal to achieve these objectives.

e. **Funding for Genetic Quality Assurance.** OREHP shall provide funding in amount sufficient to enable a contractor to achieve the objectives set forth in Section 6.0, for studies of the genetics of the wild stock of seabass, of the hatchery brood stock, and of any seabass released to the wild from the hatchery. Funding for these studies shall be in addition to the $170,000 to be allocated annually for the evaluation program (see 3.0(a)). The Joint Panel shall determine the necessary amount of funding and duration of studies, and shall oversee the genetic studies.

f. **Annual Reports.** On an annual basis, the evaluation contractor and genetic quality assurance contractor shall report on the previous year's activities and overall status of the hatchery project, identify problems and make recommendations for solving them, and review the next year's

program at the Annual Mitigation Monitoring Review Meeting (to be held in accordance with the requirements of Condition D, Permit No. 183-73, dated July 16, 1992). The contractors also shall prepare quarterly or semi-annual status reports for CCC and OREAP review.

g. **Failure to Carry Out the Terms of the MOA.** If the actions described in the MOA are not carried out fully, the Executive Director shall evaluate the situation, and recommend an appropriate course of action to the Coastal Commission.

h. **Environmental Degradation.** Contracts let by DFG in connection with the white seabass hatchery project shall require the hatchery contractors to closely monitor the operations of the hatchery and grow out facilities to ensure that they are not causing significant environmental degradation. Examples of ways that a marine hatchery can cause environmental degradation are: (1) discharge of effluent from the hatchery, (2) decayed or excess food and dead fish from the rearing pens, (3) introduction of pathogens or parasites, (4) trophic alterations such as cannibalism, food competition or predation on other species, and (5) genetic alterations to the wild stock due to hybridization or displacement. If, after consulting with the Joint Panel, the Executive Director determines that the hatchery is causing significant degradation of the environment, the Executive Director may order that the operations be halted until the degradation is stopped.

4.0 Failure to Sign an MOA

If, after a reasonable period of time, it becomes evident to the Executive Director that the parties specified in Section 3.0 are not willing to enter into an MOA that conforms to the standards of Section 3.0, the Executive Director shall consider a range of options for addressing the situation, and shall bring a recommendation to the Commission. Such options shall include requiring SCE to fund an alternative project. In that event, the Commission will determine if this permit condition shall be modified, or shall be null and void.

5.0 Evaluation Program

As described in Section 3.0 above, the Joint Panel shall develop an RFP for an evaluation contract, review proposals and recommend a contractor to the Director of DFG. The evaluation program shall have two stages: (1) the nearshore habitat sampling program for young white seabass (years 1 to 4), and (2) the ocean sampling

program for adult white seabass (years 5 to 10). The evaluation proposals shall be judged, in part, on the ability of each proposal to achieve the following objectives.

5.1 Nearshore Habitat Sampling Program Objectives

a. Released fish should be counted accurately and marked, so that their source, date of release, place of release, and numbers released in each place can be determined if they are subsequently recaptured.

b. The field sampling program should be adequate to obtain the following estimates:

(1) How many wild juvenile fish are present in each habitat area sampled?

(2) What are the annual losses (emigration and mortality) and gains (immigration and releases) of wild and hatchery raised juveniles in each embayment sampled?

c. The results of marking fish and sampling in nearshore habitats should answer the following questions:

(1) Do certain habitat areas or seasons result in better apparent survival of released fish?

(2) Can habitat areas be saturated by the release of too many juvenile fish?

(3) What are the optimal stocking densities and seasons for individual habitat areas?

5.2 Ocean Sampling Program

a. Heads of legal-sized white seabass (where tags will be found if present) should be collected from anglers and commercial passenger fishing vessels in cooperation with California Department of Fish and Game personnel and private parties. The fish heads should be collected from locations covering as wide an area as possible.

b. The study should be well publicized to inform the public about the purpose of the sampling and to increase the likelihood of recovering heads of tagged fish.

c. Fish heads should be deposited in freezers in standard locations and collected at appropriate intervals. Heads preserved in freezers could provide material for genetic studies, if needed.

d. The data from the ocean sampling program should be used to:

(1) Estimate the contribution of hatchery fish to the catch; and

(2) Estimate the mortality rate of hatchery fish.

6.0 Genetic Quality Assurance Objectives

The following section contains the objectives of the Genetic Quality Assurance Program. Some of the objectives will be achieved through genetic studies, others address aspects of the hatchery operation. As described in Section 3.0 above, the Joint Panel shall develop an RFP for a genetic quality assurance contract, shall evaluate proposals, and recommend a contractor to the Director of DFG. The genetic quality assurance proposals shall be evaluated, in part, on the ability of each proposal to achieve the relevant objectives.

a. Population genetics and diversity of the wild population shall be described from enough individuals and for enough genetic loci (plural of locus, the location of a gene on a chromosome) to characterize the population so changes can be detected by reasonable monitoring efforts. The Joint Panel will determine whether the genetic diversity of white seabass is already adequately characterized or if the database should be expanded and more precise techniques developed.

b. The hatchery broodstock shall consist of a enough fish in the appropriate sex ratio to ensure that the effective hatchery population size will maintain genetic diversity and rare alleles (the different forms of a gene which can occur at a locus) in the hatchery-produced fish. The hatchery broodstock should consist of approximately 100 males and 100 females based on current information. The Joint Panel will determine the precise number.

c. Hatchery spawning and rearing practices will be implemented to achieve equal input from a large number of random breeders to preserve quantitatively the allelic diversity and genotypic variety of the wild stock in the fish released from the hatchery.

d. The effects of selection within the hatchery for traits favorable to survival within a hatchery, but not necessary for survival in the wild, shall be minimized. This should be done by adjusting the numbers of fish released from each batch spawned, so that the genetic composition of fish released is representative of the genetic composition of the wild population to the maximum extent possible (given the characteristics of the brood stock and knowledge of the genetic composition of the wild population).

e. Genotypes of spawners and samples of their offspring that are to be released shall be monitored as a quality assurance measure to document hatchery contributions to the wild stock and to provide data to detect long term changes in genetic diversity of the wild population. Tissue samples shall be taken from all of the spawners and an adequate sample of each batch released to the wild.

FINDINGS

A. Construction and Evaluation of Fish Hatchery

1.0 Need for an Additional Element in the Mitigation Package

In adopting a mitigation package for the impacts of San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 on July 16, 1992, the Commission directed the staff to investigate and report back on the possibility of requiring that Southern California Edison (SCE) fund a marine fish hatchery.

On May 13, 1992, the Commission found that a marine fish hatchery is a necessary addition to the mitigation package. The Commission based its decision on several considerations. The mitigation package includes a requirement that SCE create or restore 150 acres of tidal wetland to compensate for the impacts of SONGS Units 2 and 3 on fish. Restoration of a tidal wetland provides many important resource benefits in addition to providing habitat and a nursery area for fish. However, there are limitations on the fisheries benefits that can be achieved through wetlands restoration. The need for fisheries habitat must be balanced with the need for other types of habitat within a wetland system.

A requirement for a marine fish hatchery complements the wetland restoration requirement. The fish hatchery has the potential of directly increasing the stock of white seabass, and thus providing a clear fisheries benefit to offset the loss of fish due to the power plant operations.

The Commission recognizes that scientific findings on the efficacy of a marine fish hatchery for enhancing a fishery are inconclusive. In its May 13, 1992 decision to require SCE's funding of the hatchery, the Commission found that "because of the status of the science of marine fish hatcheries, a fish hatchery does not provide any guaranteed mitigation." However, the Commission further found in the May 13, 1992 decision that the requirement would move the science of fish hatcheries forward "to where it would be possible to determine the hatchery's effectiveness...and the inclusion of such a requirement would raise the level of certainty that the impacts (from SONGS) would be compensated."

The marine fish hatchery requirement is suited to the unique circumstances of the SONGS Units 2 and 3 impacts and mitigation requirement. The hatchery requirement provides an additional level of mitigation assurance that is warranted by the uncertainty surrounding the mitigation values that will actually be achieved from the wetland and reef projects, to address the substantial impacts to fish from SONGS. Should it prove to be effective, the hatchery will provide direct environmental benefits to supplement the fisheries benefits of the wetland restoration and reef projects. In addition, the hatchery will provide information on the benefits and problems of future similar projects.

The Commission finds that Condition E, which requires that SCE provide funding for a marine fish hatchery, is a necessary supplement to the wetlands mitigation requirement to address fully the impacts of SONGS on fish.

2.0 Importance of Funding for the Evaluation Program

When the Commission voted to require a marine fish hatchery project as a condition of the SONGS permit, it recognized that the critical element in the requirement involves the development of an evaluation program to test the effectiveness of the hatchery in enhancing the stock of fish. Therefore, it voted to require that SCE spend up to $1.2 million on the project, to be allocated partly to fund the capital costs of constructing a new hatchery, and partly to fund a 10 year evaluation program. The Commission directed the staff to develop the details of this requirement.

At approximately $500,000 per year, the current funding level for the Department of Fish and Game's Ocean Resources Enhancement and Hatchery Program is inadequate to fund the construction of a hatchery, but is adequate to fund the operation and evaluation of the hatchery. In addition, the DFG and OREAP indicate that the program has funding adequate to support studies to ensure that the hatchery does not adversely affect the genetic diversity of the wild stock. The Commission finds that maximum resource benefits could be achieved by requiring

SCE to provide $1.2 million toward the capital costs of the hatchery, and by entering into a cooperative arrangement with the Department of Fish and Game, the Ocean Resources Enhancement Advisory Panel, and SCE to jointly develop and implement an evaluation program and a genetic quality assurance program with funding from DFG/OREHP. The mechanism for achieving this arrangement will be through a Memorandum of Agreement (MOA).

Condition E specifies SCE's obligations and lays out the required elements of the MOA. SCE is required to place $1.2 million into an account for the purpose of funding the capital costs of a hatchery. Prior to the Executive Director authorizing the expenditure of any funds from this account for the capital costs, the Commission, the Department of Fish and Game, the Ocean Resources Enhancement Advisory Panel and SCE must have entered into the Memorandum of Agreement. Among other requirements, the MOA would require that DFG/OREHP maintain at least $170,000 per year in funding for the evaluation program, and provide adequate funding for a genetic quality assurance program.

The Commission finds that the evaluation program is a critical element in the requirement since it will both test the success of the hatchery in enhancing white seabass stocks, and provide information on alternative release strategies so the operation of the hatchery can be optimized.

B. Genetic Monitoring and Quality Assurance

Coastal Act Section 30230 states:

> Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, an educational purposes.

Coastal Act Section 30231, in part, states:

> The biological productivity and quality of coastal waters...appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and where feasible, restored...

The above sections of the Coastal Act provide authority additional to that contained in Permit 183-73 for the Commission's consideration of the hatchery operation and evaluation requirements. The Coastal Commission's mandate under these sections

is both to enhance marine resources, and ensure that projects in coastal waters do not cause a degradation of the marine environment.

It is the intent of the Coastal Commission that hatchery enhancement of stocks increase the standing stock of fish, and increase the supply of fish to the fishery and therefore contribute to mitigation for the killing of fish by the San Onofre Nuclear Generating Stations Units 2 & 3. However, releases of hatchery produced fish into the coastal environment also have potentially harmful consequences to the existing stock of white seabass. Parasites and diseases can be introduced from a hatchery to a wild stock, and the genetic diversity of the wild stock can be detrimentally affected by hatchery fish if proper precautions are not taken.

Genetic impacts are especially serious because natural populations have adapted over millions of years and will be unlikely to recover genetic traits once they are lost. This problem was not recognized by hatchery operators until recently, but now evidence has accumulated that inappropriate releases of hatchery fish to the wild have negative consequences on growth, reproduction, and behavior of the wild stock. The long-term adaptability of the natural population to such things as El Niño and climate change also depend on genetic diversity. Loss of genetic diversity increases the possibility of extinction of a species. A loss of genetic diversity in the seabass stock thus could cause a negative impact on the species, rather than enhancement as intended by the Commission.

The Department of Fish and Game's OREHP Program has done preliminary investigations into the genetics of seabass relevant to hatchery enhancement of the stock, but some questions remain to be answered. The Commission staff estimates that additional necessary studies might cost $50,000 to $70,000 per year, over approximately the next five years, but recognizes that these are rough estimates. By signing the Memorandum of Agreement described in Condition E, Section 3, and securing the $1.2 million in funding for construction of the hatchery, OREHP will commit to funding studies and operational procedures to protect the genetic diversity of the wild white seabass stock, in addition to providing at least $170,000 per year for the evaluation program. The necessary genetic studies and operational procedures are described in Condition E, Section 6. The Commission finds that the genetic quality assurance program described in Condition E, Section 6, is necessary to ensure that the fish released from the hatchery maintain the genetic diversity of the wild stock.

C. Need for a Coastal Development Permit

Since it is certain to be located within the coastal zone, the new hatchery facility and operation, including the grow-out pens and activities, will require a coastal development permit. A detailed, site-specific review of the environmental impacts

of construction and operation of the hatchery will be conducted for the coastal development permit.

V. SUBSTANTIVE FILE DOCUMENTS

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