REPORT OF THE SECOND CALIFORNIA SALMON AND STEELHEAD RESTORATION CONFERENCE

JANUARY 28-29, 1984
EUREKA, CALIFORNIA

The California Sea Grant College Program is a statewide multiuniversity program of marine research, advisory services, and education activities, administered by the University of California Institute of Marine Resources. Through the research it sponsors, Sea Grant contributes to the growing body of knowledge about our coastal and oceanic resources and helps solve contemporary problems in the marine sphere. Through its Marine Advisory Program, Sea Grant transfers information and technology developed in its research efforts to a wide community of users in California, the Pacific region, and the nation. Sea Grant also supports a range of educational programs for students, teachers, and the general public to promote the wise use of our coastal and oceanic resources by this and future generations.

This work is sponsored in part by NOAA, National Sea Grant College Program, Department of Commerce, under grant number NA80AA-D-00120, through the California Sea Grant College Program, and in part by the California State Resources Agency, project number A/EA-1. The U.S. Government is authorized to produce and distribute reprints for governmental purposes.

Printed by: California Sea Grant College Program

Cover Photo: Summer Run Steelhead Trout were photographed in the Middle Fork Eel River in 1979. These fish were trapped behind a natural barrier to upstream migration near Fly Creek, which was later removed (by blasting).

(Winning entry in the first Salmon and Steelhead Symposium photo contest, January 1984.)

Photograph by Vaughn G. Hutchins, Arcata, California

$5.00 per copy. (Please make your check or money order payable to the Regents of the University of California.) Send Send your order to:

Dr. Robert J. Price
Marine Advisory Program Coordinator
Department of Food Science and Technology
University of California
Davis, California 95616

UCSG-MAP-21

REPORT OF THE 2nd CALIFORNIA SALMON AND STEELHEAD RESTORATION CONFERENCE

JANUARY 28 - 29, 1984
EUREKA, CALIFORNIA

Edited By:

Ken Hashagen - California Department of Fish and Game
Christopher Toole - Univ. of California Cooperative Extension Sea Grant Program
Bruce Wyatt - Univ. of California Cooperative Extension Sea Grant Program
Sari Sommarstrom - Mendocino County Fish and Game Advisory Committee
Steve Taylor - California Department of Fish and Game

CONTENTS

INTRODUCTION

Background

California has a long history of public involvement in salmon and steelhead restoration. The role of the public until recently has primarily been one of advocacy, in which legislators and resource agencies have been encouraged to appropriate funds and perform projects beneficial to the state's anadromous salmonid populations.

In recent years, the role of the public has expanded from encouraging agencies to perform needed habitat and fish restoration work, to actually doing some of that work through local, non-profit organizations. Funded by community donations, county "fine monies", barbeques, service club contributions, timber companies, and fishermen's assessments, some of these groups have been active since the late 1960's. However, the number of active restoration groups has increased tremendously during the 1980's

This increase can in part be attributed to passage of AB 951 (Bosco-Keene) in the 1981-82 legislative session. The bill provided for Renewable Resources Investment Funds (RRIF) to be granted to non-profit groups and subdivisions of State government. A total of $925,000 was available for salmon and steelhead rehabilitation along the north coast. AB 951 was a one-time appropriation.

In 1982-83 AB 2513 was also sponsored by Assemblyman Bosco and State Senator Keene, continuing the RRIF monies available for restoration ($900,000) and expanding the grants to include Indian tribes. In 1983-84, the California Department of Fish and Game (CDF&G) budget included $900,000 of RRIF money to continue the restoration grant program. A similar amount is proposed for 1984-85, but the source may be from Environmental License Plate Funds.

This program has been variously referred to as the AB 951 program, the Bosco program, and the Bosco-Keene program. It is referred to in the CDF&G budget as the Northcoast Cooperative Salmon and Steelhead project.

Purpose

While many organizations and individuals were doing simliar types of restoration work for the last few years, communication between the various groups was limited. It appeared that a forum in which each group could describe its operations and techniques (whether successful or not) to the other organizations would be beneficial. In addition, it also appeared that the universities, the California Department of Fish and Game, and other state and federal fishery programs could contribute technical information which would be of use to the restoration groups.

With this purpose in mind, the editors planned the first conference, which took place January 22-23, 1983, at Bodega Bay. It was attended by about 100 people and their enthusiastic response encouraged us to plan for another one the next year.

The Second California Salmon and Steelhead Restoration Conference was held January 28-29, 1984, at Redwood Acres Fairgrounds in Eureka. This time about 200 people registered, coming from as far away as Monterey Bay, Placerville, and Portland, Oregon. Out-of-state speakers from British Columbia and Washington State were brought in to give Californians another perspective on salmonid enhancement programs.

The popularity of salmon and steelhead restoration efforts was also evident by the opening remarks of legislators representing the Eureka area. Following a warm welcome by Humboldt County Supervisor Ervin Renner, Assemblyman Dan Hauser (D-Arcata) and Congressman Doug Bosco (D-Occidental) offered continuing political support for fishery restoration programs. They also presented updates on proposed state and federal legislation.

Content

This Report is intended to serve as a written document of major presentations made by invited speakers at the conference and a directory of the activities of groups and agencies involved in salmon and steelhead restoration in California.

The directory is presented in Section II. Groups included in this directory are those who responded to our questionnaire asking for information to include in the Report. Most of the listed groups, but not all, made presentations describing their activities at the conference. We estimate that about 60% of the restoration groups in the state are included here. The format is the same as that used in the 1983 Report for groups that are listed for the first time. An "update" is included for groups that were listed in last year's Report. Copies of the 1983 Report can be obtained from: Sea Grant M.A.P. Extension, University of California, Davis, CA 95616.

Contributed papers are presented in Section III. Also included is the abstract of one paper presented at the 1983 Conference, which was received too late for inclusion in the 1983 Report.

Use of Report

It is our hope that this Report will serve both as a document of the second California Salmon and Steelhead Restoration Conference and as a resource for those involved in or contemplating restoration work. We anticipate future conferences and reports which will hopefully include any organizations or agencies inadvertantly left out. We also hope that any errors in this Report will be brought to the attention of the editors.

Ken Hashagen
Christopher Toole
Bruce Wyatt
Sari Sommarstrom
Steve Taylor
May 1984

SECTION II

NEWS CLIPPINGS

Times-Standard photo by Wayne Miller

W.D. Cummins of Scotia examines display at fish restoration conference Saturday.

Times-Standard 28 Jan 84 page 1

Groups gather here to discuss fisheries restoration progress

By the Times-Standard

EUREKA — Groups working to restore Northern California's salmon and steelhead fisheries gathered in Eureka Saturday for a two-day conference to exchange technical information and discuss progress being made on individual restoration projects.

The Second Annual California Salmon and Steelhead Restoration Conference was attended by more than 150 members of non-profit groups that restore or improve stream habitats, and operate pond-rearing programs or fish hatcheries from Monterey to Del Norte counties. The conference was sponsored by the California Department of Fish and Game and the U.C. Cooperative Extension Sea Grant Program and primarily included short presentations by individual project members.

Most of the groups doing this kind of work are community organizations that receive grant funding through the state Renewable Resources Investment Funds. Use of these funds for salmonid restoration was initiated in 1981 by Sen. Barry Keene and then-Assemblyman Doug Bosco. Eight restoration projects are currently under way in Humboldt County, with total grants exceeding $100,000.

Saturday morning's session opened with brief speeches by Supervisor Erv Renner, Assemblyman Dan Hauser, D-Arcata, and Congressman Doug Bosco, D-Occidental. Special presentations on fishery enhancement programs in British Columbia and Washington were given by Bill Schouwenburg, a senior planning biologist with the Canadian Department of Fisheries and Oceans, and Ernest Brannon, a professor at the University of Washington's School of fisheries.

Both Hauser and Bosco commended the groups for their efforts and gave an update on proposed fishery legislation. Bosco said that his bill to spend $55 million on restoring the Trinity River fishery was promised a hearing by the Merchant Marine and Fisheries Committee. The bill, co-sponsored by Rep. Gene Chappie, R-Chico, is aimed at helping the Trinity fishery recover from damage caused by a federal water diversion project, which depleted the fishery by about 85 percent of its original level.

According to Schouwenberg and Brannon, fishery enhancement programs today need to concentrate on improving monitoring programs to gauge success rates and determine which restoration projects are providing good economic returns on the investment. In addition, Brannon warned that over-ambitious hatchery programs could lead to the depletion of natural strains of fish.

The conference will continue today at Redwood Acres Fairgrounds with reports on several local projects from 11:30 a.m. to 3:30 p.m.

Second Issue February — 1984

California's commitment to fish — salmon and steelhead restoration conference

by Andrea Granahan

Low-tech, community involvement, and government funding commitments for fish restoration emerged as the major themes in two days of meetings and demonstrations January 28-29, in Eureka, California. The Second Annual Salmon and Steelhead Restoration Conference drew almost 200 people representing 35-40 organizations actively involved in restoration as well as north coast lawmakers Congressman Doug Bosco (D-Occidental) and Assemblyman Dan Hauser (D-Arcata). It was a surprisingly large turnout for the event co-sponsored by California Department of Fish & Game and University of California Cooperative Extension Sea Grant Program, and it was an indication of the growing interest California is taking in restoring the fisheries. Last year's conference in Bodega Bay drew only 30-40 people.

Note: There were 84 registered + about 10-15 interested participants in 1983.

Legislative Commitments to Restoration

The conference opened the same day California State Senator Barry Keene announced he was introducing a bill that would commit $10 million a year to fish restoration. The money would come from tideland revenues that are currently going into the state Water Fund, for water development.

Both Hauser and Bosco stressed developing cooperation between conflicting groups interested in restoration.

"The long run problem is awareness. Cooperation between logging, fishing, Native American groups, anglers, all of us must be the rule," Hauser said.

Bosco echoed the call, "Conflicting groups must get together and quit arguing, gillnetting, ocean fisheries, and sports fisheries. We can solve problems together."

The lawmakers described pending legislation related to restoration including a $55 million Trinity River restoration bill that Bosco hopes to get through Congress this year.

"In another decade the Trinity will be producing. It will never be at historical levels, but it will be vastly improved, Bosco said.

Hauser spoke of the state's battle over water, the south demanding water contracts be fulfilled, the north wanting environmental and fishery safeguards. He warned that even obtaining instream appropriations for fish would be a legislative struggle. He said legislation was pending to make Bosco-Keene fish restoration monies derived from geothermal revenues permanent, ending the annual budget fight over the approximately $900,000 allocation in Sacramento.

Canada's $183 Million Investment in Salmonids

It was evident the seriousness of Canada's commitment to salmonid restoration puts the U.S. to shame when Bill Schouwenburg from the Canadian Department of Fisheries & Oceans described the $183 million Salmonid Enhancement Program (SEP).

When the Canadian Pacific salmon runs were reduced by half, the government became concerned and devoted $150 million to enhancement and $33 million to maintenance of existing programs to bring the runs back to historical levels in British Columbia from 1977-'84. That was just phase one of a long term goal.

THE FISHERMEN'S NEWS VOL. 40, NO. 1 PAGE 15

It is being evaluated before phase two is designed and funded.

Washington State Report

Just as California was impressed by Canada's efforts, so Washington state looks to California as a leader in enhancement according to Ernest Brannon of the University of Washington School of Fisheries.

Brannon addressed the issue of water.

Just as there is a north-south battle in California, there is an east-west confrontation over water in Washington. Brannon pointed out that one gallon of water per minute equals 20,000 eggs, 6,000 fry, 700 fingerlings and 250 smolts.

Hatcheries are of prime importance in Washington, where 50 percent of the salmon harvested originates in hatcheries, but hatcheries should be used for enhancement, not replacement of wild stocks, Brannon warned. He also said technology should be geared specifically to sites and species, and frequently low-tech methods were the most productive.

Low-tech, Grass Roots, El Nino and Where do we go from here?

Thirty non-profit California organizations reported on fish restoration projects. Mike Bird of Fish & Game announced that using the Bosco-Keene monies Fish & Game managed to award 31 contracts that cleared 145 log jams, eight rock barriers, built 12 fishways, two fish screens, five culverts and baffled stream banks.

In some areas whole communities have committed themselves to restoring watershed and fisheries, bringing together widely diverse groups such as fishermen, farmers, schoolchildren and environmentalists who devote weekends and vacations to the projects.

In Marin County, the Lagunitas Creek Advisory Committee has worked at erosion control, water flow management, stream clearance and salmon and steelhead hatch box rearing with hundreds of volunteer hours from the community.

The Mattole Restoration Council has undertaken the major long range task of restoring the fisheries on the Mattole River on the north coast.

In Humboldt County, the Redwood Community Action Agency is working on the Eel River watershed, installing fish gates and stablizing eroding creek banks.

SECTION III

ACTIVITIES OF SALMON AND STEELHEAD RESTORATION GROUPS

Note: Groups and agencies included in this section are those which responded to our questionnaire asking for information about their activities during the past year. We regret that not all California restoration groups are described here; we estimate that about 60% are represented.

ASSOCIATION OF NORTHWEST STEELHEADERS
Klamath River Chapter

Box 782
Klamath, CA 95548

CONTACT: Bob Bostwick
Box 128
Klamath, CA 95548
(707) 482-3405

CORRECTIONS TO LAST YEAR'S LISTING: None

ACTIVITIES DURING 1982-83 SEASON: Incubated 40,070 steelhead in hatch box on McGarvey Creek, a tributary of the Klamath River. The eggs were from Iron Gate Hatchery. Approximately 80-90% of the eggs hatched and were released into the creek.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: The hatch box program was discontinued this season due to lack of personnel and interest.

PLANS FOR REMAINDER OF 1983-84 SEASON: None mentioned.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: None mentioned.

CALIFORNIA COASTAL CONSERVANCY

1330 Broadway, Suite 1100
Oakland, CA 94612
(415) 464-1015

CONTACT: John Zentner

TYPE OF PROJECT: Stream restoration.

LOCATION OF PROJECT: See Redwood Community Action Agency description.

PROJECT DESCRIPTION: The Coastal Conservancy is the funding agency for the projects that are being carried out by the Redwood Community Action Agency. The Conservancy is primarily involved in riparian restoration, rather than instream work. It is also involved in projects that require resolution of some planning conflict. The Conservancy accomplishes its goals by awarding grants.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: See RCAA.

SPECIAL TECHNIQUES OR DEVICES IN USE: See RCAA.

FUTURE PLANS: See RCAA.

CALIFORNIA CONSERVATION CORPS

201 PROJECT

P.O. Box 176
Weott, CA 95571
(707) 946-2262

CONTACT: Melvin Kreb

The Salmon Restoration Project is a cooperative work project among the Department of Fish and Game, the Department of Forestry, and the Conservation Corps, to restore and enhance anadromous (sea-run) fish habitat on the North Coast. Sixty corpsmembers work full-time, year-round, to provide fish access to the gravel spawning areas of creeks blocked by debris and log jams. Since redwood logs rot very slowly, the log barriers would remain for hundreds of years--without the work of the California Conservation Corps. Corps members use chainsaws, griphoists and hand tools to manually dislodge the log barriers.

To restore salmon and steelhead rearing habitat and to reduce soil erosion, corpsmembers hoist logs and root wads from debris jams and cable them along the stream banks as instream-habitat structures.

Riparian tree planting, primarily with red alder and willows, is done in the winter. Riparian revegetation increases the shade areas for rearing fish, reduces surface erosion, and provides nutrients for fish food.

Fish hatch boxes are used to hatch eggs for the planting of fish fry into streams that have depleted fish stocks.

Fish rearing ponds that utilize 18' wide Doughboy pools, hold thousands of fish from fry to smolt stages. When four to eight fish grow to a total weight of approximately one pound, they can be released into the creeks. Timed with the new moon in March, the fish are released to begin their swim to the ocean to feed for two to three years. They will complete their life cycles by returning to their creeks near the rearing ponds to spawn.

Fish rescue work begins in late summer when low creek flows and high temperatures combine to kill young fish fry growing in shallow pools and riffles. These dying fish are trapped and moved to cooler, deeper creeks in the same watershed, or are temporarily reared in washout ponds until the winter rains begin.

Electroshocking of fish fry is done during the summer to estimate the fish populations in streams that have been cleared by corpsmembers. Small fry are temporarily knocked unconscious by an electric shock. They float to the surface and easily can be counted. A population estimate for the entire stream can be made from several test sites.

Carcass counts of spawned-out (salmon die after laying their eggs) adult fish are done in the fall and winter on numerous creeks to determine the extent of adult fish return (escapement) from the ocean.

The Salmon Restoration Project crews based at Humboldt Fire Center and the two semi-permanent spike locations in Leggett and McKinleyville worked 49 north coast streams in California during the 1982-83 fiscal year:

Ah Pa Creek
Baker Creek
Bear Creek
Bear Pen Creek
S.F. Bear Creek
Blanton Creek
Bond Creek
Butler Creek
Cloney Gulch
Cow Creek
Dinner Creek
S.F. Eel River
Elk River
Elk Creek
Eubanks Creek
Freshwater Creek
Little Freshwater Creek
Main Freshwater Creek
Greenlaw Creek
Harris Creek
Healy Creek
Hollow Tree Creek
Little River
Jackass Creek
S.F. Little River
Leggett Creek
Lynch Creek
East Branch N.F. Mad River
Mattole River
Mattole Canyon Creek
Michaels Creek
Mill Creek
Newman Creek
Nooning Creek
Pearcy Creek
Pilot Creek
S.F. Redwood Creek
Root Creek
Shaw Creek
Sprowl Creek, W.F.
Standley Creek
Squaw Creek
Thompson Creek
Twin Creek
Upper Mattole River
Van Arkin Creek
Waldron Creek
Wildcat Creek
Weber Creek

A total of 2,349 cords and debris was removed and burned; 39.9 miles of stream were reopened. Total project hours totaled 88,847.

Two hundred acres of the riparian zone were seeded with Alnus rubra, Ceanothus, and Baccharis.

Two miles of stream were planted with 39,120 Alnus rubra and 2,700 willows.

Six hundred deer browse vexars were installed and adjusted.

A total of 54.5 bushels of Alnus rubra cones was picked; 69 bushels of Baccharis seed were collected and dried; 24 bushels of Ceanothus seed were broadcast.

Crews planted 6,207 Alnus rubra cuttings.

A fish weir was installed in conjunction with Humboldt Fire Center and the Department of Fish & Game.

Three hatch boxes were installed and 29,000 steelhead hatched and released.

Five salmonid rearing ponds were installed and maintained in conjunction with Humboldt Fire Center and Garberville Rotary.

Since the inception of the Salmon Restoration Project in February, 1980, 7,447 cords of wood and debris have been removed from anadromous fish streams, 233 miles have been reopened or cleared with a total of 288,411 corpsmember man-hours.

CALIFORNIA DEPARTMENT
OF FISH AND GAME

Salmonid Enhancement and
Restoration Activities

CONTACT: Bob Rawstron
Ken Hashagen
1416 Ninth Street
Sacramento, CA 95814
(916) 323-7324

The California Department of Fish and Game uses a variety of funding and manpower resources to improve salmon and steelhead populations and their habitat. Basically, their programs can be divided as follows:

Regional Activities. Unit biologists, each responsible for fisheries management in one or more counties, survey streams, conduct population estimates, and coordinate stream rehabilitation and hatchbox/pond rearing efforts with private groups, conservation camps, lumber companies, Native American tribes, and county and city work programs. Funds for this work come from either Fish and Game Preservation funds (from the sale of hunting and fishing licenses) or Dingell-Johnson funds (Federal Aid to Sport Fish Restoration programs).

Salmon Habitat Restoration. Funded with Energy and Resources Funds (ERF), this program was funded at the level of $2.9 million in 1980-81, $2.0 million in 1981-82, and $1.0 million in 1983-84. One million each year pays for a contract with the California Conservation Corps for stream rehabilitation work on the north coast. The remaining money has been used to identify sites on the upper Sacramento, the Shasta, and Klamath rivers where spawning gravels can be enhanced. Contracts with the Department of Water Resources have been paid for surveying and designing these sites. The first two sites were constructed on the Shasta River in the summer of 1983. Other work funded by these monies include construction of additional salmon rearing ponds at Thermolito and the Department's share of a three-agency sand removal project on the Trinity River. Energy and Resources Funds will not be available in 1984-85; the C.C.C. contract will be funded by California Environmental License Plate funds in 1984-85.

"Bosco" Projects (Bosco-Keene projects, AB 951 projects, North Coast Cooperative Salmon and Steelhead Projects). Using Renewable Resources Investment Funds, the Department granted out $925,000 in 1981-82 and $900,000 in 1982-83 and 1983-84 for stream rehabilitation and pond rearing/hatchbox programs. Monies went to non-profit groups, subunits of state government, and recognized indian tribes. In 1984-85 an additional $900,000 is budgeted from California Environmental License Plate funds.

California Forest Improvement Program (CFIP). This program is coordinated by the California Department of Forestry but does provide funds to improve fish and wildlife populations. Funds are derived from the sale of forest products on State lands. A percentage of the money collected must be spent on fish and wildlife and is granted out to landowners owning less than 5,000 acres.

CENTER FOR EDUCATION AND MANPOWER RESOURCES
(C.E.M.R.)

Mendocino Fisheries Program
P.O. Drawer F
Ukiah, CA 95482
(707) 468-0194

CONTACT: Ron Kusina, Director

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACCOMPLISHMENTS DURING 1982-83 AND PLANS FOR 1983-84 SEASON: During the 1982-83 season, the program focused its efforts on the Ten Mile River and its tributaries. As of this writing, operations are complete in the Little North Fork and tributaties, North Fork and tributaries, and much of the Middle (Clark) Fork. It is anticipated that the remainder of this work, and that planned for the South Fork, will be complete in the 1984-85 program year, and mark the initial restoration of the entire Ten Mile River watershed. It is anticipated that periodic maintenance will be required in the drainage to insure its level of productivity. In addition to the above, work was completed on one stream in the Big River watershed, and three ocean-going streams. Totals for the year are; operations on 17 streams removing 181 barriers, comprised of 5080 cubic yards of material, and opening approximately 29.5 miles of new habitat.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: Equipment malfunctions.

SPECIAL TECHNIQUES OR DEVICES IN USE: Military surplus 6x6 trucks equipped with winches and booms.

NEW LISTING

CIRCUIT RIDERS PRODUCTIONS
AND
MARIN COUNTY RESOURCE CONSERVATION DISTRICT

CONTACTS: Liza Prunuske (CRP)
9619 Old Redwood Highway
Windsor, CA 95492
(707) 838-6641

Phyllis Hartly (MCRCD)
P.O. Box 219
Point Reyes Station, CA 94956
(415) 663-1231

TYPE OF PROJECTS: Stream restoration: sediment control.

LOCATION OF PROJECTS: Unnamed tributary of San Geronimo Creek north of Woodacre; Devils Gulch Creek in Samuel P. Taylor State Park; and various erosion projects throughout Lagunitas Creek watershed. (Marin County)

PROJECT DESCRIPTIONS: Redwood, rock/filter fabric, and gabion checkdams have been built to control instream sediments. Streambank stabilization has been done with willow wattling, brush matting, live willow staking, grass seeding with jute netting, and rock placement. This effort has been spread over approximately 3 miles of stream; the impacts of sediment reduction affect 11 downstream miles. Previous years' projects by CRP have included barrier removal, wide-scale revegetation of riparian sites, crib wall construction, and vegetative stabilization of road fill slopes adjoining streams.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: We've used 3 different types of check structure on our restoration projects; wood, rock, and gabion. We've learned a little about which works best in different situations in our coastal watershed. All are sometimes effective, though(so far) we are less satisfied with the rock dams since they seem to be accelerating bank erosion upstream of the dam.

We are looking for advice on methods for evaluating the success of sediment control projects; ideas on tolerable, inexpensive erosion control methods for horse owners; and cost analyses to make erosion control more attrative to private landowners.

SPECIAL TECHNIQUES OR DEVICES IN USE: We use vegetative techniques that are not new, but they may not be familiar to other groups. Brush matting is new for us. We will see how well it holds up over another year.

FUTURE PLANS: Beginning a 2-year sediment control project on both private and public lands. Goals are to reduce the amount of sediment entering the system and to provide examples of sediment control techniques for landowners and managers in the area.

CITY OF ARCATA
DEPARTMENT OF PUBLIC WORKS

736 F Street
Arcata, CA 95521
(707) 822-5951

CONTACTS: George H. Allen Frank R. Klopp

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: 1983 was the initial year of operation under Salmon Restoration funding. The main effort was in constructing a hatch-box aquaculture system of: 1) well water water supply (to be tested by hatch-box technique), 2) construction of hatch-box and water delivery system, 3) construction of in-stream fry rearing pond.

Delays in obtaining right-of-way permits, and installing electrical and water services, resulted in 1983 activities mainly of construction and installation.

CWT-tagged coho salmon smolts released into Jolly Giant creek in the spring of 1983 failed to appear in our traps as jacks. A good run of 3-year-old coho expected as based on jack returns in fall of 1982, failed to appear. As of 1 February 1984, only two unmarked coho jacks were trapped, and on 13 February 1984, one unmarked steelhead jack was recovered in Jolly Giant Creek trap.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: See attached report, Allen, G.H., "Arcata Hatch Box Project".

PLANS FOR REMAINDER OF 1983-84 SEASON: Install pump at tube well; complete installation of plate glass and plywood in aquaria being retrofitted as hatch-box; mount two storage tanks and attach to hatch-box; test water delivery system; test hatch-box with trout eggs as available.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: Adaptation of our previously constructed by-pass channel to a hatch-box aquaculture system as outlined in report. Future success of operation of system will be principal contribution from the project.

NOTE: A detailed report of the City of Arcata's activities is available on request from the above address.

EEL RIVER RESTORATION PROJECT

CONTACTS: Scott T. Downie
P.O. Box 278
Redway, CA 95560
(707) 923-3459

Mike Evenson
P.O. Box 202
Redway, CA 95560
(707) 923-2979

Bill Eastwood
P.O. Box 424
Redway, CA 95560

TYPE OF PROJECTS: Stream restoration: barrier removal, pool development, stream-bank stabilization; Rearing: hatchbox, early rearing trough, rearing pond; Monitoring. (Humboldt County)

LOCATION OF PROJECTS: Trap site, hatchbox, and early rearing trough are located on Redwood Creek, 2 miles upstream from confluence with South Fork Eel River. Rearing pond is 6 miles upstream from this facility. Restoration work has been in the upper reaches of Redwood Creek, 6-8 miles west of Redway.

PROJECT DESCRIPTIONS: Native-run fish are trapped in Redwood Creek, kept in adult holding tanks until ready for spawning, eggs are taken and incubated in hatchbox. Fry are reared in "Dough-boy" style rearing ponds, fin-clipped, and released at about 90/lb in May or June. Capacity of the system is 75,000 chinook salmon. Restoration work is focused on 1.5 miles of the upper reach of Redwood Creek. Barrier removal is just beginning. Boulder and log placement for pool development and gravel retention, use of logs and root clods to stabilize slips, and revegetation work has begun. Work emphasizes control of sediment from gravel access roads. Monitoring consists of carcass counts, redd census, juvenile census, and coded wire tagging of smolts.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: Holding tubes for keeping adults until ready to spawn works extremely well. Butterfly valves in large pipe work well.

FUTURE PLANS: Operate facility for 4 more years; restore habitat throughout watershed; begin a program to monitor fines in stream gravels and the sediment entering streams from selected stretches of roads; develop a public education and involvement program.

ENT FORESTRY

Box 576
Forks of Salmon, CA 96031
Phone Toll Station 4740

CONTACTS: Dean Stansberry
Kathy Sartorius
Lloyd Ingle

TYPE OF PROJECT: Stream restoration: barrier removal.

LOCATION OF PROJECT: Know-Nothing Creek, 4 miles east of Forks of Salmon, Salmon River. (Siskiyou County)

PROJECT DESCRIPTION: A 13-ft high log dam was removed, opening four miles of stream. After removing the dam a concrete infiltration gallery was built and a 600-ft pipeline, anchored to bedrock and protected by a steel cage, was put in place. Local fishermen have reported adult salmon and steelhead 2 miles above the old dam site.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: Infiltration gallery design.

FUTURE PLANS: The next project is to blast a natural rock gorge on the South Fork of the Salmon River to make a step and pool side channel for low water salmon passage.

GARBERVILLE ROTARY CLUB

CONTACTS: Lincoln Beck
472 Beach Road
Whitethron, CA 95489
(707) 986-7593

Monroe Tobin
734 Cedar Street
Garberville, CA 95440
(707) 923-2611

Jim Johnson
601 Hillcrest Drive
Garberville, CA 95440
(707) 923-2293

John McGrath
948 Redwood Drive
Garberville, CA 95440
(707) 923-2422

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: We released approximately 40,000 steelhead fry from wash-out ponds at 8 to the pound in December and 9000 fry at 3 to the pound in March.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: We received 12,000 fry (steelhead) from the Prairie Creek Hatchery in September for rearing in Dough-boy pond for release in the last of March.

Part of our ponds will be used to raise chinook salmon fry from Redwood Creek (near Redway) hatch-box from February to release time in May.

PLANS FOR REMAINDER OF 1983-84 SEASON: We have been scheduled by CDF&G to receive 28,000 steelhead fry for pond rearing in the last part of June, 1984 to hold until release time in March of 1985.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: Gill bacteria going internal on steelhead fry.

SPECIAL TECHNIQUES OR DEVICES IN USE: Incorporated uses of large quantities of non-iodized salt in our treatment.

Recommend use of smog pumps for back-up air.

We have high regards for Steve Sanders, the biologist assigned to our projects by CDF&G. He takes this fish rearing seriously and is not only helpful with information but is not afraid to pitch-in and get his hands dirty.

HOOPA VALLEY BUSINESS COUNCIL

FISHERIES DEPARTMENT

P.O. Box 417
Hoopa, CA 95546
(916) 625-4267

CONTACTS: Bill Brock Bob Hannah

CORRECTIONS TO LAST YEAR'S LISTING: Didn't end up doing everything that was planned, as stated below.

ACTIVITIES DURING 1982-83 SEASON: Corrections to future plans, as stated on page 30 of 1983 Report.

No fish were raised in 1983 due to unavailability of Lewiston Hatchery eggs or fry. Did not install rearing trough. Electro-shock sampling was conducted but only to check for species presence per stream, not estimate populations, etc.

The projects accomplished directly from Bosco bill monies during the field season of 1983 were as follows.

Mill Creek - 36 gabions with dimensions of 3 ft x 3 ft x 12 ft were installed as deflectors and revetment to keep stream flow away from a silt/sand terrace 200 ft long by 15 ft high. Irrigation diversion screen welded and installed to prevent attracting salmonid juveniles into the 3 cfs diversion flow. Placed 145 boulders, minimum diameters from 2 ft to 5 ft, in the lower 1000 ft of creek channel.

Tish Tang Creek - Repaired and/or modified two of three instream gabion weirs installed in 1982 so as to improve ability to trap spawning gravels as bedload.

Campbell Creek - Removed 3 log jam barriers; diverted a stream section away from an impassable meander cut-off into the passable, longer meander stream section.

Supply Creek - Introduced 40 cubic yards of spawning gravel behind 3 gabion weirs installed in 1982. Used 24 gabions 3 ft x 3 ft x 12 ft to deflect and revet a 250 ft length of stream from eroding a slide face extending up to 150 ft in vertical height.

Hostler Creek - Installed irrigation diversion fish screen at inlet. Deflected stream away from a 75 ft long, 15 ft tall silty flood terrace face. Used gabions as rip-rap to protect toe of rotational slump from being eroded by storm flows, silting up the stream and causing additional slumping.

Soctish Creek - Two small log jam barriers removed; yield: 2 miles steelhead access.

PLANS FOR REMAINDER OF 1983-84 SEASON: Install baffles in the concrete box culvert of Campbell Creek under the main Highway 96 at the south end of Hoopa Valley. Successful baffling will open an additional 3 miles of stream for steelhead.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: Don't count on getting any salmon eggs from hatcheries for rearing purposes.

SPECIAL TECHNIQUES OR DEVICES IN USE: No equipment that's new; we only used the grip hoist. We had success this year on several occasions by inexpensively diverting stream sections away from erosive terraces or slumps and applying minimal revetment to the source of the problem. The more normal, expensive option of pulling back the source of the erosion and extensively rip-rapping is not always the only alternative. Deflectors were always accomplished with gabion.

NOTE: A detailed report of the Hoopa Business Council's restoration activities is available on request from the above address.

HUMBOLDT COUNTY
PRAIRIE CREEK FISH HATCHERY

Orick, CA 95555
(707) 448-2253

CONTACT: Steven D. Sanders, Manager

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Chinook salmon releases - 6,715 weighing 490 lb. on November 23,1982; coho salmon releases - 115,311 weighing 5,588 lb. in March, 1983; steelhead releases - 80,920 weighing 7,673 lb. in March, 1983; rainbow trout releases - 14,500 weighing 1,561 lb. released all through the season.

Adult salmonids trapped (1982-83): 29 chinook salmon; 103 coho salmon; 80 steelhead; 1 chum salmon; 0 cutthroat.

Total hatchery visitors (1982-83): 38,645.

Raised enough funds to continue hatchery operations. Curtailed several activities including but not limited to catchable trout program and support of Humboldt Fish Action Council activities.

ACCOMPLISHMENTS SO FAR DURING 1983-84: Released 33,250 yearling chinook salmon weighing 2,558 lb., November 24-25, 1983; transferred 12,155 steelhead to Scotia Pond, Pacific Lumber Co.; transferred 12,010 steelhead to rearing pond in southern Humboldt County; released 5,318 2-year-old steelhead December 2, 1983, weighing 1,026; holding 53,630 steelhead for yearling release in March, 1984; holding 9,000 coho for yearling release in March, 1984.

Adult salmonids trapped to date (1983-84): 44 chinook salmon; 44 coho salmon; 34 steelhead; 2 chum salmon; 0 cutthroat.

Eggs realized to date (1983-84): 15,510 chinook salmon; 15,620 coho salmon; 20,000 steelhead.

Hatchery visitors to date (1983-84): 30,420.

Did a fund raising project that raised $150,000 for the continuing operations of Prairie Creek Fish Hatchery.

Had California Conservation Corp do some deflector and gabion work on Lost Man Creek, County property as a result of grant from California Conservancy through Redwood Community Action Agency.

PLANS FOR REMAINDER OF 1983-84 SEASON: Continue trapping and spawning, egg hatching, caring for growing fish; predator control (in particular human predators - unable to get any cooperation from CDF&G wardens in this matter); looking at long range funding for hatchery operations; hoping to put in hydro-electric project to reduce hatchery costs; using various colors of flagging tape to discourage predator birds and seems to work well; have approached Dept. of Fish & Game in the past and doing so presently for $1.00 Humboldt County Fishing Stamp in conjunction with State fishing license to fish in Humboldt County and adjacent ocean waters; still training CCC volunteers in fisheries work and plan to continue this training as long as possible. Hope to do more stream improvement work in Lost Man Creek this summer. Of course, we are always involved in public awareness of fisheries work and needs through direct contact with thousands of tourists. Many claim this is their first exposure and experience at a hatchery.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: If and when you have predator problems and you receive permission to kill or control such critters from CDF&G, be sure this permission is in writing.

SPECIAL TECHNIQUES OR DEVICES IN USE: The various colored flagging tapes seem to do an adequate job of discouraging predator birds, are light in weight, easily strung and easily handled by one person. The tape moving in the breeze is totally random as opposed to the rote bird scarers I have seen not work in the past.

HUMBOLDT FISH ACTION COUNCIL

P.O. Box 154
Eureka, CA 95501

CONTACTS: David Miller (707) 445-2055 Jud Ellinwood (707) 839-4235
Chris Toole (707) 443-8369 Larry Wunschel (707) 445-8601

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Raised and released 9,000 Noyo River coho salmon and 14,000 Freshwater Creek coho salmon into Freshwater Creek at 17/lb. Improvements to the pond included installation of an otter-proof fence and demand feeders, construction of a new intake, draining and re-shaping ponds, replacement of stoplogs, and addition of new netting covering the ponds to prevent bird predation.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Currently raising 45,000 Klamath River coho salmon in Cochran ponds. Under our grant through the County of Humboldt a permanent fish trap and egg-taking station was constructed on Freshwater Creek. This facility consists of a weir composed of welded steel tube panels, hinged at the base and raised and lowered by a block and pulley system; a concrete trapping channel with a V-shaped fyke; two tomato tub tanks for holding spawners; a pump system that delivers 300 gpm to the holding tanks; and a spawning shed. The trap just became operational this month (January, 1984).

PLANS FOR REMAINDER OF 1983-84 SEASON: Attempt to catch and spawn salmon at the Freshwater trap site; complete several remaining projects at the trap site including development of a brailer, re-aligning the pump and pump hoist, and improving the cable and pulley system; continue to rear coho salmon in Cochran ponds and release this spring at 10-15/lb.

The Council is also working with several other groups to initiate a salmon rearing project in some abandoned wastewater ponds near the PG&E plant at King Salmon.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: There are a few bugs in the design of the fish trap that will be worked out before next year's trapping begins.

SPECIAL TECHNIQUES OR DEVICES IN USE: Plastic tubes for holding spawners, as suggested by Scott Downie.

HUMBOLDT FISHERMEN'S MARKETING ASSOCIATION

216 H Street
Eureka, CA 95501
(707) 443-8369

Contact Jud Ellinwood
P.O. Box 4451-B
Arcata, CA 95521
(707) 839-4235

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Two fibreglass incubation boxes were again operated on Squaw Creek, a tributary of Lindsey Creek and the Mad River. Thirty thousand Iron Gate Hatchery coho salmon and 15,000 Mad River Hatchery chinook salmon were hatched. Survival to the swim-up stage was estimated at 80-85%.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: As of January there have been no eggs available for incubation.

PLANS FOR THE REMAINDER OF 1983-84 SEASON: Obtain salmon or steelhead eggs if no salmon are available from Mad River Hatchery for incubation. Next year we hope to have a complete trapping and spawning operation in place that will feature the use of a modified Morford trap and PVC tubes for holding unripe adult salmon.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: In previous years the primary problem we have had to deal with has been the obstruction of the intakes and water lines.

Squaw Creek originates on the steep slopes of a nearby mountain then flows a short distance into a narrow valley drained by Lindsey Creek.

The boxes are located in this low gradient portion of Squaw Creek.

To generate sufficient head to provide an adequate supply of water to the boxes, over 600 feet of 2-inch plastic pipe had to be run up the creekbed.

During peak flows the stream will rise several feet in a matter of hours and transport large quantities of sediment.

During these times the intakes have tended to fill in or have been partially washed out. The pipelines sag in places creating low and high spots, where sediment and air, respectively, collect and restrict the flow of water.

SPECIAL TECHNIQUES OR DEVICES IN USE: This year we have attempted to prevent the recurrence of this problem by installing Miller float-arm intakes and by installing sediment cleanouts and air vents in the water lines.

We have also slightly modified our boxes this year by providing a resting substrate for newly hatched alevins consisting of fist sized rocks loosely placed above and beside the upwelling inflow pipe below the egg trays.

Also the tops of the outlet stand pipes have been notched to facilitate fry escapement.

NEW LISTING

KLAMATH-TRINITY FALL CHINOOK
SALMON ENHANCEMENT GROUP

CONTACTS: Kerry Overton
U.S. Forest Service
507 F Street
Eureka, CA 95501
(707) 442-1721, ext. 288

Scott Downie
P.O. Box 278
Redway, CA 95560
(707) 923-3459

Jerry Boberg
216 H Street
Eureka, CA 95501
(707) 822-0143

TYPE OF PROJECTS: Incubation boxes and rearing of chinook salmon smolts.

LOCATION OF PROJECTS: The project sites are (1) Horse Linto Creek - approximately 3/4 mile upstream from confluence of Horse Linto Creek and the Trinity River - west end of Horse Linto Campground and (2) on the south fork of the Salmon River - approximately four miles upstream from Cecilville along U.S.F.S. road 37N24.

PROJECT DESCRIPTIONS: The facilities will eventually consist of two hatchboxes and two fiberglass rearing tanks per site. The construction of the Horse Linto site is completed; the facilities at the Salmon River site are still under construction. The maximum rearing capacity at each site is 80,000 90/lb. chinook salmon smolts. Our plans include the marking of all fish produced, using coded wire tags and adipose-only finclips.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: Because our program emphasizes concern for natal stocks, our original plans called for relying on adult trapping operations in the Trinity system for an egg source. Adult trapping operations proved to contain more pitfalls than anticipated. This, and a general shortage of surplus eggs from other sources, resulted in no fish being reared the first season.

SPECIAL TECHNIQUES OR DEVICES IN USE. None.

FUTURE PLANS: Continue working to achieve production capacity of planned facilities.

MARIN CONSERVATION CORPS

P.O. Box 89
San Rafael, CA 94915
(415) 454-4554

CONTACTS: Harvey Morrison, Executive Director
Gregory Andrew, Resource Planner
Michael Swezy, Resource Manager

TYPE OF PROJECTS: Stream restoration; barrier removal, sediment control, stream-bank stabilization; Monitoring.

LOCATION OF PROJECTS: Walker Creek, Lagunitas Creek, and Inverness Ridge streams. (Marin County)

PROJECT DESCRIPTIONS: On Walker Creek did bank revegetation (willow, alder, redwood plantings) of a 4-mile stretch to restore a riparian habitat. Project site is through the San Francisco Foundation property below the Marshall-Petaluma Road bridge. Some fencing was also done along with extensive watering, through the summer months (1983), to protect the redwood plantings. Constructed a 1/8-mile trail along the stream bank to provide a fishing access site. Project site is near the mouth of the creek, just south of the town of Tomales. On Lagunitas Creek did stream debris clearance along a 6-mile reach from Samuel Taylor State Park down to the Nicasio dam. Built 40 check dams, repaired 1 fish ladder, and did stream clearance in the Devil's Gulch tributary to Lagunitas Creek. On Inverness Ridge Streams did stream clearance in 8 of the streams of Inverness Ridge, totaling roughly 15 stream miles. Did bank revegetation (alder and native shrubs), bank stabilization (seeding and jute netting) along the First and Second Valley streams. Also did some road and culvert maintenance on the fire roads on these two watersheds.

We are currently conducting a monitoring program of the revegetation project on Walker Creek. We have just begun a full analysis of this project, 1 year after its completion, to evaluate its success. We will send the results of this evaluation when completed.

We have conducted a follow-up survey of the streams of Inverness Ridge to identify any debris jams that have developed since the stream clearance program. We are making arrangements to clear the new jams this spring.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: None mentioned.

FUTURE PLANS: We are beginning to organize a watershed management program for the Walker Creek watershed. We plan to apply for a Bosco grant to do salmonid enhancement projects here. We also plan to apply for Coastal Conservancy funds to do range management and erosion control.

We hope to do more work in the Lagunitas and Inverness drainage as well, similar to what we have already done there.

MENDOCINO COUNTY FISH & GAME ADVISORY COMMITTEE

Courthouse
Ukiah, CA 95482

CONTACTS: Bill Townsend, Chairman
P.O. Box 765
Ukiah, CA 95482
(707) 462-5228

*Bob Keiffer, Vice Chairman
P.O. Box 454
Hopland, CA 95449
(707) 744-1160

*Sari Sommarstrom, Coordinator
P.O. Box 538
Covelo, CA 95428
(707) 983-6435

* New Information since 1983

CORRECTIONS TO LAST YEAR'S LISTING: Change Bill Townsend's phone number to the one listed above.

ACTIVITIES DURING 1982-83 SEASON: Rearing ponds at Talmage raised and released 96,657 steelhead in 1982-83. The following fish were released between March 29 and April 1, 1983: Russian River tributaries - 11,000 smolts; Navarro River - 40,000 smolts; Big River - 25,000 smolts;Noyo River - 24,000 smolts. Average weight was 5 per lb.

Riparian revegetation (under AB 951 funds) was completed in April, 1983 for portions of String Creek in the Tomki Creek drainage; 1050 willows; 1000 alders.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Rock Barriers removed by blasting on Sherwood and Woodman Creeks (Eel River Basin) (under AB 951 funds) from June-July, 1983.

Fish ladders completed on: 1) Ackerman Creek (Russian River Basin), a 40 ft. long Denil-type ladder for $22,000, completed September, 1983; 2) Woodman Creek (Eel River Basin), a 30 ft. long Alaskan-Steeppan ladder for $30,000, completed November, 1983.

PLANS FOR REMAINDER OF 1983-84 SEASON: No steelhead fingerlings available for Talmage Ponds in 1983-84 due to failure at Mad River Hatchery; will resume October, 1984.

Adoption by the Mendocino County Board of Supervisors of the County Salmon and Steelhead Management Plan, expected in February, 1984.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: Although the county successfully completed the projects funded under AB 951, we'd recommend that counties not directly contract with CDF&G to carry out such stream restoration projects in the future, unless special circumstances warrant it. County bid procedures, liability precautions, access agreements, and administrative overhead necessarily cause additional expenses and time delays beyond those that State or non-profit groups experience.

SPECIAL TECHNIQUES OR DEVICES IN USE: We'd like to highly recommend the engineering services of George Rau, C.E., c/o Scheft & Rau, 100 N Pine, Ukiah, CA 95482, (707) 462-6536, who assisted the County most capably in the design and construction of the two fish ladders.

MENDOCINO COUNTY RESOURCE CONSERVATION DISTRICT
SOIL CONSERVATION SERVICE

405 Orchard Ave.
Ukiah, CA 95482
(707) 468-9223

CONTACTS: Richard E. Jacobsen, Chairman, R.C.D. Board of Directors
Bryan Furman, S.C.S. District Conservationist
Tom Schott, S.C.S. Soil Conservationist
Bob Hayden, R.C.D. Fisheries Conservationist

CORRECTIONS TO LAST YEAR'S LISTING: CONTACTS: Tom Schott's title is now Soil Conservationist and Bob Keiffer is no longer employed by the R.C.D. (unfortunately). Under FUTURE PLANS: The Watershed Conservation Plan for Tomki Creek has been completed. Implementation funding is being sought.

ACTIVITIES DURING 1982-83 SEASON: Sixty-two landowners received conservation planning assistance on 15,000 acres of private land. Another grade stabilization structure has been installed that arrested streambank degradation from migrating up the West Fork of Wheelbarrow Creek - a salmon spawning tributary to Tomki Creek. About 1,000 acres of prescribed burning has been applied to chaparral stands in the watershed to prevent major wildfires from occurring. Several thousand willow and alder trees have been planted. Sixteen different culverts have been installed to improve road surface drainage problems. Several hundred feet of log-cable revetment and rock rip/rap have been installed by private landowners along seriously eroding banks of salmon spawning streams.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Completion of the final report for the Tomki Watershed Conservation Plan which describes the types, extent and location of natural resource problems that relate to erosion and anadromous fishery habitat. A listing of potential treatments and estimated costs are also presented. Priorities for watershed treatment have been developed that emphasize upstream treatments prior to instream treatments and account for basin position in the total watershed, amount of landowner cooperation in the project, and sediment delivery rates per acre.

PLANS FOR REMAINDER OF 1983-84 SEASON: Completion of 2 miles of riparian fence to protect the streambanks of Wheelbarrow Creek from the effects of livestock grazing. Installation of additional grade stabilization structures on both forks of Wheelbarrow Creek under the Salmon and Steelhead Restoration Fund and the Agricultural Conservation Program. Execute prescribed burns on 200-300 acres in the Tomki Watershed. Continue conservation planning and practice installation with cooperating landowners, develop implemenation funding for planned treatments.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: None mentioned.

NEW GROWTH FOREST SERVICES

CONTACTS: Ross Walker
P.O. Box 281
Calpella, CA 95418
(707) 485-0414

Dick Jordan
P.O. Box 254
Yorkville, CA 95499
(707) 894-4704

Meca Wawona
P.O. Box 224
Calpella, CA 95418
(707) 462-2114

CORRECTIONS TO LAST YEAR' LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Daugherty Creek (tributary to Big River) - completed clearing of barriers over 7 miles of creek in the summer of 1983. Poor road access except for some areas of the upper watershed; hence, most work performed by hand removal using grip hoists, cable rigging with blocks, chain saws, and related hand tools.

Garcia River (north fork) - completed barrier removal project begun in the winter of 1982 in spring of 1983. No road access - all hand work done in rainy season to allow use of fire to burn woody debris.

Woodman Creek and Bloody Run Creek - completed rock barrier removal by means of blasting.

Woodman Creek fish ladder (tributary to Eel River) - constructed and placed fish ladder opening access to creek in conjunction with County of Mendocino.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Tombs Creek (tributary to Gualala River) - removed barriers using hand equipment as above and burned debris. Also removed root mass with explosives.

South branch North Fork Navarro River - 70% completion of barrier removal in the fall and winter of 1983. Approximately 8 miles of habitat opened so far. Mostly hand work with some access by mechanical winch equipment. Extensive use of burn pile method during rains.

PLANS FOR REMAINDER OF 1983-84 SEASON: Complete Navarro project by spring 1984; begin Little North Fork Navarro project (barrier removal by spring or summer 1984; remove barriers on Indian Creek during summer 1984; and further removal of root mass with explosives on Tombs Creek if CDF&G determines a need for this.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: Having a wide array of techniques available to attack the varying conditions of specific sites is the key to cost effective barrier treatment. These include 1) mechanical equipment when access permits, 2) knowledge of burning techniques, 3) use of blasting where appropriate, 4) cable rigging systems, 5) re-entry or "2 STEP" removal where use of high flows to clear previous work aids production and permits reduced rate of streambed disturbance.

SPECIAL TECHNIQUES OR DEVICES IN USE: Extensive use of high line cable rigging in areas with no equipment access and steep slopes with little side bank bench - enables removal and placement of large logs without cutting and carrying, ideal in situations where winter access is restricted and burning is not an option.

Extensive use of burning method of removal in conjunction with above techniques during rainy season - most cost effective method.

PACIFIC LUMBER COMPANY

P.O. Box 37
Scotia, CA 95565
(707) 764-2222

CONTACTS: Gene Rothlin (ext. 220)
Don Bryant (ext. 233)
Ken Bryant (ext. 232)
Dennis Jones (ext. 271)

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned

ACTIVITIES DURING 1982-83 SEASON: A total of 10,665 coho salmon (Noyo River stock) was released from Scotia pond and planted in the Eel River on March 14, 1983. From the Yager Creek ponds, 2,500 coho salmon (Noyo River stock) were released on March 11, 1983, and 15,500 chinook salmon (Yager Creek stock) were released July 6, 1983.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: A stream clearance project was completed in Cooper Mill Creek (tributary to Yager Creek) from the fish ladder weir upstream to the diversion dam. Two large log jams, brush and debris were removed. Bank stabilization was accomplished at south end of weir. Constructed a concrete and rock wall with provision for high water overflow to prevent future erosion.

PLANS FOR REMAINDER OF 1983-84 SEASON: Clean and disinfect ponds. Repaint interior pond walls and floors with copper naphthenate prior to receiving fish in late May.

We expect to receive about 20,000 steelhead for Scotia rearing pond and approximately 15,000 steelhead for the Yager rearing ponds from Prairie Creek fish hatchery.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: The severe winter storms of 1983-84 resulted in unusually high water in Cooper Mill Creek, the water source for Yager ponds, and created an extreme siltation problem in the ponds. These conditions may have been a factor in our inability to induce returning chinook salmon to ascend our fish ladder to the Yager pond this year.

SPECIAL TECHNIQUES OR DEVICES IN USE: Nothing new this year.

REDWOOD COMMUNITY ACTION AGENCY

904 G Street
Eureka, CA 95501
(707) 445- 0881

CONTACTS: Nancy Reichard Dwight Streamfellow

CORRECTIONS TO LAST YEAR'S LISTING: Change Forest Improvement Center to Natural Resources Division.

Contacts: Nancy Reichard, Natural Resources Director, Dwight Streamfellow, Natural Resources Coordinator

Type of Project: add; riparian vegetation restoration, barrier modifications, sedimentation control, public education.

ACTIVITIES DURING 1982-83 SEASON: McDonald Creek - riparian vegetation planted on former pasture land in 1982 is growing well. Swing-gates have functioned well over two winters, allowing water and debris but not cows to move downstream.

The inventory of coastal streams conditions revealed lots of restoration potential. Identification of possible projects revealed landowner cooperation to be the key variable for getting more habitat restored (provided that money and other resources are available).

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Logjam removal and erosion control on Mattole,Little Larabbee, Tryon, McDonald, and Jacoby creeks; boulder-barrier blasting on Grouse Creek; instream modifications in Powers and Francis creeks; tide-gate modification on Salmon Creek to allow for fish passage.

Completed inventory of condition of 140 Humboldt and Del Norte coastal streams.

PLANS FOR REMAINDER OF 1983-84 SEASON: Erosion and/or sedimentation control plus livestock-exclusion fencing and riparian planting on Tryon, Prairie, Little, Washington, and Francis streams. Continue work on McDonald and Jacoby creeks.

Continue sponsorship of Mattole Salmon Group and Coastal Headwaters projects in Mattole basin. Assist Prairie Creek Fish Hatchery with education and planning.

Increase community involvement and education regarding restoration and protection of stream resources, and conduct a forest and watershed improvement training program for 30-40 American Indians, via the North Coast Indian Development Council.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: A "fish-gate" which allows fish passage through tidegates without effecting tidegate function.

REDWOOD COMMUNITY ACTION AGENCY
WITH
JACOBY CREEK CANYON COMMUNITY
AND
NORTH COAST FLY FISHERS

CONTACT: Bob Wunner
1567 Central Ave.
McKinleyville, CA 95521
(707) 839-1609

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: During the 1982-83 season erosion control on roads and stream debris removal was carried out on McDonald Creek. Debris was not removed from January to May so that sediments would not be released into spawning areas.

It was ascertained that more work needed to be done on the streams and a proposal was submitted to CDF&G to continue the project.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: The 1983-84 McDonald Creek Project is being administered by the Redwood Community Action Agency in addition to last years sponsors - the Jacoby Creek Canyon Community and the North Coast Fly Fishers.

During this year's project we have cleared debris jams along 1½ miles of the main fork of McDonald Creek. We also have continued to treat logging roads which contribute to streamside landslides and sediments along the main fork.

PLANS FOR REMAINDER OF 1983-84 SEASON: A detailed report on the 1983-84 season is in preparation. Another grant has been secured from the Coastal Conservancy to rehabilitate the north fork of McDonald Creek and to continue treatment of problem areas along the main fork.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: A yarding area adjacent to the stream channel has continued to pose problems. The area's left bank eroded during high flows of December, 1983, uncovering more log debris in need of removal. Hand work is required in this area as the access road slid out in the winter of 1982-83. Our experience at this site has lead to the realization that complex problems may require several years of restoration efforts, and also reinforced the idea that some debris jams need to be removed in stages.

SPECIAL TECHNIQUES OR DEVICES IN USE: None mentioned.

REDWOOD NATIONAL PARK

P.O. Box SS
Arcata, CA 95521
(707) 822-7611

CONTACTS: Terry Hofstra
Jim Harrington
Joe McKeon

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Document entitled Management Alternatives for the Redwood Creek Estuary was prepared summarizing research and management activities and results. The document also outlined short and long term restoration alternatives. Three public meetings were held to obtain public input on estuary research and management. Management and research activities undertaken in 1983 included excavation of accumulated sand from the necks of the north and south sloughs, installation of temporary drainage culverts in the sand berm at the mouth of the creek, log boom repair, restoration of approximately two acres of wetland, embayment water level control, water quality monitoring, aquatic invertebrate sampling, trapping of downstream migrating juvenile salmon, steelhead, and cutthroat trout, and numbers and growth monitoring of juvenlie salmonids utilizing the embayment. Flooding of private property was prevented by controlled breaching while maintaining tolerable embayment conditions so that some habitat was available for juvenile salmonids. Juvenile chinook salmon, steelhead trout, and cutthroat trout spent an extended period rearing in the embayment. During the period, rearing salmon and steelhead grew substantially which enhances their chances of survival during the ocean stage of their life cycle.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: A report of last years management and research activities has been prepared. Management activities for 1984 are proposed.

PLANS FOR REMAINDER OF 1983-84 SEASON: A public meeting will be held to again obtain comments on the results of last year's activities and the proposals for 1984. Activities for 1984 include; embayment water level control by controlled breaching; monitor estuarine water quality, aquatic invertebrate production, downstream migration juvenile salmonids, and numbers and growth rates of salmonids utilizing the embayment. We are also having the Corps of Engineers evaluate some alternatives for levee modification.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: No new problems described.

SPECIAL TECHNIQUES OR DEVICES IN USE: Controlled breaching again proved to be effective in controlling water levels. Controlled breaching could prove effective in other areas where summer flooding cause problems to adjacent private property. Water may be lowered without the total destruction of fish habitat.

NOTE: The report mentioned in this summary is available on request from the above address.

ROWDY CREEK HATCHERY

P.O. Box 328
Smith River, CA 95567

CONTACTS: Art Lawn, Project Director
Tom Smith, Biologist

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Work began on 60 ft x 30 ft incubation and spawning building. Upgraded water intake for fish ladder. Fish production: 35,000 chinook at 12/lb and 60,000 steelhead at 16/lb.

Five acres of hatchery property excavated to sub-grade.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Continued construction on incubation and spawning building

60,000 chinook eggs incubating and hope to also raise 100,000 steelhead yet to spawn.

PLANS FOR REMAINDER OF 1983-84 SEASON: Construct water inlet on Rowdy Creek for operation of 4 standard Burrows ponds and associated plumbing. Complete incubation and spawning building interior - plumbing, sorting tables, dope tank, etc. Construct 35 ft x 15 ft building for hatchery offices.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: Continuing studies noted last year.

SALMON RESTORATION ASSOCIATION OF CALIFORNIA

P.O. Box 1448
Ft. Bragg, CA 95437

CONTACTS: Don Bradley (707) 964-5859 Frank Welch (707) 964-6631
Bill Maahs (707) 964-5832 Carol Steele (707) 964-6631

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Hollow Tree Creek (tributary to South Fork Eel) constructed pond with roller screens but rains washed out pond and by the time pond was ready, water temperature reached 70° and so a different site, Mule Creek (tributary to Hollow Tree Creek) was used, where water temperature was 56°. We raised and released 12,000 chinooks from egg taking at Hollow Tree Creek weir in 1982. This year we trapped 44 female chinook for 137,000 eggs.

At Johnson Creek (tributary to Big River) a temporary trap was installed in an attempt to capture coho salmon. The trap was installed a bit late and no coho were trapped. Also at Johnson Creek 2000 yearling coho were raised and released.

At Pudding Creek no fish were planted or eggs taken but there were returns of chinook jacks from 1982 release of approximately 65,000 chinook fingerlings which had contracted a gill bacteria and had to be released early. Sport fishermen caught some of these fish in the lower river which returned as jacks.

In July, 1983 we received 100,200 fingerlings (originally of Sacramento River stock and transferred to Lake Michigan) from CDF&G at 25-40/lb. The fish were reared in river ponds on Ten Mile River and released on November 15, 1983. Approximately 5000 fish were lost due to Columnaris and Ich. Ten Mile saw returns of 4-year-old chinook from a plant of Eel River stock and a jack return from a plant of 20,000 fingerlings from the Pudding Creek release.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: Captured 44 female chinook at Hollow Tree Creek project for 137,000 eggs.

PLANS FOR REMAINDER OF 1983-84 SEASON: Raise chinooks in both Hollow Tree Creek and Ten mile River and mark Hollow Tree Creek fish with C-W-T for an evaluation of Eel River stock contribution to ocean fisheries survival and contribution of the projects to the Eel River spawning run.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: None mentioned.

SOUTH FORK TRINITY WATERSHED IMPROVEMENT ASSOCIATION

CONTACTS: Tom Stokely
Box 1395
Hayfork, CA 96041
(916) 628-4608

Dwight Streamfellow
Box 329
Willow Creek, CA 95573
(707) 445-0881

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Jump pools and baffles were constructed for fish passage through state highway culvert. We were unsuccessful in our attempts to build a fish ladder over the dam on Baker Creek due to an uncooperative landowner and the instability of dam structure. We screened another dam diversion and 7 pump diversions.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: We identified three diversions which needed screening and one culvert which needed baffles to enhance fish passage.

PLANS FOR REMAINDER OF 1983-84 SEASON: We will attempt to build gabion jump pools below the dam barrier on Baker Creek and/or stabilize unstable streambanks on Baker Creek.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: When dealing with dam barriers, always push for fish ladders, and jump pools instead of seasonal dam removal for fish passage. Try as hard as possible to please local landowners, even if you or anybody else feels the landowner is to blame.

SPECIAL TECHNIQUES OR DEVICES IN USE: When building concrete forms on an uneven surface such as bedrock, use a scribe to transfer surface shape to forms. To facilitate the removal of sediment from concrete jump pools, a 4-inch x 10-inch or 4-inch x 12-inch board should be keyed into the concrete wall so that it is easily removable. When the pools fill with sediment, the board may be removed, the sediment can be "swept" downstream, and the board replaced.

NEW LISTING

TRINITY COUNTY
RESOURCE CONSERVATION DISTRICT

CONTACT: Joseph Bower
Box 1510
Hayfork, CA 96041
(916) 628-5004

TYPE OF PROJECTS: Stream restoration: barrier removal, pool development, stream-bank stabilization.

LOCATION OF PROJECTS: Little French Creek, Price Creek, Connor Creek, Rush Creek, Kingsbury Creek, Limestone Creek, and Post Creek; all tributaries to the Trinity River. (Trinity County).

PROJECT DESCRIPTIONS: Rebuilding fish ladder, installing culvert baffles, and creating rest pool on Little French Creek. This will open 2.3 miles of new habitat. Removing boulder barrier and log jam and creating a jump pool over dam on Price Creek. This will open 3 miles of new habitat. Baffling culvert, creating jump and rest pools, armoring bank, and screening a water diversion on Connor Creek. This will open 1.5 miles of new habitat. Removing a log jam on Rush Creek to open 6.5 miles of new habitat. Clearing mouth, installing baffles in culvert under airport runway and building a deflector, and creating jump and rest pools on Kingsbury Creek. This will open 3.5 miles of new habitat. Building jump and rest pool, baffling an 8-ft culvert, armoring banks, and removing log jams on Limestone Creek to open up 1.5 miles. Removing 3 log jams, blasting out 2 bedrock barriers, baffling a culvert, and building a rest pool on Post Creek to open 7 miles of new habitat.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: None mentioned.

SPECIAL TECHNIQUES OR DEVICES IN USE: None mentioned.

FUTURE PLANS: Dependent upon evaluation of present projects.

U.S. FOREST SERVICE
SIX RIVERS NATIONAL FOREST

CONTACTS: Kerry Overton
Six Rivers N.F.
507 F Street
Eureka, CA 95501
(707) 442-1721

Scott Woltering
Lower Trinity R.D.
Willow Creek, CA 95573
(916) 629-2118

Joe Moreau
Gasquet R.D.
Gasquet, CA 95543
(707) 457-3131

CORRECTIONS TO LAST YEAR'S LISTING: None mentioned.

ACTIVITIES DURING 1982-83 SEASON: Projects completed on the Forest through the 1983 Fiscal Year:

1. 46.5 acres of stream opened up to salmon and steelhead, barrier modification. Funded by E.R.F. (Energy Resource Funds - CDF&G Administration).
2. 49 acres of stream seeded with salmon and steelhead - egg boxes fund by K.U. and appropriated F.S. (Forest Service) funds.
3. 30 structures for steelhead trout (yearling) were constructed - F.S. and E.R.F. monies.
4. 13 structures were constructed to stablize stream channels - F.S., K.U. and E.R.F. monies.
5. 52 structures were constructed for creating salmon and steelhead spawning sites.
6. Smolt production facility proposal developed for Salmon and Horse Linto Creeks - cooperative effort by several user groups and management agencies. Funding through PCFFA for salmon stamp, Boscoe-Keene funds and F.S. funds.

ACCOMPLISHMENTS SO FAR DURING 1983-84 SEASON: 1. Smolt production facility constructed on Horse Linto Creek. Six Rivers N.F. paid for materials, Bosco-Keene and salmon stamp monies paid for construction.

2. Spawning ground counts for salmon adults, carcasses, redds, and potential spawning areas were completed on five streams on National Forest lands.

PLANS FOR REMAINDER OF 1983-84 SEASON: 1. Conduct steelhead spawning ground counts on fish streams within the Forest.

2. Develop cooperative proposal with CDF&G and smolt production project cooperators for egg-taking stations for the 1984 spawning season.

PROBLEMS OTHER GROUPS SHOULD WATCH OUT FOR: 1. Debris jam removal can have negative effects on fish habitat if not carefully analyzed. Large number of debris jams that appeared to be barriers were not barriers.

2. Projects for constructing spawning and rearing habitat are more cost-effective in fourth to seventh order streams.

SPECIAL TECHNIQUES OR DEVICES IN USE: Underwater observation (snorkel and mask) is a low cost technique to determine species composition and fish response to habitat improvement structures.

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION
SEA GRANT MARINE ADVISORY PROGRAM

CONTACTS:

Chris Toole (Humboldt Co.)
Foot of Commercial Street
Eureka, CA 95501
(707) 443-8369

Ed Melvin (Monterey, Santa Cruz Co.)
1432 Freedom Blvd.
Watsonville, CA 95076
(408) 724-4734

Bruce Wyatt
(Mendocino, Sonoma, Marin Co.)
2555 Mendocino Ave., Rm. 100-P
Santa Rosa, CA 95401
(707) 527-2621

John Richards
(San Luis Obispo, Santa Barbara Co.)
377 Storke Road
Goleta, CA 93111
(805) 685-8187

Jim Waldvogel (Del Norte Co.)
981 H Street
Crescent City, CA 95531
(707) 464-4711

Connie Ryan (S.F. Bay Area)
P.O. Box 34066
San Francisco, CA 94134
(415) 586-4115

Chris Dewees (Statewide)
Sea Grant MAP Extension
University of California
Davis, CA 95616
(916) 752-1497

Fred Conte (Statewide)
Aquaculture Extension
University of California
Davis, CA 95616
(916) 752-7490

Cooperative Extension is a branch of the University of California and cooperating state colleges. Its purpose is to provide useful and practical information derived from university and government research to the public, and to encourage the application of that information in commercial and non-commercial settings. Farm advisors (previously known as county agents) have been serving the agriculture industry through Cooperative Extension since 1914. Marine advisors, and funding of applied marine research, originated in 1966 with passage of the National Sea Grant Act.

Some of the Sea Grant research which applies to salmon and has implications for restoration and enhancement are: studies of the use of artificial attractants to increase returns of salmon to hatcheries; genetic studies of salmon populations; studies of smoltification which will determine the best times to release salmon; and studies of diseases of salmon. Sea Grant has sponsored major conferences on salmon smolting and the effects of salmon releases on Pacific ecosystems and on advances in salmon reproduction.

Marine advisors in coastal counties with salmon-producing streams have been active in working with enhancement groups such as the Northwest Steelheaders, Humboldt Fish Action Council, S.O.S., Monterey Bay Salmon and Trout Project, and others. Advisors have also helped develop equipment for use in rearing projects (see 1983 Report),have organized cooperative feed-buying in local areas, and have sponsored workshops and conferences such as this one. Cooperative Extension and the Marine Advisory Program also provide a disease diagnostic program through the U.C. Davis campus and the Bodega Marine Laboratory. A variety of publications are also available.

SECTION IV

CONTRIBUTED PAPERS

ENVIRONMENTAL, BEHAVIORAL AND ENDOCRINE BASIS OF LUNAR-PHASED HATCHERY RELEASES OF SALMON

Richard S. Nishioka, G. Young
E.G. Grau, and H.A. Bern
Dept. of Zoology
University of California
Berkeley, CA 94720

Editor's Note: A paper on this subject was presented at the 1983 Conference but a written report was not received in time for publication in last year's Report. The following abstract was submitted for inclusion in this Report. Readers wishing more detailed information on this subject are encouraged to contact Dr. Nishioka at the above address.

The salmonid fishery of California, Oregon and Washington, both commercial and sport, is of considerable economic importance. Because of the steady decline in natural runs of salmon and steelhead trout, the success of the fishery is largely dependent on hatchery-reared fish, particularly chinook salmon (Oncorhynchus tschawytscha) and coho salmon (O. kisutch). Despite large increases in the number of fish released since the mid-1960's, the percentage of hatchery-reared salmon contributing to the fishery has not increased correspondingly. Indeed, the ocean survival of hatchery-reared fish has often been below the estimated survival rates of natural populations (Wedemeyer et al., 1980).

Although hatcheries release large and healthy fish which appear to have completed the parr-smolt transformation which prepares them for life in the ocean, the limited contribution of these animals to the fishery strongly suggests that many are not functional smolts. Essential to the success of the fishery is the ability to identify fully-smoltified fish and to release them at the appropriate time; if this is not achieved, fish may fail to out-migrate or may fail to grow in the ocean (Folmar and Dickoff, 1981). Attention has therefore focused on the environmental and endocrine factors contributing to the parr-smolt transformation since only a complete understanding of this process will provide the criteria to identify fully-functional smolts.

Our presentation described ways by which basic endocrine research may be applied in order to increase the contribution of hatchery-reared fish to the salmonid fishery in California. In particular, an apparent correlation between levels of the hormone thyroxin, which is important in the process of smoltification, and phases of the moon was discussed. The majority of this work is supported by the University of California Sea Grant Program, in close collaboration with personnel of the Anadromous Fisheries Branch of the California Department of Fish and Game.

Folmar, L.C., and W.W. Dickoff. 1981. Evaluation of some physiological parameters as predictive indices of smoltification. Aquaculture 23: 309-324.

Wedemeyer, G.A., R.L. Saunders, and W.C. Clarke. 1980. Environmental factors affecting smoltification and early marine survival of anadromous salmonids. Marine Fisheries Review 42: 1-14.

A FISH AND GAME OVERVIEW

Ken Hashagen
Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95816

Good Morning. My remarks this morning are not so much an overview as they are a welcome and an announcement that "Bosco-Keene" funds, North Coast Cooperative Salmon and Steelhead Restoration Funds, or AB 951 funds-- whatever we choose to call them-- are once again budgeted in the Department's budget. We don't anticipate any changes in the situation and, although we won't know for sure until the Governor signs the budget, we are soliciting proposals and plan to go through the proposal review process, selection, and contract preparation and then wait until the budget is signed before we send out the "Notice to Proceed" letters. As in previous years, we will notify each prospective grantee as to the decision made on their proposal. The deadline this year is 5 p.m., May 11th on my desk. Any proposals received after that date will not be considered.

I'd like to make a couple of other comments about this year's program. We have randomly selected two projects this year and had our auditor go over their books. The records on both projects were in great shape (actually far better than the auditor had expected!). This is just a reminder that we will be auditing one or two projects each year. If you have any questions on how your books and records should be set up, please give me a call and I'll line you up with our auditors.

We are still having some minor problems with our invoicing process, which delays our paying you promptly. Mike Bird and Steve Sanders are working with me to refine the system and speed up the payment process. Each grantee next year will get a detailed example and explanation of the correct billing procedure.

That's it for my remarks. I'm pleased to see so many people here today. I hope you'll enjoy the program we've put together for you.

THE SALMONID ENHANCEMENT PROGRAM

IN BRITISH COLUMBIA AND ITS EVALUATION

W.J. Schouwenburg
Department of Fisheries & Oceans
1090 West Pender Street
Vancouver, B.C., V6E 2P1

British Columbia's Salmonid Enhancement Program (SEP) was first visualized in about 1974. It was developed in a 2-year planning process, extending from 1975 to 1977, at a cost of $6 million, and became a full fledged operating program in May of 1977, with a $183 million budget and a life span of five years, which was subsequently extended to seven years. The program, as approved, was the first phase of a multi-phased, multi-objective program. The seven year period ends in March, 1984.

The Salmonid Enhancement Program received the support of the Federal Cabinet (fisheries resources are a federal responsibility in Canada, under the British North America Act, which established our nation) because it was seen to contribute substantially towards many of the socio-economic goals which the federal government had established for the nation. Had an attempt been made to get support for a series of enhancement projects, solely on the basis that it would restore our salmon stocks and catches to historic levels, there is no doubt that it would have been rejected. Fisheries' goals had to be linked to the goals of government. Let me briefly describe how this was successfully accomplished.

BACKGROUND CONDITIONS (Circa 1975) - Within the period of acceptable records, it is apparent that B.C.'s natural salmon stocks were in a steady state of decline. (Figure 1) In the early 1930's the average total salmon landings were 180 million pounds per year; by 1940 the 10-year average was 164 million pounds per year; by 1950, 155 million pounds; by 1960, 137 million pounds per year - an all time low. In the 1960's, our department intensified its conservation, protection and enhancement efforts. By the end of the 1960's the 10-year average catch had risen to 139 million pounds, and by the mid-1970's the 10-year average had increased to 145 million pounds. These gross averages indicate that the decline in basic stock levels had been halted and that levels were increasing. However, as Figure 2 partially illustrates, all was not as it seemed to be. There was good evidence that significant numbers of salmon, approximately two million fish, has been added to the basic stock by construction of fishways, spawning channels and hatcheries, and that another million salmon of U.S. hatchery origin were being taken as well. As the figure illustrates, the downward trend had in fact continued. What the figure does not show is that more precise management in some areas had eliminated over-escapements of many stocks and that developing mixed stock fisheries were over-harvesting many other stocks.

The next question to be addressed was what catch levels could be expected given proper management and enhancement. Analysis of sketchy catch information and examination of known escapements and stream capacity information led us to conclude that the rivers of British Columbia could sustain a catch in excess of 300 million pounds of salmon per year.

DEVELOPMENT OF THE ENHANCEMENT PROGRAM - With recognition of the probability that B.C.'s salmon catch could be doubled if the capacity of the streams could be reached, and that our limited enhancement efforts were already contributing substantially to the catch, the department began to identify opportunities for enhancement projects and to establish the relationship between the completion of those projects and the realization of the goals of the government.

With regard to the opportunities for enhancement, the project identification exercise indicated that 25-40 million additional adults could be produced through the application of proven enhancement technology on in excess of 200 potential projects. It was decided that limits should be placed on any enhancement program so that natural production plus enhanced production should not exceed the probable historic level of production on the assumption that the carrying capacity of the nearshore marine environment would not be exceeded. This meant that enhancement goals were established at the 25 million fish level and are subject to further revision, depending on the success of natural stock management strategies.

The goals of government, then and now, can be categorized as follows:

1. National Income: Obviously, the government wants to ensure that its expenditures in resource development would return good value for the dollars invested and, since its resources are somewhat limited, they wanted to make sure investments made in fisheries would provide similar or better returns than if it were spent on other aspects of the Canadian economy. The federal government also expects that money advanced on resource development programs will be recovered as returns are generated. Twenty-five million additional salmonids would generate an additional annual revenue of $274 million (1976) so it was clear that a well-managed salmonid enhancement program would be an attractive income generator.

2. Regional Development: Because of the diminishing economic viability of the coastal communities of central and northern British Columbia, and the increasing social costs associated with this trend, the government wanted to see economic development stimulated, which would contribute to a revitalization of these communities and a reversal of the trend. Enhancement activities were seen to contribute to better incomes and increased employment in these communities.

3. Native People: The federal government's objectives, with respect to Native Indian people, are basically aimed at improving their socio-economic status in the Canadian fabric through improvements to income, employment and training. The potential candidate enhancement opportunities, along with the Coastal Indian's traditional affinity to salmon, made this a natural combination to stimulate more employment in the catching and processing of fish and involvement with and employment at specific enhancement projects.

4. Employment: Canada has always had a high unemployment rate because of its climate and its reliance on the harvesting or extraction of natural resources. This rate of unemployment has, for the past decade, ranged between 8% and 12% of the work force nationally, and in British Columbia has been generally higher because of our critical dependency upon resource harvesting and resource extraction, which are highly seasonal, dependent

upon market conditions, or both. Widespread application of enhancement technology was seen to be a substantial potential employment generator in B.C. and across Canada.

5. Environmental Issues: Our department's goals were to restore natural stocks, to restore and rehabilitate fish habitats and to prevent loss of fish production resulting from industrial or population growth. A large scale enhancement program was visualized as contributing towards all three of these goals.

After considerable discussion, with Treasury Board staff included, it was decided that a phased enhancement program should be proposed. Along with the proposal, there would be an evaluation process related to the goals of government, identified so that Cabinet and Treasury Board could assess the merits of each major project, or to the next phase of the total program. Thus was borne our "Five Account" Evaluation Process. A program or a project cannot be evaluated without monitoring and assessment data. Consequently, when Cabinet approved Phase I of SEP, they approved a monitoring and evaluation process as well.

WHAT HAVE WE DONE? - SEP's goal was to produce 50 million pounds of additional catch as a consequence of Phase I activity. Through the application of a wide spectrum of enhancement technology, we will achieve 86% of that goal - 43 million pounds. Not so shabby, considering the fact that the combination of program extension by two years and inflation had the effect of reducing our real purchasing power by one third.

These are some of the highlights:

- Ten major hatcheries were built, ranging in cost from $800,000. to $9.6 million. They have a total production capacity of 2.6 million pieces. Species production from these are 1.66 million chum, 416,000 chinook, 415,000 coho, 100,000 pink, 16,000 steelhead, and 8,000 cutthroat.

- Eight pilot scale hatcheries--fore-runners of bigger ones to come--with production capacities of 24,300 chinook, 15,800 chum, 14,400 coho, and 1,000 steelhead were built.

- A 4.2 km long spawning channel was constructed for chum salmon. It has a potential capacity of 367,000 pieces. Associated with this channel was additional rearing to produce 40,000 chinook and 1,200 steelhead trout.

- A lake enrichment program was undertaken to fertilize 13 lakes to increase sockeye production. The original target of 1.8 million pieces has been considerably exceeded.

- A Community Economic Development Program was initiated. It involves 22 projects, 11 of which directly involve Native Indian communities. Potential production from these is 905,000 pieces. The species production breakout is as follows: 353,000 chum, 206,000 sockeye, 185,000 coho, 95,000 chinook, 56,000 pink, 6,500 steelhead, and 1,900 cutthroat trout.

- A Public Involvement Program was initiated which has grown beyond our wildest expectations. We have over 6,000 volunteers working on approximately 220 projects, ranging from stream clearance work to small production oriented hatcheries. Currently, we are turning down interested groups

because the permanent staff advisors cannot take on more work. An educators package was developed to promote a grass roots interest in salmonid management, protection and enhancement. This package, called "Salmonids in The Classroom", has been purchased by 133 schools in 52 school districts in the Province. It has been enthusiastically received by students and teachers alike.

- Finally, a whole series of in-house, small-scale projects, costing less than $50,000 each, were initiated in support of habitat extension, stream rehabilitation and applied enhancement research. The end product of these are small fishways, log jam removal, mini hatcheries and side channel rehabilitation.

The following table illustrates the comparison between our initial species production goals and our end product. This clearly demonstrates the significance of lake enrichment to the perceived success of our program.

Table 1 Targets and Expected Production For Phase I

Species	Target	Production capacity March 1982	Expected production capacity by end of Phase I	Expected production as percentage of initial targets
Sockeye	9.0	13.1	16.9	187
Chum	28.9	11.6	16.0	55
Pink	3.8	1.4	1.4	37
Coho	2.4	1.4	2.9	120
Chinook	4.7	3.3	5.8	101
Steelhead & Cutthroat	0.2	0.4	0.4	200
TOTAL:	50.0	31.2	43.4	87

Source: Unpublished data provided by the Department of Fisheries and Oceans.

MONITORING AND EVALUATION - From my perspective as a planner, evaluation entails measuring three aspects of a program. I need to know the technical success of each operation or technique, the managerial success of the organizational unit responsible for the operation of various groups of projects, and finally, I need to know if the project or group of projects are meeting the economic performance criteria which were established at the time project or program was obtained. The economic success is dependent upon technical success and sound management.

TECHNICAL SUCCESS: The need to demonstrate our technical performance was immediately recognized and led to the development of a system of recording survival data for each SEP project. Basically, these records contain egg take or deposition data, fry produced, egg to fry survival, fry on hand, number of smolts released, fry to smolt survival, egg to release survival, a projected adult return and comments noting special circumstances prevailing during incubation and rearing. Originally, this information was recorded manually at each project site. Now, each major facility has an Apple computer

and the data are entered directly into the data base for each project. Records for smaller projects are still manually maintained and subsequently put into the data base. Two forms of these records are brood year summaries and status reports, examples of which are shown in Tables 2 and 3. If fish have been tagged or otherwise marked to establish marine survival, another separate set of records is maintained to record mark release data, which is then provided to our Mark Recovery Program, whose function is to obtain and keep track of mark recoveries.

The information described above is basically error free within the limitations of the sampling, and it represents the most complete set of records we have about any project. In the past seven years of operation we have, beyond any reasonable doubt, confirmed that the biostandards used to calculate egg to release survival were correct or conservative for every conventional enhancement technology (hatcheries, boxes, spawning channels, side channels, fishways). The biostandards used to calculate the production from each project are shown in Table 4.

To establish marine survival after release is more difficult and dependent upon the ability to mark the releases and the ability to recover statistically valid numbers of marks in the fishery and on the spawning grounds. If we aim for 95% confidence levels for assessing the merits of a specific technology or strategy, we need to put out a minimum of 100,000 chinook, 30,000 coho or 75,000 fed chum marks to get acceptable returns. We have not marked pink or sockeye because we're not yet convinced that pink fry or sockeye smolts are markable. The sample size requirements have also limited our ability to mark naturally reared fish. From this you can gather that we cannot completely assess the success of our pink and sockeye enhancement efforts, nor can we properly assess the merits of many of our small scale projects. Similarly, we cannot assess projects which rely on natural rearing.

A further constraint on the assessment of marine survival is that, depending on species, we must wait 2, 3, 4 and sometimes 5 years before we get all the recoveries from a particular release. Since many of the larger projects were not completed until two years ago, it simply is not possible to establish the marine survival for all substantial projects that have been completed. However, enough recovery data have been obtained to verify that survivals from artifical rearing technology, as applied to chinook, coho and chum salmon, are equivalent to or better than our design expectations as contained in the Biostandards employed in program development. A cautionary note, however, is appropriate. While SEP has attempted to mark production from every project with the previously mentioned exceptions, budget constraints have precluded marking all production from every facility in every year of operation. As a consequence, we do not have a very good idea of the range of marine survivals which might be expected for each technology. It has also been assumed that small scale projects employing the same technology will get the same survival as large scale projects.

How then is the technological success of those projects relating to pink and sockeye determined? For pinks, which are produced only by artifical incubation means, spawning channels and boxes, it is assumed that natural marine survivals will prevail. The same is assumed for sockeye facilities. Sockeye production from lake enrichment is another matter entirely.

The theory behind lake enrichment at the time of SEP's origin was that enrichment of oligotrophic lakes increased within-lake survival so that more smolts were produced. However, subsequent study has not supported that hypothesis. What is now being demonstrated is that the smolts are considerably larger when lakes are fertilized and this is believed to have led to a doubling of their marine survival. While there is no doubt that post fertilization returns have increased markedly, our inability, to date, to measure production directly by marking smolt output has led to considerable debate about the success of lake enrichment technology. The debate has been fueled by many scientists who, in this respect, consider negative thinking as a definite career opportunity. From a planner's perspective, it is interesting to note that coded wire tagging methodology for sockeye was not developed as a recognized need by those whose future is most closely linked to the success of lake enrichment. It has now been developed in Alaska.

MANAGERIAL SUCCESS: The management of the fisheries resources on both coasts of Canada has been the subject of mounting public criticism over the past ten or fifteen years. This criticism reached a crescendo about three years ago when two Royal Commissions, one for each coast, were set up to look into the resource, its use and its management. The West Coast version was headed by Dr. Peter Pearse, a highly regarded resource economist from U.B.C. The following excerpt reflects his views on the management of the program:

> "I have reviewed the accomplishments of the enhancement program and the concerns about it in some detail because I believe we must take these matters carefully into consideration in designing future policy in this matter. Phase I is a bold experiment in resource development. Moreover, it has been well organized. Particularly impressive is the thoroughness of project planning, the scope of the benefits considered and the rigor of project evaluations. The scrutiny these projects have received from program planners and boards is probably unsurpassed in governmental planning of major expenditures."

The Commissioner was undoubtedly impressed with the technical project monitoring that I have described and with the evaluations of program sectors that have taken place. Although the program sector evaluation is not yet complete, the results to date have spurred considerable interest because they dealt with heretofore untested approaches to the management of enhancement projects. SEP has three operational groups: Engineering, who have the responsibility of designing and building major projects; Facility Operations, who run those projects after construction is completed, and; Special Projects, where most of the innovative approaches to enhancement and management was concentrated. The latter was viewed by many people in our department as being a drain on the resources of the program which could be better spent elsewhere. The Special Projects Division is responsible for the Community Economical Development Program (CEDP) and the Public Involvement Program. CEDP was conceived as the vehicle whereby Native Indians could become involved in fish production on a contractural basis. After a hundred years of confrontation and hostility between the Department and our Native people, you can understand why some were skeptical in the extreme. Yet, when CEDP was evaluated as a total program, the program received such a glowing report that the skeptics went into a state of shock. Not only could the Department and Indian bands develop a cooperative working relationship, but they could

produce fish out of jerry-built hatcheries with the same rate of success as our own facilities after an initial training period of two to three years. To illustrate the point, CEDP projects will contribute about one-third as many fish as our new major hatcheries and spawning channels, at about one-quarter of the cost (Figure 3).

The Public Involvement Program sector of the Special Projects Division was the first significant attempt by our Department to promote public participation in particular projects of their own choice and in the management of SEP as a whole. SEP management direction comes from the Salmon Enhancement Board, five out of twelve being from the private sector. They are supported by a 19-person advisory group, representing user groups and other competing resource interests. The level of participation has been overwhelming. When this enthusiasm spread to the education system on the scale it has, it is obvious that fisheries managers of the future are going to have many more, albeit discerning, allies. Furthermore, we found that for every dollar we put into public involvement projects, we get five times that amount invested in money and time by the participants.

The small projects section, which, while it is responsible for technical advice to CEDP and Public Involvement Projects, has pioneered development of "low technology" enhancement. They developed and piloted incubation pit technology using "groundwater seepages". Their "layman's approach" to construction has pioneered inexpensive construction approaches and the training of previously unskilled people to functional enhancement personnel. The benefits of their spawning ground rehabilitation and development efforts are such that they basically make the section economically self-supporting.

SOCIO-ECONOMIC SUCCESS: I am not an economist, so I shall limit my remarks here to the barest of essentials in the hope that you will not press me to demonstrate my ignorance of the subject. First of all, the benefit to cost ratio objective for SEP was 1:5:1. If the returns meet expectations, when we achieve full production and the fish are harvested where they were predicted, we will achieve a benefit/cost ratio of 1:3:1, which is not bad considering that the inflation experienced during Phase I tended to increase costs more than benefits. Full production will not be attained for another decade. The question of where a particular stock will be harvested is still just that - a question. When planning for the program took place, certain assumptions about allocating stocks to various fisheries were made. For example, a Fraser River Chinook caught in Georgia Strait Troll has a landed value of $5.39 on average, whereas if its caught in N.W. Vancouver Island its value is $18.85. If our assumptions about the percentage caught in each fishery are incorrect, then our benefit/cost ratios could be significantly altered. The only way of verifying the assumptions contained in the production model used to derive SEP benefits is to put on enough marks of each enhanced stock to get statistically significant returns in each catch area. For Fraser River Chinook we need to release a minimum of 500,000 coded wire tagged fish to ensure significance in the recoveries. Marking on that scale has yet to be undertaken.

WHERE & WHAT NEXT? - If the foregoing has left you with some reservations about the overall success of the SEP Program, you are not alone. Dr. Pearse concluded his examination of SEP with the following statement:

> "The Salmonid Enhancement Program is both exciting and challenging. Phase I has been well planned and efficiently carried out, and the funds have been spent carefully. Present information provides grounds to hope that the returns will be satisfactory.
>
> But these are only expectations; the evidence of success of the experiment is not yet in, and experience in Canada and elsewhere indicates that predictions are fraught with uncertainties. The message I want to convey in this chapter is one of caution. The program would be renewed with a modified mandate, but we should not proceed with additional major works with uncertain results until we have more tangible evidence of the success of those already built. And we must begin to face up to the obstacles to the program's success that I have identified here, especially the threat to natural stocks under present fishing patterns and the threat of dissipating the gains in further expansion of redundant fishing capacity."

In the planning for the continuation of SEP, the Commissioner's cautions were taken into account. We have obtained approval for a two-year transition phase which will concentrate on lower technology enhancement, more assessment of returns from projects built in Phase I, and insofar as future big projects are concerned, we are only to go so far as bio-reconnaissance and engineering design. Expansion of existing facilities will be undertaken only in those cases where such expansions will not necessitate additional operating manpower. For our part as planners, we are moving toward improved marking programs, especially in the area of lake enrichment, and we will be increasing our efforts to make comparisons of the benefit arising from enhancement and improved fishery regulation without enhancement. Whether SEP will in fact have a second Phase has not yet been decided. What is clear is that our future is dependent in large measure on our ability to demonstrate the success of Phase I. That result is likely to come only from increased monitoring and evaluation effort.

FOR FUTURE REFERENCE:

1) Annual Report 1982 Salmonid Enhancement Program, Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

2) Assessment of the Community Economic Development Program, A. Dennis Rank, May, 1982. Department of Fisheries and Oceans, Canada, Pacific Region, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

3) Criteria for Conducting National Income Account Evaluations of Salmonid Enhancement Program Research Projects, Small Stream Improvement Projects, and Pilot Production Projects. Robin Gregory, 1980. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

5) Estimation of Commercial Fishery Benefits and Associated Costs for the National Income Account. J.C. Barclay & R.W. Morley, 1977. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

6) Evaluation of the Public Involvement Program in Salmonid Enhancement. D.P.A. Consulting Ltd. and A. Dennis Rank, April, 1983. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

7) Evaluation of the Small Projects Program in Salmonid Enhancement. D.B. Lister & Associates, D.P.A. Consulting Ltd. and Kerr, Wood, Letdal Associates Ltd., May, 1983. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

8) Native People Account Methodology Salmonid Enhancement Program. Frank Blassetti & G. Alex Fraser. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

9) Regional Development Account Methodology. Michael J. Friedlander, 1979. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6D 2P1

10) The Employment Impacts of Salmonid Enhancement Programs and the Social Cost of Labor. Marvin Scheaffer, 1977. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

11) Turning the Tide - A New Policy for Canada's Pacific Fisheries. Peter H. Pearse, September, 1982. Department of Fisheries and Oceans, Canada, 1090 West Pender Street, Vancouver, B.C. V6E 2P1

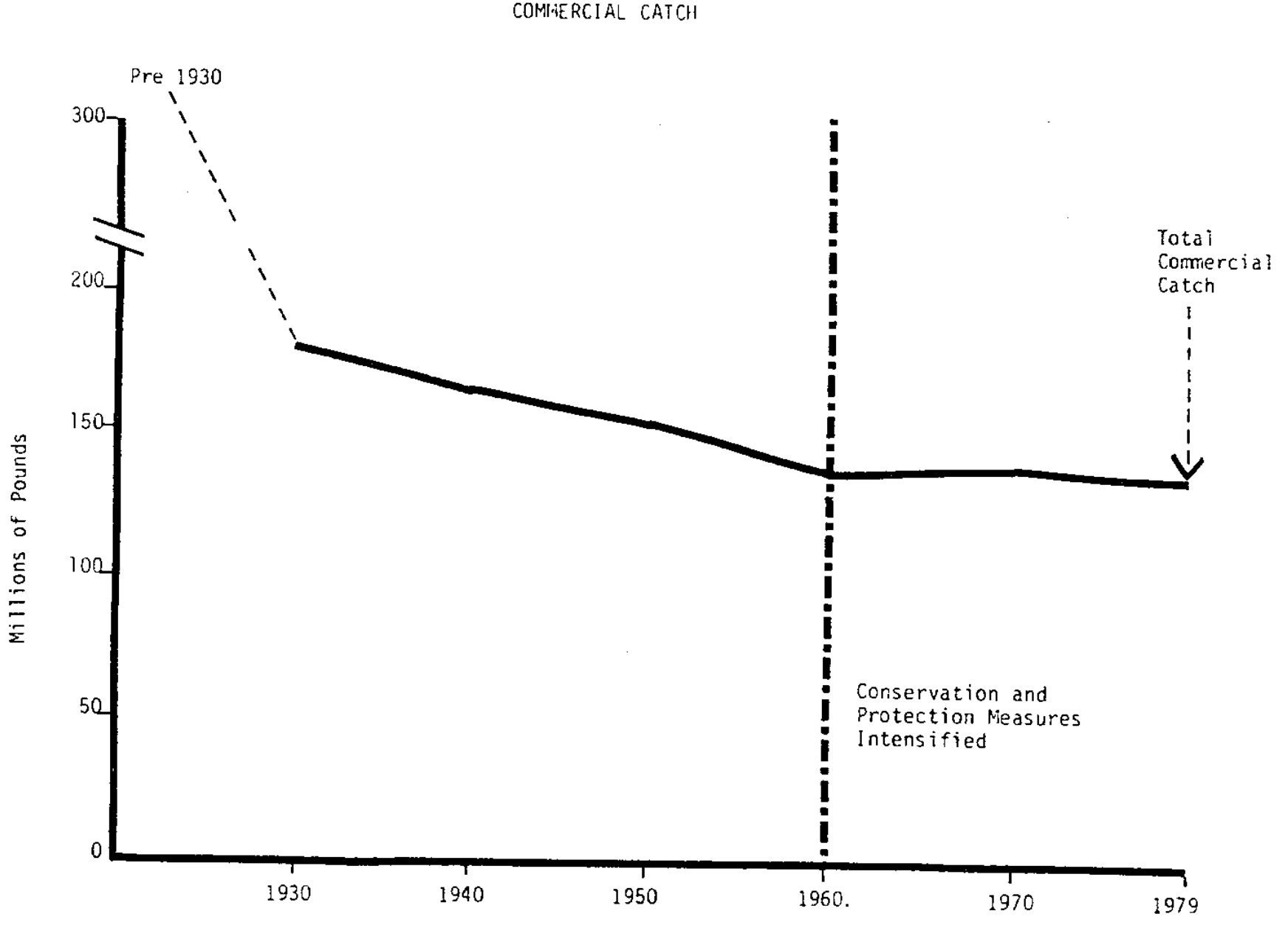

FIGURE 1 Commercial Catch of Salmon in British Columbia

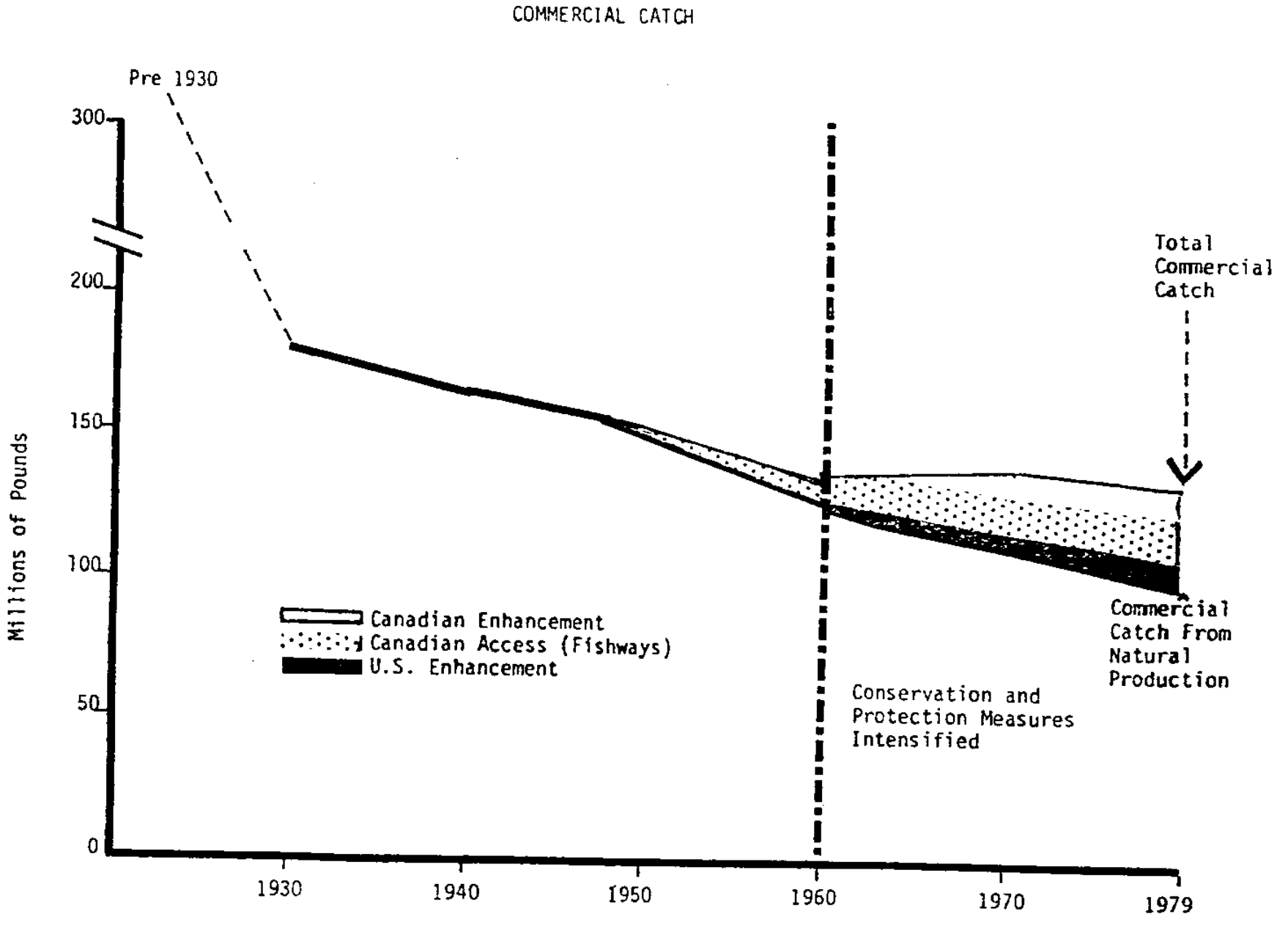

FIGURE 2 Commercial Catch of Salmon in British Columbia

TABLE 2. DATE: 1981 BROOD YEAR SUMMARY

Community Development Projects

PROJECT	RIVER	SPECIES	EGG TAKE		EGG TO FRY		FRY TO SMOLT		% SURVIVAL EGG TO RELEASE	EXPECTED ADULT PRODUCTION	REMARKS
			CAPACITY	ATTAINED	EMERGENT ON HAND/TOTAL	%	ON HAND/RELEASED	%			
Nanaimo	Nanaimo	Chinook SP81	100,000	3,740	3,635	97	2,813	77	75%	84	Egg take Sept. 30; Hatched Nov. 20. Released July 2/82 (4.1g).
		AU81	400,000	20,960	14,598	78	11,537	79	55%	346	Egg take Oct. 2, 6, 14, 19. Hatched Nov. 21; 4356 unfertile eggs from one female. Released July 2, 1982 (7.3g).
		Steelhead 81		45,000	39,500	88	37,400	95	83%	239	Released July 27-30, 1981 (2g).
		Cutthroat 81	20,000	5,140	5,112	97	2,188	43	43%	219	Furunculosis and Columnaris. Released May 4 (144.8g) and 20, 1982 (30g).
		Chum 81	1,000,000	1,146,700	915,609	80	888,000	97	77%	14,208	Egg take Oct. 15-28. Eggs shocked Nov. 10 80% survival to eyed. Released Apr. 82 (0.9g)
		Pink 81	10,000	3,334	2,600	78	2,560	98	77%	64	Egg take Oct 2-6. Released April 30,'82(0.9g)
		Coho 81	350,000	161,186	144,000	89	51,998/65,007				Egg take December. 50,100 released May 22 and 27, 1982 (0.7g). 14,907 CWTs released July 14, 1982 (2.5g).
Nimpkish	Willow Creek	Sockeye81		1,700,000	393,100	82	1,393,100	100	82%	23,335	Eggs shocked Dec. 7. 94% survival. Released April, May, June, '82 on emergence.
		Chum 81		499,000	235,940	47	235,940	100	47%	1,889	Released July 9, 1982; 50,000 RV fin clip.
Port Renfrew	San Juan	Chinook81		251,130	191,537	76	186,932	98	74%	4,486	Egg take Sept 18,20,27, Oct 3,4,10,15. 103,000 CWT. Released June 19-27,'82 (1-3g)
		Chum 81		est 7,000	7,100	100	7,100	100		57	Egg take Oct. 24. Released on emergence April, 1982
		Sockeye81		est62,000	92,854	100	92,854	100		1,560	Egg take Oct 15,24. Released on emergence April, 1982
		Coho 81		608,000	517,632	85	507,415	98	83%	6,089	Egg take Oct 24, Nov 1,2,7,14,15,24, Dec.2,11, 16,21,24, Jan 9. Released April 12,23 (0.8g). Remainder Released June, 1982 (1g).

Linda Thorson: 666-3425

TABLE 3 ENHANCEMENT OPERATIONS STATUS REPORT June 24, 1983

			EGGS				REARING		RELEASED		
FACILITY	SPECIES	GROUP	CAPACITY/EXPECT (,000's)	TAKEN	TRANSFERRED	ON HAND	FRY	YEARLING	FRY	FED FRY	SMOLT
Nitinat	coho			80,000						63,000	
	chum		28,000/5,000	9,120,000						8,432,000	
	chinook		1,500/1,500	2,663,000	45,000						2,400,000
Robertson	coho		1,500/1,500	1,500,000			1,323,000				983,100
	chinook	Robertson	9,200/9,200	10,356,000							8,420,000
		Nahmint	-/50	145,000							115,000
	steelhead		300/300	628,000			298,000			236,000	139,000
Tlupana	chum	all stocks	23,000/16,500	21,085,000						18,966,000	
		Sucwoa	5,000	5,900,000						4,850,000	
		Canton	750	1,500,000						1,346,000	
		Tlupana	750	2,850,000						2,590,000	
		Conuma	5,000	5,500,000						5,200,000	
		Deserted	5,000	5,335,000						4,980,000	
	chinook		2,000/200	550,000							485,000
	coho		-/75	193,000			75,000			80,000	
Bear	pink		5,000/5,000	0							
Quinsam	chum		-/100	76,300						63,000	
	pink		7,000/7,000	3,572,000					3,000,000	450,000	
	coho		2,050/2,050	2,656,500			2,016,000				1,205,000
	chinook		1,400/1,400	1,517,000			93,000				1,005,000
	steelhead	Quinsam	-/68	78,279			61,000				21,000
		Salmon	-/0								

Table 4 DESIGN CRITERIA FOR AVERAGE PERCENT SURVIVAL
INTERIM STANDARD FOR PHASE 1

UPDATED - March 23, 1981
AFL, RMG, DWN, FEAW.

These standards are a revision of the preliminary ones developed by FKS, RMG and DS. They are for the purpose of improving the estimates for the Phase 1 model in time for decisions relating to the 80-81 program. They will be improved and revised when the new computer model is available. Input received from RMG, EZ, AWA, DA, JW, HS, FKS, FJF. UNLESS NOTED IN THE "EXCEPTIONS" TABLE, THESE STANDARDS WILL BE APPLIED TO PROJECTS IN THE PHASE 1 MODEL, BUILT TO LONG-TERM STANDARDS, WITH FULLY EXPERIENCED STAFF, AT LEVELS ESTABLISHED BY THE FACILITIES OPS. GROUP - higher risk facilities draft standards are under review.

Sockeye	Eggs[o]	C/E[o]	% Egg Fry	X	% Fry Smolt	X	% Smolt Adult	=	% Egg Adult
Natural	(Deposition								
Coastwide ex.	3,000	1.3/1	15		22		4.5		0.15
Fraser	4,000	4/1	15		28		6.0		0.25
Channel[1] (1.5 yds^2/female)	Coastwide ex.		50[1]		20		4.5		0.45[1]
	Fraser		60[1]		28		6.0		1.01[1]
Lake Fertilization			Site Specific						
Chum (Revised Aug. 29/79)	2,800						Fry/Adult		
Natural	Coastwide	0.8/1	9				1.4		0.13
Channel[1] (1.5 yds^2/female)	Coastwide		60[1]				0.8		0.48
Box	Coastwide		80				0.8		0.64
Incub. and Rearing* (freshwater)	Coastwide where applicable		90		80 (fed fry)		2.0*		1.44*
Incub. and Rearing (Marine - 4 g)	Coastwide where applicable		72 to pens		90 (Marine release)		2.5		1.62
Pinks									
Coastwide (even)	1,500	1.8/1	13				2.8		0.37
Coastwide (odd) and Q.C.I. (even)	1,500	1.3/1	12				2.5		0.30
Fraser (odd)	2,000	2.8/1	13				2.9		0.38
Channel[1] (1.5 yds^2/female)			50[1]				2.5		1.25[1]
Box			80				2.5		2.00
Coho	2,500						Smolt/Adult		
Natural		1.25/1	15		8		15		0.18
Box - natural			80		8		15		0.96
- rearing			80		75		15		9.00
Incub. - rearing			90		75		15		10.13

TABLE 4 (Cont'd)

Steelhead (Revised July 6/78) H.S.	Eggs[o]	C/E[o]	% Egg Fry	X	% Fry Smolt	X	% Smolt Adult	=	% Egg Adult
Natural	4,000	1/1	15		8		8		0.10
Hatchery 2 year rearing			75		60		4		1.80
Hatchery Winter 1 year			75		70		4		2.10
Hatchery Summer 1 year			75		70		3		1.58
Cutthroat (corrected July 10/78) H.S.									
Natural	1,100	2/1	16		14		25		0.56
Hatchery - 1 year rearing			80		60		10		5.60
Hatchery - 2 year rearing			80		54		25		10.80
Chinook (Revised Nov. 23/78, July 4/78)	5,000								
Natural (Maint. Level) (Coastal)		4/1	15		33		6		0.30
Box - Rearing* Coastal 90 days (90/lb)			80		80		3		1.92
Coastal 1 year (Super-Smolts)			80		65		6		3.12
Up River[o] 90 days			80		80		2.25		1.44
1 year (Natural 1 - year smolts)			80		65		6		3.12
Heath Rearing Coastal 90									
Coastal 1 year			90		80		3		2.16
(Super-Smolts)			90		65		6		3.51
Up River 90			90		80		2.25		1.62
Up River 1 year (Natural 1-year smolts)			90		65		6		2.51

*Japanese Technique-areas where poorer conditions are expected to be encountered reduce smolt/adult to 1.5%=1.20.
[o]Up River-Fraser above hope, Skeena above Hazelton, Yukon @ Whitehorse.
[1]Side Channels-reduce channel standard by 50%, reduce by 25% if gravel replaced to channel specs, life reduction bases on flood-proofing also to be applied.

Exceptions

			% Fry/Adult	
Big and Little Qualicum Chum Channels egg deposition	2,890	73.4	0.634	0.5

[o]Note: The C/E Ratios and egg depositions are intended only as a guide and where specific site information is known it should be applied. The C/E ratio should not exceed 4/1 for all projections on enhanced net stocks with "terminal" fisheries, and will be lower in may cases, to allow for mixed stock fisheries.
[2]Note: Adult is defined as caught or escapement, regardless of maturity.

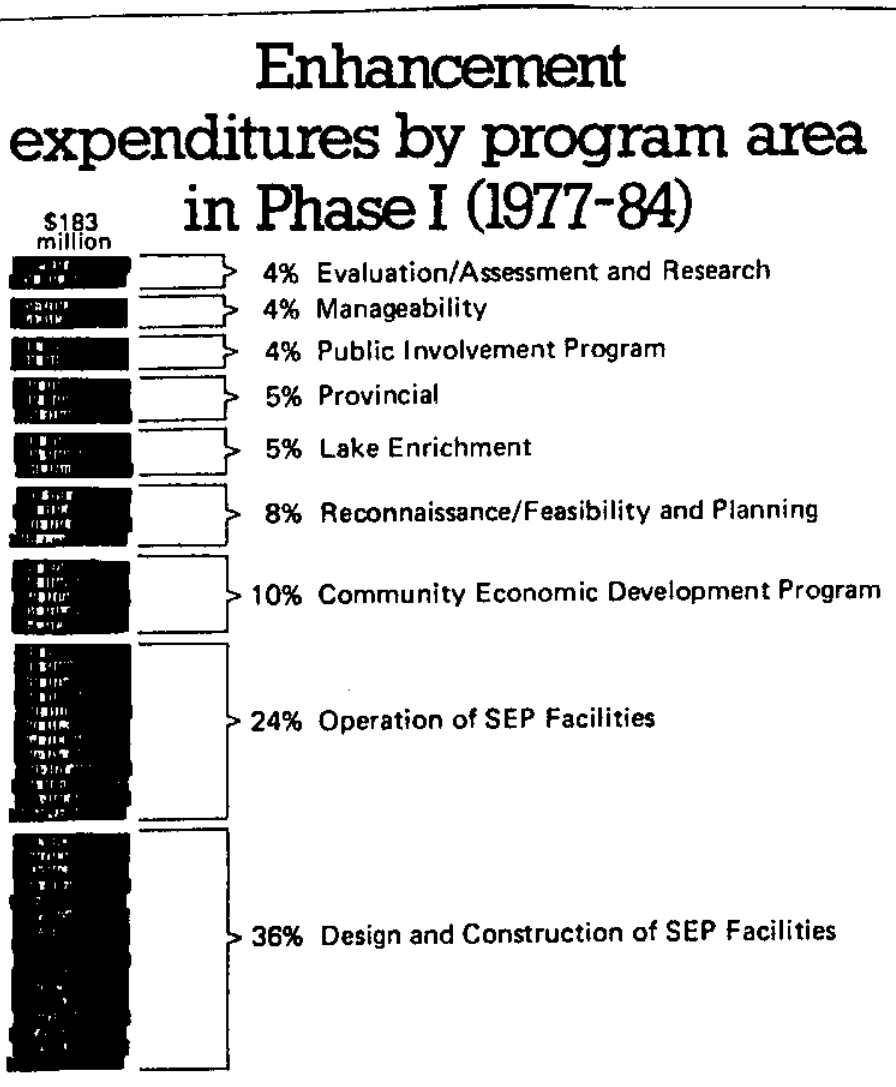
Enhancement expenditures by program area in Phase I (1977-84)
$183 million
4% Evaluation/Assessment and Research
4% Manageability
4% Public Involvement Program
5% Provincial
5% Lake Enrichment
8% Reconnaissance/Feasibility and Planning
10% Community Economic Development Program
24% Operation of SEP Facilities
36% Design and Construction of SEP Facilities
3

FIGURE 3

SALMON ENHANCEMENT IN WASHINGTON STATE

Ernest L. Brannon, Ph.D
School of Fisheries
University of Washington
Seattle, WA 98195

Enhancement is the only future for the Pacific salmon. Under the present fishing pressure and the politics endemic to the fishery, natural spawning cannot sustain the runs. It is not logical to expect that with a fishery taking 60 to 90 percent of the returning adults, sufficient escapement could occur to adequately seed the natural rearing areas of our streams. There is no alternative to enhancement. The form that enhancement can take, however, is as varied as the environments in which such measures can be employed.

In Washington State, we have seen a great deal of emphasis given to enhancement in the form of hatcheries beginning even before the turn of the century. With the Columbia River chinook salmon showing a marked reduction from overfishing as early as the 1880s, the solution that early managers sought was to build hatcheries to improve the incubation survival of eggs. Hatcheries were able to increase incubation survival tenfold over that experienced under natural spawning conditions, but the subsequent success of the production was much poorer than the wild fish. A substantial improvement in hatchery production success was realized with the development of better diets and the termination of the practice of using uncooked salmon carcasses for feed. Hatcheries continued to grow in importance in Washington, and production took the form of smolt releases to provide the maximum survival success. At present there are over 50 state salmon hatchery facilities producing primarily chinook and coho.

The problem with the development of the hatchery program in Washington was the loss of the concept that hatcheries were enhancement tools. Rather than supplementing natural populations, hatcheries tended to replace them, with the result that natural production no longer contributed effectively in the system. The net gain in production from the use of hatcheries in this manner may have been even negative in many cases.

Hatcheries are enhancement tools. In some situations, such as in the Cowlitz River where major dams denied the spring chinook access to spawning grounds, complete dependence on hatcheries to maintain the runs is required. In other situations the hatchery should play only a supplementary role, increasing the production of the native fish by providing higher survival success to a portion of the run.

Another problem with hatchery management is that production centers are created where several million fish are released from a single site, and often within a narrow time interval. The negative influence of this strategy is that it concentrates fish below the release area and leaves

many other sites vacant, sites that could have production potential. Even when presmolt releases are made, 25,000 to 50,000 fish can be involved which may be in excess of the stream's carrying capacity. Hatchery production should be spread out in space and time to provide the most efficient survival strategy.

Hatcheries are one of the finest enhancement tools that we have. The problems they cause are the result of how we use them. They are generally too large, over capitalized, and too crowded.

Concrete structures, ponds, and buildings are not always necessary. In some cases the appropriate hatchery isn't the standard facility that we associate with the term. Depending on the species, the hatchery may be a spawning channel, a gravel incubation box, or even a satellite rearing station. Facilities of this nature allow the distribution of production in a system more similar to that of natural systems.

One of the most important criteria in selecting the enhancement method is the species that will use the system. Chinook are large stream dwellers and coho generally tributary dwellers. The controlling factor in both species is feeding area. These species are generally not abundant at any one site or even in a single stream. Chum, pinks, and sockeye on the other hand are often very abundant. These species are only limited by spawning. They feed in the ocean or in large lakes as newly emerged fry so feeding area is generally not limiting. The enhancement tool, therefore, must be applied to the appropriate species. Rearing hatcheries are necessary for chinook and coho, and they do poorly in spawning channels. Spawning channels are ideal for chum, pink, and sockeye and all species can do well in egg boxes or egg plants, but feeding destination will determine seeding density.

In Washington a growing interest has been developing among the resource users to assist the Department of Fisheries and the Department of Game in fish production. Gravel boxes, fry releases in poorly seeded streams, and even private hatchery developments have occurred in cooperation with the state agencies. I will briefly cover two very different projects as examples of the type of operations going on.

The first project is gravel box incubation and seed distribution of coho in the Chehalis and Willapa river systems by the Pacific Trollers Association (PTA). The Chehalis river is a magnificent stream with over 1,390 tributaries and 3,353 miles of stream, but under-seeded and with a poor contribution of natural spawners. An enthusiastic group of men in the PTA conceived and executed an enhancement plan in cooperation with the Department of Fisheries in an attempt to start a recovery of that system and the Willapa River. Teams of volunteers were assigned to construction, site selection, gravel acquisition, egg planting operations, fry planting operations, and evaluation duties. Everything was coordinated with the Department of Fisheries. They requested the Department to take as many extra eggs as possible to include in their program. Before the season began the evaluation team assessed the streams targeted for enhancement to estimate the number of juvenile coho

present and decide what number of fish should be released in the stream. Gravel boxes were constructed and transported to the sites. Water sources were secured for incubation and the eggs planted. After the fry started to emerge, some of them were released at the site while others were distributed further up or down the stream. Eyed eggs were obtained from the Department and planted in other streams in egg tubes designed to be filled with gravel and placed on the stream bottom for incubation and natural emergence. Excess fry were also requested from the Department for distribution to stream sites that couldn't be serviced otherwise. As many as twelve pickup trucks with at least two volunteers each descended on the Willapa hatchery with 60 gallon plastic barrels equipped with aerators to transport fry to a number of small out-of-the-way streams for planting. Each pickup with its team and allotment of fry followed particular routes to different release sites reconnoitered the previous weekend by another team making maps for the releases. The PTA had identified their goal, coordinated their plan, assembled a variety of specialized talent to make the needed equipment, and executed the program with professional efficiency. Their approach was to assist the Department with labor and the use of simple equipment to help restore salmon runs.

The second project contrasted with the first in nearly every respect except in the organization and efficiency with which it was executed. A resident on Orcas Island in the San Juans, Mr. Jim Youngren decided to assist the Department with salmon enhancement as a member of the Northwest Steelhead and Salmon Council. At his own expense and utilizing his spring water supply flowing less than one cfs, he built a model fish hatchery with incubation facilities, a shallow fry feeding channel, an earthen rearing pond, two small rearing lakes, by-pass outlet piping systems, and an adult return pond with freshwater and saltwater capacity to handle one million juvenile salmon fingerlings. He obtained chinook and coho eggs from the Department of Fisheries at the Samish Hatchery, incubated the eggs and fry, and raised the fish for release with no previous experience in fish culture. Three years after releasing his first chinook smolts, 1,000 adults returned to the site, with an estimated contribution of 3,000 to 5,000 salmon to the fishery. Because of the success of his project he was the first private citizen able to supply eggs to the state to help cover their own shortages. Jim Youngren identified a need, developed a strategy to address the need, and executed a plan in an efficient manner that resulted in an unqualified success. Salmon were produced for the fishery by a concerned resident where salmon could not be produced naturally and in an area where no salmon runs existed. At his success rate with just chinook salmon, this one enhancement project will add to the fishery at least 10,000 fish annually.

Here are two examples of what private citizens can do for their salmon resources through effective but different methods. Perhaps the greatest advantage of this approach is that it spreads production out to the little streams in the same manner that natural runs would have existed. Numerous small production sites spread out over our coasts will maximize the productivity of potential salmon rearing areas without crowding the estuary and concentrating the predators. It builds in a security against failure, and it reduces the

dependence on a few major sites where a failure will have much greater impact. The success that Youngren had as a inexperienced culturist multiplied by the number of sites at which such operations could be executed would amount to a very substantial production of salmon. Enhancement projects have a part, and a very major part, to play in the rebuilding of our salmon runs.

Enhancement cannot proceed without applying the lesson that history should have taught us, however. Hatchery managers have persistantly used transplants to restock diminished populations of salmon. If there has ever been a lesson to learn from failure, it should be abundantly clear that transplants should not be used to strengthen weak runs, used carefully in places where there are no runs, and used no longer than necessary. Several studies exist that show the specificity of stocks to their environment. Innate orientation patterns in both fresh and marine environments, precise temporal responses in migratory behavior, energy reserves during fasting, spawning times, and the selective importance of temperature on fry emergence all point to the very dominating influence of the genetic element. The native or resident stock should be the stock enhanced in a stream. Generations of time have selected the characteristics that provide the highest fitness in that environment. Chance will seldom provide a better genetic combination that what's there. If native fish are gone, then hybridizing stocks is a good strategy, but once adults start returning it is best to terminate transplants and build up the fitness of the returning fish. Studies at the University of Washington have shown that introduced stocks may return with only about 10% of the success that local stock will have. Time is necessary to build return success through stock selection.

Enhancement projects that are spread out on small streams will not only represent the more natural distribution of historical salmon runs, they can target the natural stock in the stream for enhancement without worrying about genetic loss or degradation. There are several advantages that small, well distributed enhancement projects can have over large hatchery sites. Enhancement approaches can provide the major breakthrough needed to rebuild and maintain healthy salmon runs. In Washington State, management has isolated hatchery and natural spawning stocks, which has severely limited the production potential from both elements. It must be recognized that proper enhancement measures can eliminate the need to isolate hatchery programs, and provide the only means whereby salmon runs can be rebuilt.

CALIFORNIA DEPARTMENT OF FISH AND GAME POLICIES AFFECTING PUBLIC SALMON AND STEELHEAD RESTORATION PROGRAMS

Steven N. Taylor
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, CA

RESTORATION GRANT ADMINISTRATION

Written policies governing the actions of the Department of Fish and Game, and in turn, the operations of the cooperative programs have been issued by the Legislature, the Fish and Game Commission, and the Department of Fish and Game. These written policies provide the broad guidelines for operation and are presented for reference in the Appendix. In fact, however, the written policies *per se* are much too brief and general to resolve all of the questions and conflicts arising during the term of a restoration project.

The solution the Department has chosen to deal with the need for day-to-day field guidance, on a case-by-case basis, is to designate five experts in their fields to serve as primary contacts for contractors. Three, Michael Bird, Ken Gallagher, and Steve Sanders work full time as Field Coordinators; their positions were created specifically to provide technical guidance to cooperative programs. The other designees, Bruce Barngrover and Robert Snyder, provide assistance to a limited number of programs in addition to their other region job responsibilities. The name and telephone number of each field supervisor, the responsibilities of each, and their relationship to other Fish and Game Department personnel involved in administration of the Salmon and Steelhead Restoration Grant program, are shown in the organizational chart (Figure 1).

RESTRICTIONS ON ANADROMOUS SALMON AND STEELHEAD INTER- AND INTRA-BASIN TRANSFER AND PLANTING

The Department of Fish and Game, for the purposes of fish disease control and for the protection of the genetic integrity of native stocks, has imposed a number of restrictions upon the transfer of fish from one water to another.

The most serious disease problem in California salmon and steelhead hatcheries today is the virus disease called "Infectious Hematopoietic Necrosis," or "IHN".

Typical symptoms are exophthalmia (popeye) and subdermal hemorrhages, especially at the base of the pectoral fins.

Our losses of chinook salmon to IHN in 1983 were 4½ million, and 1983 was not considered a bad year. In bad IHN years we have seen losses of closer to 10 million chinook salmon, or about 20% of the statewide production capacity.

IHN is currently firmly established in the salmon populations of the upper Trinity River, the upper Sacramento, the Feather, and the American rivers. As a result, the State prohibits the transfer of chinook salmon eggs or fish from Trinity Hatchery to any location downstream from the mouth of the North Fork Trinity, or from Coleman, Feather River, Nimbus Hatchery, or the Mokelumne River Fish Installation, to any coastal drainage (Figure 2).

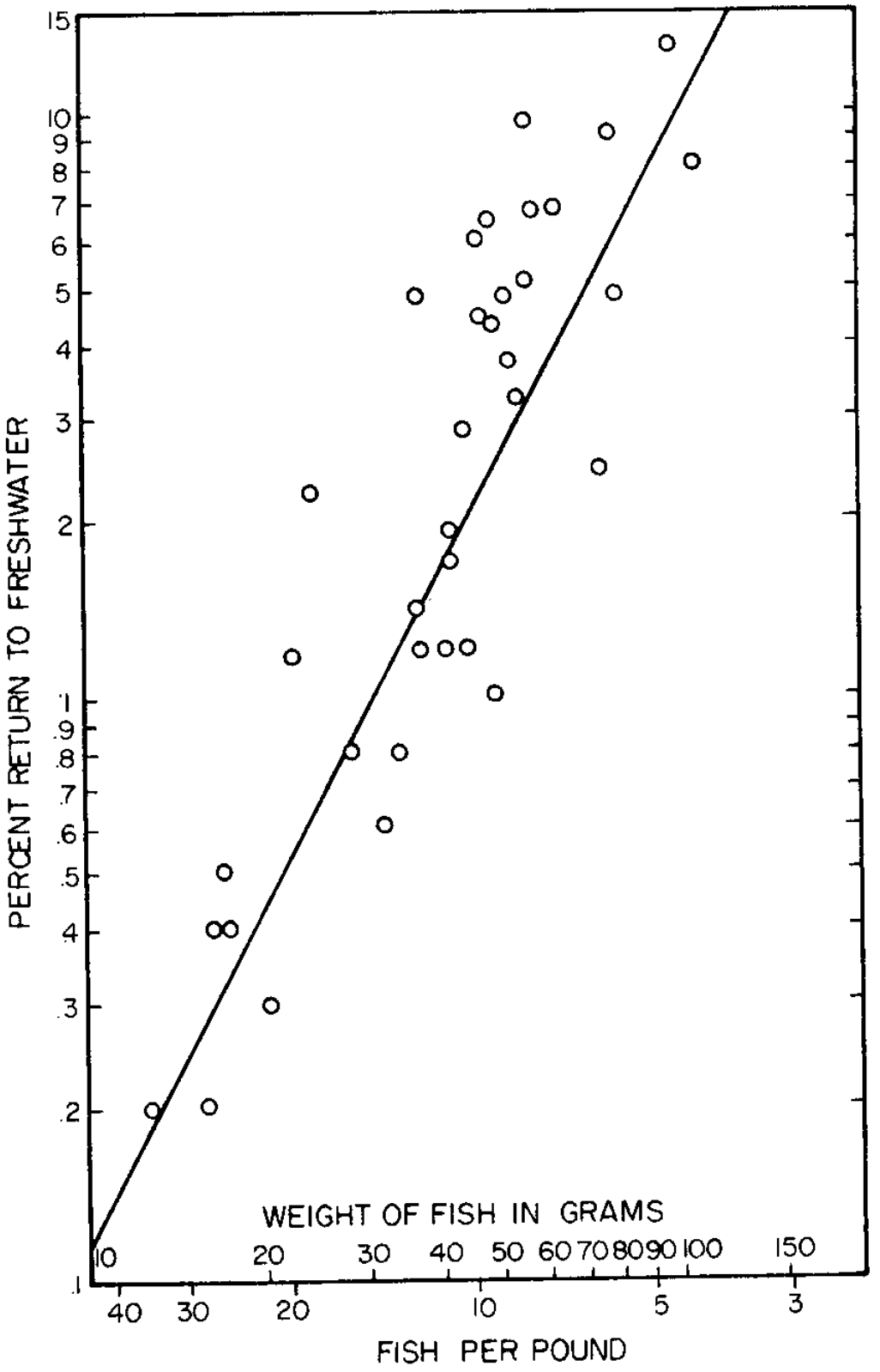

Figure 4. Relationship between steelhead survival and size at planting (from Royal, 1973).

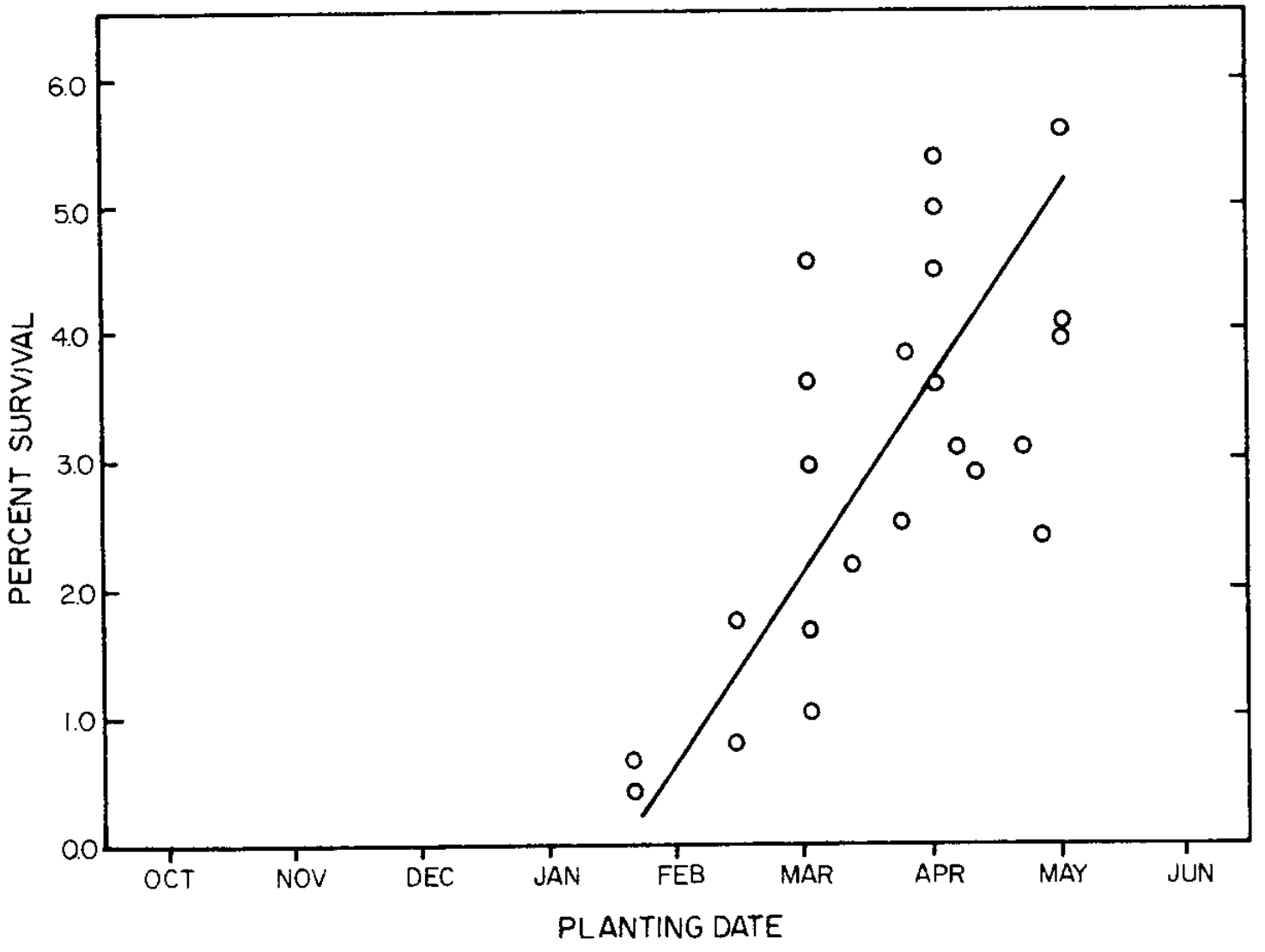

Figure 5. Relationship between coho salmon survival and date of planting.

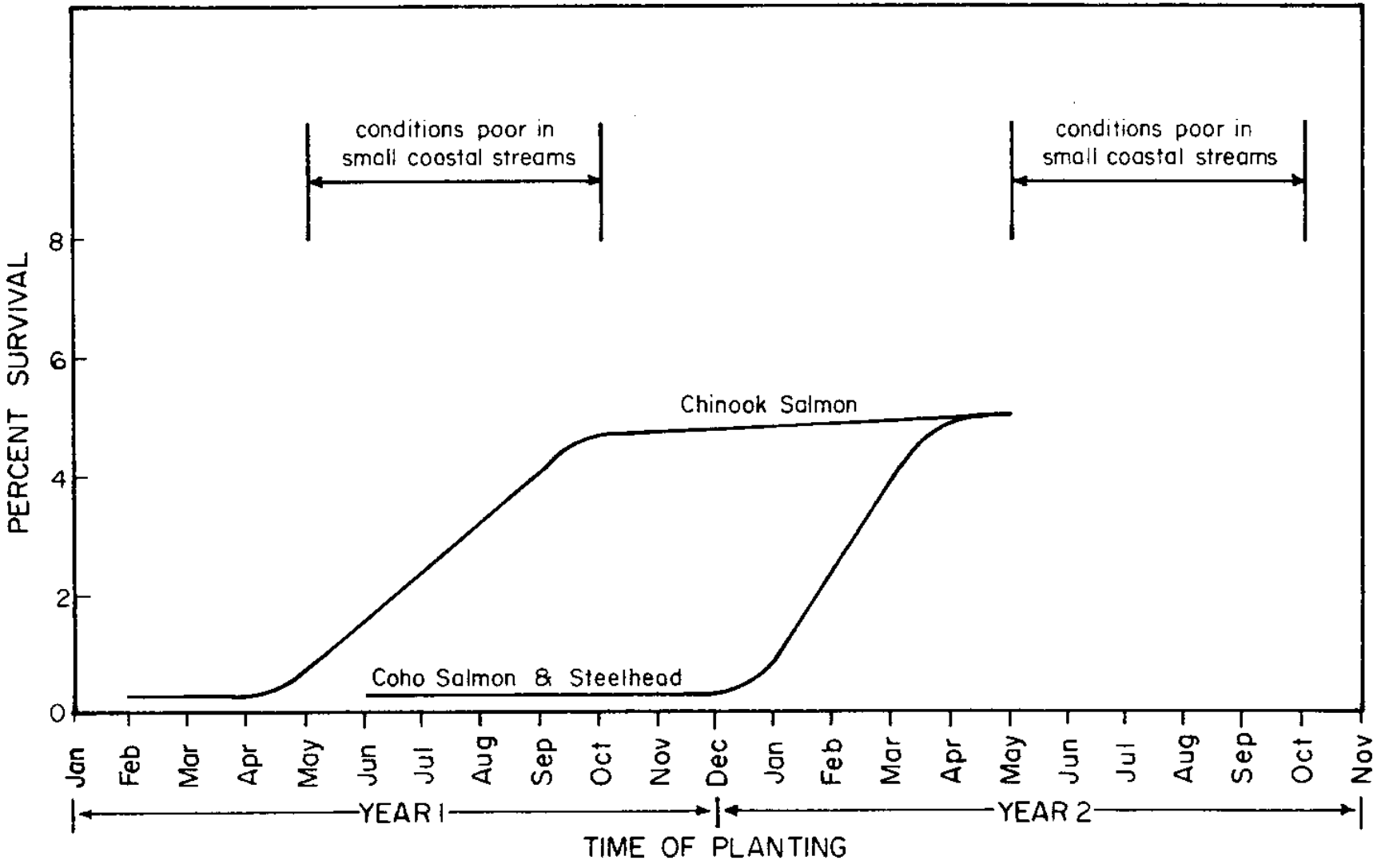

Figure 6. Relationship between survival and planting date: comparison of chinook salmon with coho salmon and steelhead.

Marking experiments and other research indicates that survival is very low for either coho salmon or steelhead planted when smaller than critical size, which is about 20/lb for coho and about 10/lb for steelhead. Fish smaller than this residualize (do not emigrate seaward when released). State guidelines, therefore, require that coho be at least 20/lb and steelhead at least 10/lb when released. State guidelines further discourage the production of coho larger than 10/lb because these extra-large fish tend to return to freshwater as grilse (2-year old adults) which have low fecundity and relatively low harvest rates.

Research also shows that for coho or steelhead of any size, the "window in time" during which releases will result in acceptable high survival rates is much narrower than is the case for chinook salmon.

There is a very sharp increase in survival over the 10-week period from January through mid-March. High survival rates (4% or higher) are likely to result from plants of fish released between mid-March and May 1. Much lower rates can be expected from releases of coho or steelhead earlier than this, or later than this in smaller coastal streams, regardless of the size of fish at planting. Fish planted before mid-March tend to residualize; fish planted after about May 1 in many California coastal streams stand a chance of encountering water temperatures which are above the optimum range for salmonids.

State guidelines, therefore, call for the release of coho and steelhead only between the dates of March 15 and May 1.

REFERENCES

Royal, L. A. 1973. Steelhead program evaluation and planting, Jan. 1, 1971 - Feb. 28, 1973. State of Washington Department of Game. 176 p.

Jensen, P. T. 1971. Fishery contribution and escapement of hatchery-produced silver salmon in California. Calif. Dept. Fish and Game Anadromous Fisheries Admin. Rep. 71-10. 11 p.

Bagatell, C., T. Rasch, and C. Johnson. 1980. A review of the experiments with the 1970 and 1971 brood coho salmon (Oncorhynchus kisutch) from thirteen Washington Department of Fisheries Hatcheries. State of Washington Dept. of Fish. Progress Rep. No. 94. 155 p.

APPENDIX

CALIFORNIA FISH AND GAME CODE

Article 6. Cooperative Salmon and Steelhead Rearing Facilities

1200. The department is authorized to enter into agreements with counties, nonprofit groups, private persons, individually or in combination, for the management and operation of rearing facilities for salmon and steelhead. All such agreements shall be in accordance with the policies of the commission and the criteria of the department which govern the operation under such agreements.

The purpose for operating such facilities shall be to provide additional fishing resources and to augment natural runs.

1201. An applicant who wishes to enter into an agreement to operate a rearing facility shall demonstrate, to the satisfaction of the department prior to executing such agreement, such applicant's financial ability to properly operate the rearing facility. The department shall develop and specify the means for an applicant to make such a demonstration.

1202. All fish handled or released under authority of this article are the property of the state and may be taken only after their release into the wild and under the authority of a sport or commercial fishing license.

1203. The release of fish reared in facilities pursuant to this article shall be made in accordance with the policy of the commission.

1204. The department shall fund the agreements provided for in Section 1200 only on a matching basis with the persons or entities who enter into such agreements. Funds appropriated for the purposes of this article shall not be used to purchase equipment or for construction.

The department shall be reimbursed from funds appropriated for the purposes of this article for administrative costs, legal costs, and supervisorial costs relating to the execution and supervision of such agreements by the department.

1205. The department shall, subject to the limitations of appropriate egg sources and funding, make available fish of appropriate size and species to persons or entities who enter into agreements pursuant to this article.

1206. Salmon and steelhead raised pursuant to this article shall be released in streams, rivers, or waters north of Point Conception and upon release shall have unimpeded access to the sea.

POLICY OF THE FISH AND GAME COMMISSION REGARDING PUBLICLY OPERATED REARING PROGRAMS FOR SALMON AND STEELHEAD

It is the policy of the Fish and Game Commission to:

I. Support the utilization of the state's salmon and steelhead resources for public rearing programs, within the following constraints:

   A. Only those fish surplus to the needs of the Department programs shall be utilized for such programs.

   B. The suitability and acceptance or rejection of proposed programs shall be determined by the Department.

   C. Priority of allotment of available surplus fish among acceptable programs shall be based on past performance on existing programs and the Department's evaluation of the potential of proposed new programs.

   D. Routine care and food costs shall be the financial responsibility of the sponsoring group. The Department will provide technical advice and counsel and special assistance as appropriate.

II. It is recognized that natural production provides the great bulk of the state's salmon and steelhead resources. The Department's goals of maintaining and improving this production shall not become subservient to the goals of publicly operated rearing programs.

CALIFORNIA DEPARTMENT OF FISH AND GAME POLICY ON THE PLANTING OF ANADROMOUS SALMON AND TROUT (FROM DEPARTMENT OPERATIONAL MANUAL)

Time and Size of Planting for Anadromous Salmon and Trout - Unless otherwise authorized, all anadromous salmon and trout shall be reared and planted under the following guidelines:

Chinook (King salmon) - All fingerlings shall be at least 90/lb in size at the time of planting (in the Sacramento-San Joaquin system they shall be 60/lb) and shall be planted between April 15 and June 15.

Coho (Silver Salmon) - All coho salmon shall be at least 20/lb, but no larger than 10/lb at the time of planting. All fish shall be planted between March 15 and April 30.

Steelhead Trout - All steelhead trout shall be at least 10/lb at the time of planting and planting shall take place between March 15 and April 30.

STATUS OF THE CDF&G PUBLIC SALMON AND STEELHEAD RESTORATION PROGRAM

Michael Bird
California Department of Fish and Game
5553 Elm Lane
Redding, CA 96001
(916) 241-3199

Since it's beginning, the Cooperative Salmon and Steelhead Rehabilitation Program has funded a total of 64 contracted projects at a total cost of $2,422,589. There are 31 contracts in effect at this time. Of these 14 are considered habitat restoration and 17 in the pond rearing category.

The habitat restoration project has completed the removal of approximately 145 log jams, the blasting of eight rock barriers or rough passage areas, the construction and installation of 12 fishways, baffling five culverts and the placement of 43 gabions to halt streambank or watershed erosion.

On August 1, 1983, the pond rearing program, funded by A.B. 951, was taken over by Steve Sanders, Department of Fish and Game, using funds provided to the Department through Salmon Stamp money. After a year as the project coordinator, meeting with various groups and interested individuals as well as groups that have already received a grant, it has come to my attention that it is not fully understood how a proposal becomes a contract and what takes place after one has been awarded.

First a brief summary of what the Cooperative Salmon and Steelhead Rehabilitation Program is. The program began in 1981 under terms of Assembly Bill 951, commonly known as the "Bosco Bill." A.B. 951 authorized the Department of Fish and Game to make grants to non-profit organizations, political subdivisions and recognized Indian tribes to cooperate with the Department in salmon and steelhead rehabilitation along the north coast. These cooperative programs to be funded may include fish rearing operations, log jam removal, fish ladder construction and other salmon and steelhead habitat improvement projects.

OK, now how it works. Prior to the beginning of the Department's fiscal year, July 1, the Department solicits proposals for projects that can be funded through the California Contracts Register, newspapers, various groups and word of mouth. Since there are proposals for more money than is available, $2.25 million in 1983 versus $850,000 available for grants, they have to be evaluated on a biological priority basis. The evaluation process is as follows:

1. Field inspection
    a. Type of problem
    b. Will doing work solve the problem
    c. Can it be completed during the contract time
    d. Cost; too expensive for amount gained
    e. How long will it last
    f. Can work be safely performed
    g. Was this to be funded elsewhere

2. Organization doing the work
    a. Expertise of the group
    b. Willingness to do the work
    c. Can they get access

3. Priority
    a. Chinook, coho, steelhead
    b. Loss of a run; i.e., will not doing it cause a loss of a run

Once it is determined that it is a biological priority and the work can be performed, a contract is awarded. We start with the highest priorities and go until out of money. The contracts indicate where the work will take place and the cost. Once a contract has been awarded, the contractor must then obtain all necessary permits and access to the project sites. The following is a list of some of the permits that could be necessary and when they are needed:

1. California Department of Fish and Game
    a. 1603
        1. A 1603 permit is needed anytime a person wants to do work within the confines of the highwater mark or on the banks of any stream.
    b. Blasting permit
        1. A blasting permit is needed from the Fish and Game Commission anytime explosives are to be used in State waters by the cooperative contractors.

2. Cal-Trans
    a. Encroachment permit
        1. An encroachment permit is needed from Cal-Trans anytime any work takes place within the State highways right-of-way.

3. Counties
    a. Encroachment permit
        1. An encroachment permit is needed from the county anytime any work takes place within the county road right-of-way.

4. Corp of Engineers
    a. Corp permit
        1. A permit could be required when the flow is five cfs or more and is perennial (determined by rainfall charts and stream bank vegetation) and there is fill.
        2. It is recommended by the Corp that all work to be performed be listed by U.S.G.S. topographical map description and sent to the Corp to determine if a permit is necessary.

Before any work can take place any and all permits have to be obtained and permission for access has to be received. Obtaining necessary permits is the responsibility of the contractor. The locations of the worksites and the methods used will be approved in advance by a representative of the Department of Fish and Game. During the course of the work the project coordinator will make on-site inspections to insure that work is progressing in a satisfactory manner.

Billing for the work is done in arrears and can only be submitted once during a 30-day period. The bills submitted must follow the line items listed on the contract budget. Once the work has been completed, the contractor will then submit a final report on work accomplished.

LANDSLIDE STABILIZATION FOR THE IMPROVEMENT OF FISH HABITAT

Michael J. Furniss
USDA-Forest Service
Six Rivers National Forest
Gasquet Ranger District

> "Although the river and the hill-side do not resemble each other at first sight, they are only extreme members of a continuous series, and when this is appreciated, one may fairly extend the "river" all over the basin and up to its very divides. Ordinarily treated, the river is like the veins of a leaf; broadly viewed, it is like the entire leaf." - W. M. Davis (1899)

There is always an important relationship between the condition of the soils in a watershed and the quality of fish habitat in its streams. Watershed and fish habitat management in the forest environment is most importantly soil management. The maintenance of high quality water and productive stream and riparian systems is largely a consequence of good soil and slope stability and the maintenance of soil productivity. The improvement of fish habitat may also depend on the improvement or reclamation of soil and slope resources.

In planning for the improvement of fish habitat, it is appropriate to evaluate watershed conditions and determine if sediment yields, water temperature or water chemistry are contributing to the limitation of fish production. Such limitations, if uncorrected, may prevent the establishment of a productive and self-sustaining fishery. If self-sustenance of the fishery is an objective for a particular stream or stream reach, watershed conditions must be considered and limiting factors must be identified.

Although many watershed problems are uncorrectable or extremely expensive to correct, many types of problems can be corrected with cost-effective measures, particularly at the small basin (1st order stream) or stream reach level.

In the North Coast region, landslides are the most common habitat-degrading watershed problem. Very large inputs of sediment from landslides can severely degrade or eliminate downstream fish habitat. Very frequently the initial landslide is followed by years of continued high sediment inputs from additional mass failures and severe surface erosion. Following an initial failure, prevention of further mass failure and control of surface erosion from the freshly exposed slide face is often indicated. The cost of corrective measures is not always prohibitive, particularly when high value anadromous fish habitat can be reclaimed.

Landslide stabilization or remedial measures have been applied extensively to road and real estate development. The relevant engineering practices are well developed. Because of the urgency and high values at risk in these situations, very expensive measures are often justified and usually include detailed evaluation and engineering designs. Vehicular access is usually not a problem.

Where water quality or fish habitat are the only values at risk, the options for landslide stabilization are often much more limited because of: (1) a lack of perceived urgency and risk - no human life, access, or improvements are threatened, (2) small amounts of available funding, often with higher priority and more cost-beneficial projects competing, and (3) frequent lack of vehicular access. Despite these limitations, cost-beneficial options often do exist and may be an essential step in the reclamation of a stream reach or small stream system.

There is an unlimited variety of landslides that can occur in nature, resulting from the unlimited number of combinations of causative factors acting on a great variety of landforms. No standard methods of control can be prescribed, but some generalizations about approaches can be made.

In evaluation and planning for landslide stabilization the following are among the important considerations:

1. Corrective measures must be designed to act on the driving factors or processes causing the slide or secondary erosion. The specific factors causing the movement or risk of movement must be identified. An evaluation of the slide by a geologist is usually essential.

2. Corrective measures will either decrease the destabilizing forces or increase the soil's resistance to erosion.

3. A hazard and risk versus cost analysis should be done for each possible treatment and process. The hazard is the probability or potential for a particular erosion or hydrologic event to occur. The risk is the value of resource or beneficicial use that would be lost if the event occurred. The combination of risk and hazard defines the problem. Corrective measures will generally modify the hazard and the attendant risk. Comparing hazard-risk under various corrective treatments with the cost of corrective treatments allows a rational decision to be made or to do or not do, or to assign treatment priorities.

4. Self-sustaining or long-term treatments that do not require maintenance are preferable to those that do, particularly in poor access areas.

Types of corrective measures that apply somewhat generally to landslides include:

1. Relocate the affected resource (road, stream).

2. Unload the head of the slope.

3. Load the toe of the slope.

4. Remove water from the slope.

5. Restrain or divert materials.

6. Protect landslide toe from stream erosion.

7. Control gully erosion.

8. Protect erodible surfaces.

It is important to note that these same general methods apply equally well to the prevention of landslides.

Detailed discussion of these general measures can be found in several of the references given at the end of this paper. Site-specific measures are best developed when imagination and judgement are applied and the physical processes involved are understood.

A CASE HISTORY: THE RIB DEBRIS SLIDE

The Rib Debris Slide is located on Idlewild Creek, a tributary to the upper Middle Fork of the Smith River, in Del Norte County.

The slide occurred shortly following the extreme rainfall and flood of December 1964. The initial event involved 150,000 cubic yards of soil and earth debris. The slide mass moved into Idlewild Creek, effectively damming the stream. Slide debris moved downstream and drastically changed the character of lower Idlewild Creek. Upstream from the slide, damming of the stream and a backing up of flows caused a long, low gradient reach of aggraded sediments. The dam apparently persisted for several days. The stream above the slide is not entrenched in the alluvial materials.

The topography of the slopes adjacent to the slide has three distinct breaks in slope inclination. From the ridge to the stream slopes become progressively steeper. The upper slopes range from 30-45%, middle slopes are from 55-75% and in the valley inner gorge slopes are 95-100%.

Local bedrock consists of thinly-bedded metasedimentary rocks of the Galice Formation. Exposures of rock in the slide are a collection of greywacke and slate that is highly sheared, tightly folded, fractured, and deeply weathered. In places along the plane of failure a very dark gravelly clay material occurs that causes localized perching of groundwater.

The slide is nested in a complex of slope movement features including an ancient rock slump-block glide and more geologically recent rock slumps. Shallow soil slips, ravel, and bedrock creep also occur in the area.

After the initial slide event, additional large mass failures took place between 1964 and 1975. Also, large quantities of debris have eroded from the slide through rapid erosion of the toe by high flows in Idlewild Creek, piecemeal sloughing of over-steepened slopes at the slide margins, sheet erosion, ravelling, gullying, and bank erosion of the axial stream draining the slide.

The slide was probably caused by a combination of undercutting by the stream, piping erosion and solution by concentrated subsurface drainage, diversion of surface water by midslope skid trails, and the exceptionally heavy rains of December 1964.

The problem identified by the Forest Service was that there were: (1) persistent inputs of sediment degrading prime fish habitat in the Middle Fork of the Smith River, (2) a substantial risk of another major mass movement with potentially severe adverse effects on downstream fish habitat, and (3) a lack of vegetative recovery and initiation of soil building on the unstable surfaces of the slide.

The slide was investigated by a team of earth scientists and a geotechnical investigation of the slide was done by contract with Applied Earth Sciences, Inc. A Forest Service team evaluated a range of treatment alternatives based on feasibility, hazard-risk vs. cost analysis, and environmental impacts.

A major consideration in this and most other restoration projects is access. In this case, a crucial factor was whether or not building a road to the stream channel was feasible and acceptable. The team determined that is was feasible but that the risks of triggering additional mass movements would be high and would not be justified. This narrowed the treatment options considerably. The team considered in detail the following measures:

o control of surface drainage (waterbarring and vegetating of skid trails adjacent to slide).

o buttressing of over-steepened slopes at the crown of the slide with a prism of large rock.

o modification of the stream channel to control toe erosion.

o revegetation of bare slide surfaces and riparian areas.

The team decided to do all of these treatments except for buttressing of the over-steepened crown areas. This treatment was rejected because it would have been expensive, would have required the development of a rock pit, and would have carried a considerable risk of the failure of the placed rock prism, worsening the instability of the slide.

The midslope skid trails were hand waterbarred, seeded with a grass-legume mix and fertilized. This eliminated all surface drainage being delivered to the slide.

Planting

An initial planting was done in the spring of 1981. Species used and 2nd-year survival are:

White alder (1-0 containerized) - 12M - 70% survival
Douglas-fir (2-0 bare root) - 15M - 80% survival
Baccaris pilularis (cuttings) - 5M - 30% survival
Blackberry (cuttings) - 2M - no survivors
Sedge (1-0 containerized) - 3M - 15% survival

Also 25 lb/acre of lana wollypod vetch (inoculated) was broadcast on areas with less than 65% slopes. Germination was excellent but survival was less than 1%. This can be attributed to the lack of covering (soil or mulch) of the seed. (In another project on the Gasquet District, vetch seeds were planted in the soil on a slide surface, resulting in a satisfactory stand.)

A second planting was done in the spring of 1982. It included:

Jeffrey pine (1-0 bare root) - 3M - 1 st year survival = 95%
White alder (1-0 containerized) - 5M - 85% survival
Sedge (1-0 containerized) - 1M - 30% survival

A third planting was done in the spring of 1983 including 4M black locust and 1M white alder.

All available planting sites up to 110% slope have been planted.

Also, during the spring of 1981, existing and planted vegetation on the slide face was fertilized with approximately 200 lb/acre of 13-13-13-(12). As is the case with most earth debris or deep subsoils that have not supported vegetation before or have been bare for a long period, the "soil" was very deficient in the major plant nutrients, particularly nitrogen. Trees and grasses existing on the slide showed symptoms of extreme deficiencies of nitrogen (trees and grasses) and phosphorous (grasses).

The addition of fertilizer to the site produced a very rapid greening of firs and the appearance of grasses and forbes on formerly bare areas. The results suggest that soil nutrient shortages were a major factor limiting natural revegetation of the slide face.

We have seen similar results of fertilization in several other projects: in less erosive areas the application of fertilizer alone to bare soils resulted in the rapid development of a desirable cover of native grasses and forbes. This technique has the potential to be a very cost-effective method for revegetating bare soils that do not have rapidly-eroding surfaces.

The use of vegetative methods alone or in concert with structural measures has several distinct advantages. Cost is usually very low relative to structural measures. Little or no maintenance is required; the treatment tends to be self-sustaining. Most importantly, vegetation usually becomes more and more effective through time.

Stream Channel Modification

Stream channel modification was considered essential for effective stabilization of the slide because Idlewild Creek was impinging on and rapidly eroding the toe of the slide in three places.

The stream was diverted away from the toe through a combination of log jam modification, hand shoveling, and blasting. Reimpingement was prevented through a combination of a fencing-and-slash revetment and tetrahedron retards.

The upstream impingement was corrected by modifying a log jam that was causing flow diversion into the toe. Following modification, the toe was still subject to some erosion during peak flows. To prevent this, a revetment consisting of bucked-up logs and cyclone fencing restrained by deadmen was constructed. This structure has performed adequately: no toe erosion has occurred during two exceptionally heavy winters, and 6-12 inches of sand has accumulated between the structure and the main channel.

Diversion of the stream away from the slide toe in the middle and downstream impingements was accomplished through blasting.

Serial charges were used to excavate new channels away from the toe. A minor amount of shovel work was necessary to complete and cleanup the diversion. White alder and sedges were planted in the bare debris that resulted from blasting.

To prevent reimpingement in these two reaches, tetrahedron retard structures were placed in the former channel. (A retard is a structure that interferes with riparian flow such that velocities are reduced and deposition of entrained material results.) Information on the use of retards is given in California Division of Highways (1970), Federal Highway Administration (1978), and USDA-Forest Service (1969).

The retards consist of 6 ft. tetrahedrons placed on 12 ft. centers. The streamside face of the tetrahedrons was covered with 6 ft. cyclone fencing. Two steel cables run through each tetrahedron and are anchored to large trees upslope.

During the past two heavy winters the retards achieved the desired results. The stream did attempt to re-occupy its former channel but the retards caused accumulation of sediment and debris that increased the elevation of the former channel and prevented entrenchment and re-occupation of the former channel. Riparian vegetation has rapidly encroached on the inside of the retards, further ensuring the diversion.

Although complete stabilization of the slide has not been achieved, the majority of sediment input from the slide has been eliminated (estimated 80% reduction) and the risk of another large failure has been greatly reduced.

The value of the anadromous fish habitat that has been or could be substantially degraded by sediment input from the slide is estimated at $170,000 per year. The cost of the stabilization treatments to date has been $22,300.

Although the assignment of a numerical benefit/cost value is not justified, the project certainly has a positive benefit in terms of anadromous fish production. In addition, this project and others like it have benefits to soil and ecosystem building, wildlife habitat, the visual quality of the landscape, local employment and water quality.

References

Applied Earth Sciences, "Engineering Geologic Investigation - Idlewild Creek Debris Slide Gasquet California", for USDA-Forest Service, Six Rivers National Forest, 1980.

Bell, J. R., "Mechanics of Mass Soil Movement", Proceedings Forest Watershed Management Symposium, Oregon State University, 1964.

California Department of Public Works, "Bank and Shore Protection in California Highway Practice", Division of Highways, State of California, 1970.

Federal Highway Administration, "Countermeasures for Hydraulic Problems at Bridges - Volume 1 and 2". Report No. FHWA-RD-78-162, 1978.

Transportation Research Board, "Landslides - Analysis and Control", Special Report 176, 1978.

USDA-Forest Service, "Watershed Structural Measures Handbook", Forest Service Handbook 2509.12, 1969.

Nooning Creek: Future Directions for Instream Rehabilitation and Evaluation

by John Hamilton
U.S. Bureau of Land Management
North Coast Resource Area
Arcata, California

INTRODUCTION

The severe downward trend of salmon and steelhead resources in the Pacific Northwest has alarmed economists as well as biologists. Historically, those resources have contributed greatly to the livelihood of area residents. Habitat improvement projects are a popular approach taken in attempting to reverse this decline. For those anadromous salmonids which rear in freshwater, such as steelhead and coho salmon, improving the quality and quantity of instream rearing habitat has great potential for increasing smolt output, especially in streams which have suffered channel filling and habitat degradation due to past watershed abuse.

Instream habitat improvement techniques in use in North America were developed in the upper midwest (Hubbs et al. 1932; White and Brynildson, 1967) and to a limited degree in the intermountain west. Gains in abundance and harvest of resident salmonids associated with instream habitat improvement have been very perceptible, with reported increases usually between 100-300% (Shetter et al. 1949; Jester and McKirdy, 1966; Hale, 1969; Hunt, 1969; White, 1975). Instream improvement structures in these locations have been durable. The estimated life span of these devices has been estimated at as high as 100 years with minimum maintenance (White, 1975).

These results are impressive. However, as some experienced habitat managers recognize, not only is there a bias in the literature in favor of successful projects, but there are critical differences in physical and biological conditions between streams in the Pacific Northwest and these eastern waters where instream improvement techniques have their historical roots. Biological conditions also differ considerably. Temporal variation in abundance of rearing salmonids in these west slope streams is often great. Unstable, changing channel morphology alone can contribute to temporal variation in salmonid abundance. As channels agrade or degrade as they frequently do in Pacific Northwest streams, fish populations respond to these changes in habitat. A given reach of stream may have salmonid populations which vary from year to year for this reason alone. Even given a stable channel, other factors may restrict fish populations. Anadromous streams may be seeded to capacity in some years, while in other years when access is impaired or spawning escapement insufficient, these streams may be barren. In contrast, where evaluations of instream structure (Wisconsin and Michigan streams) have demonstrated increases in abundance, stream salmonid populations are relatively stable, with the range in estimated abundance in the order of one-half the mean abundance over periods of study 10-12 years and longer (Hall and Knight, 1981).

Geographic areas where instream structures were historically developed in North America are equally different. The upper midwest has a relatively arid climate and gentle terrain. Not only do coastal areas of northern California and the Pacific Northwest receive roughly half again as much annual precipitation as the upper midwest but 90% of this rain occurs during the October-April months as opposed to a fairly uniform distribution of precipitation throughout the year in these eastern areas. Stream channels where techniques have been developed are conducive to durable instream structures, with the channel meandering through low banked, flood plain areas often at a gradient of 1% or less (White, 1975). Small northern California and Oregon streams frequently have a gradient of 10% or greater, relatively straight channels with confined banks, and the potential for high water velocity and stream power.

Calhoun (1966) discussed these differences in hydrology and river morphology in a review of instream enhancement techniques applicable to California streams. He was pessimistic about the application of methods developed on eastern streams, but saw boulder placement and the use of boulders to deflect current as one encouraging application in these west coast streams.

NOONING CREEK PROJECT AND RESULTS

With these observations in mind, we began an effort to use boulders and rock to improve rearing habitat for juvenile steelhead in a small stream in the King Range National Conservation Area. Nooning Creek, a second order stream, is located approximately 60 miles south of Eureka and is a tributary of the Mattole River. Nearly the entire watershed is under the jurisdiction of the U.S. Bureau of Land Management and has an aquatic habitat management plan (U.S. Bureau of Land Management, 1982).

Habitat conditions, stream channel physical characteristics, and fish populations were documented during the summer low flow periods prior to and after October 1981 deflector installation (Hamilton, 1983). California Conservation Corps members arranged local boulders and rock in order to constrict the channel in an effort to provide the deeper, faster water habitat required by steelhead parr. We did not have deflectors designed to withstand specific flow criteria, but felt the size of construction material was sufficient to meet expected peak flows (U.S. Bureau of Land Management, 1982; Hamilton, 1983).

Following a winter (1981-1982) of fairly common storm events, we surveyed sections with instream structures (treatment sections) and control sections. The overwinter durability of deflectors was poor. At this time less than 15% of the deflectors were in place and functional. Subsequent comparisons based on change in steelhead populations or biomass in treatment verses control sections failed to detect any significant differences which could be attributable to deflectors.

DISCUSSION

This cannot, by any stretch of the imagination or interpretation be considered a successful project. However, chances are that future fishery managers may consider similar projects in similar Pacific Northwest situations. Equally important, instream structures will someday be devised which will provide durable habitat in these situations. Rather than file this report in a desk drawer or

less accessible place and contribute to this positive bias in published literature on stream enhancement projects (Reeves and Roelofs, 1982), it will behoove future managers and expedite the evolution of durable, effective instream structures to have results such as these available and factual. Despite being less than a success, this information is valuable if only as a reference of what has been attempted, what doesn't work, and a possible explanation of why it doesn't work. Raleigh and Duff (1977), in discussing intermountain western streams, emphasized that flooding offers the greatest challenge to the successful operation and maintenance of instream structures. For our west coast streams these considerations are of even greater importance. There is still room for optimism that durable, functional structures will evolve and play a role in enhancement efforts here. Perhaps these structures will be cost effective only in certain situations. How soon these hydrologically sound and functional instream habitat improvement structures are developed will depend upon our having the opportunity to learn from our past mistakes.

A second aspect of development of functional instream devices will be the biological evaluation which will be necessary to verify the response in salmonid numbers and biomass. As mentioned before, most evaluations undertaken have been on eastern streams where stable populations of resident salmonids were conducive to observing biological response resulting from instream work. On west coast anadromous streams, the natural temporal variation in abundance may mask or override rearing salmonid population response to an actual increase in quantity or quality of instream habitat. Even given comparable levels of seeding such as I observed in Nooning Creek, change from year to year can be large. Figure 1 shows the observed change in 1+ biomass per unit area in ten unaltered (control) sections of Nooning Creek between summer 1981 and summer 1982. The mean change on a percentage basis was 210%. This change in standing crop was significant ($P<0.05$). Although such natural variation in biological parameters for steelhead parr is nearly as great as any found in the literature, it is probably not unusual. Similar change between years in Nooning Creek, although not as great on a mean percentage basis, occurred in control sections for parr absolute numbers, biomass, and density. Such natural variation in control sections, even when seeding differences do not appear to be a factor, make biological evaluation difficult, and actual changes in abundance which do occur will be difficult to detect. Others have recognized this problem in relation to detecting change associated with watershed disturbances (Hall and Knight, 1981). Lichatowitz and Cramer (1981) discussed minimum detectable differences in biological characteristics in west coast streams which were statistically significant, using parametric methods, given a 3 year before and 5 year after evaluation period. They found that salmonid survival and abundance exhibited low statistical sensitivity to detect change, while parameters which dealt with time and size at an important life history stage showed high sensitivity to change. Certainly, these latter parameters should be included as part of any evaluation of habitat alteration. Some recent improvements in the design (Hall et al., 1978) for assessing impacts of watershed practices (using non-parametric methods) may have application in evaluating instream habitat rehabilitation/enhancement projects.

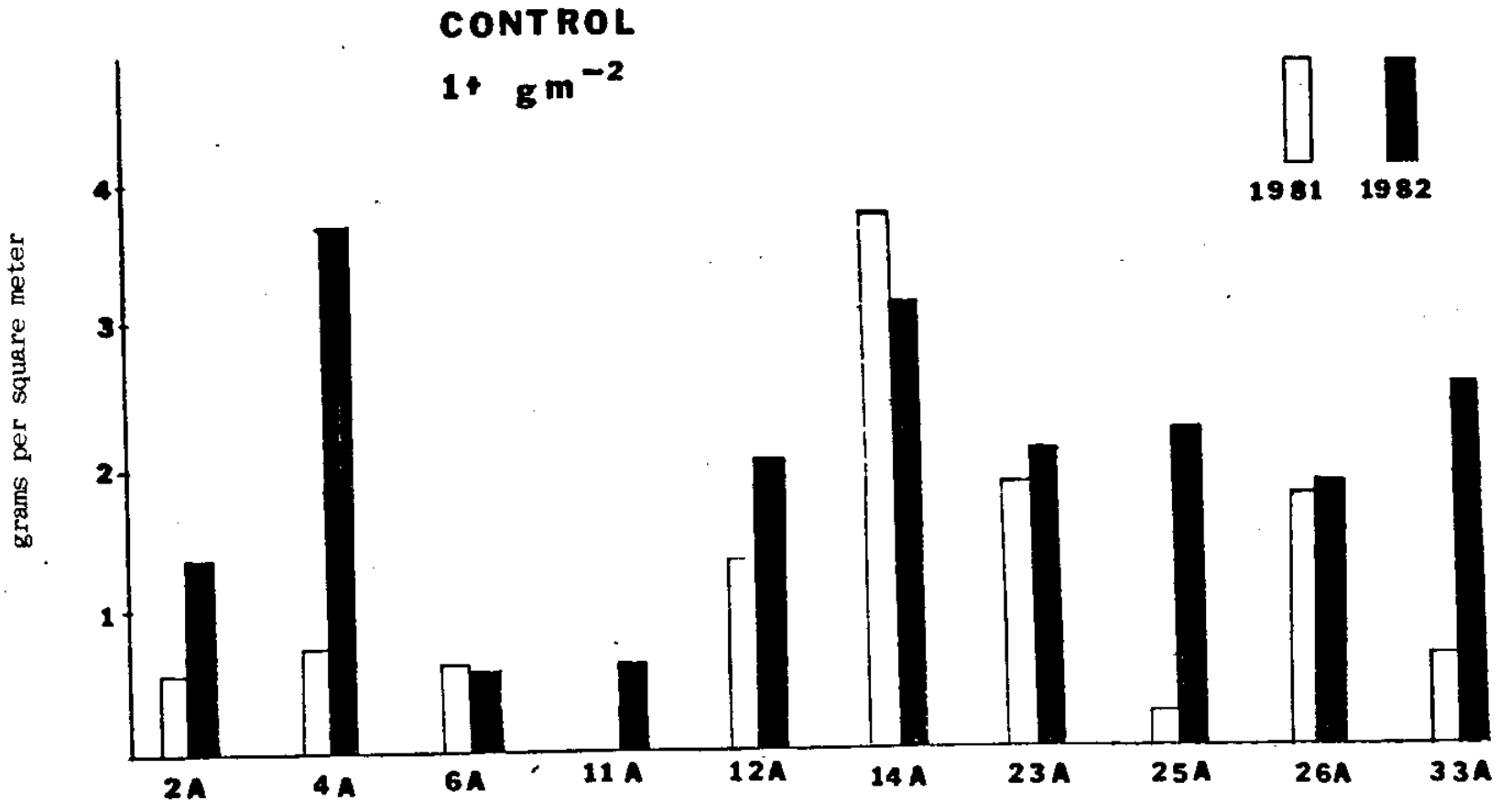

Figure 1. Standing crop of Steelhead parr in ten control sections of Nooning Creek, summer low flow perios 1981, 1982.

SUMMARY

Lack of consideration for stream hydrology and river morphology contributed to the poor durability of instream habitat improvement structures in a second order northern California stream. Better planning and consideration of the following may assist future habitat managers in similar situations:

A. Site Selection

1. On high gradient (>3%) streams with straight, confined channels such as Nooning Creek, it may be difficult to keep even the best designed structures in place. Selection of lower gradient, meandering streams and flattest channel reaches within those streams will maximize durability of instream structures.

2. Locations with adjacent overflow channels or areas where high discharge is diverted would be preferred sites.

3. Targeting of basins for instream work which have uniformally distributed precipitation and less average annual precipitation will also contribute to long term effectiveness of structure.

B. Construction

1. The use of material (boulders and rock) from the Nooning Creek channel, was, I feel, a mistake. Removal of this material for deflector construction contributed to channel instability as altered bed subsequently shifted during high flows.

2. Complete excavation of all deflector sites prior to placement would have contributed to durability.

3. The addition of cover (which would not hang up floating debris) would promote a positive biological response in that stream reach.

By starting out on a small scale with the selection of sites and structures which demonstrate effectiveness and durability, the initial trial and error period can be minimized. Once a site and structure design has been established as being hydrologically sound, then biological evaluation should follow. Long term evaluation and monitoring of stream habitat improvement should be made to determine the effectiveness and value of such programs and to provide future managers with guidelines (Wydowski and Duff, 1978). Monitoring of biological parameters should include at least an assessment of the response of rearing populations (and, if funds permit, assessment of smolt output and adult returns). Possible difficulties in showing a statistically signigicant change associated with an instream structure effort may be overcome by an improved study design or an evaluation based on parameters other than abundance. The results of stream habitat improvement projects must be available regardless of the outcome (Reeves and Roelofs, 1982).

U.S. Bureau of Land Management, 1982. Nooning Creek Watershed Aquatic Habitat Management Plan, NO:CA-OSG-WHA-A1, Ukiah District, North Coast, Eureka, Resource Area.

White, R.J., 1975. Trout Population Responses to Stream Flow Fluctuation and Habitat Management in Big Roche-a-Cri-Creek, Wisconsin, Verh. Int. Vern Limnol., 19:2469-2477.

White, R.J. and O.M. Brynildson, 1967. Guidelines for Management of Trout Stream Habitat in Wisconsin, Tech. Built., No. 39, Department of Natural Resources, Madison, p. 66.

Wydoski,R.S. and D.A. Duff, 1978. Stream Habitat Improvement as a Potential Management tool in the Intermountain West Trans. Bonneville Chapter American Fishery Society, 1-46-63.

COMMON SALMONID DISEASES AND THEIR PREVENTION

Gary L. Hendrickson
Department of Fisheries
Humboldt State University
Arcata, CA 95521

DISEASE AND THE HATCHERY ENVIRONMENT - Under natural conditions of a river or stream, fish seldom get sick even though many potential pathogens are always present. In hatcheries fish are held under relatively unnatural conditions; they are crowded, get water of poor quality, receive an unnatural (restricted) diet, are handled at regular intervals, etc. Consequently, hatchery fish occasionally do get sick. This relationship can be expressed as : Disease = Pathogen + Fish + Environment Unfavorable to Fish. There are a few exceptions to this generalization but it is clear that the first strategy in disease control is to present the fish with a favorable environment.

DISEASE PREVENTION - Emphasis on disease control in a hatchery must be on prevention simply because diseases are easier to prevent than they are to treat. Other than environmental quality, the preventive measure most effective in disease control is hatchery sanitation. In developing sanitary procedures for your hatchery, remember that fish disease organisms can be introduced by eggs, fish, people and sometimes other animals.

IMPORT ONLY EGGS INTO YOUR HATCHERY -- NEVER IMPORT FISH. Eggs can be disinfected with relatively harsh chemicals (iodophors) that kill bacteria and viruses on the surface of eggs. These same chemicals will kill fish. If you have no facilities for egg incubation and must import fish, do so with caution. Make sure that you are obtaining fish from the most reputable source possible, that fish are transported in a manner so as to minimize stress, and that your rearing units are operating properly prior to the arrival of fish.

EGGS SHOULD BE OBTAINED FROM STOCKS OR HATCHERIES CERTIFIED DISEASE FREE OR FREE OF SPECIFIC DISEASES OF CONCERN. The biggest problem in trying to maintain a disease-free anadromous fish hatchery is that we must release our future broodstock to the ocean. While we may release them clean, they do not necessarily come back clean. Hence, our eggs often harbor pathogens.

ALL EGGS SHOULD BE DISINFECTED BEFORE THEY ARE PLACED IN INCUBATORS. Egg disinfection is carried out to prevent disease transmission from parents to offspring. Disinfectants are effective against bacteria and viruses on the surface of the eggs but will not kill pathogens actually within the eggs. For this reason egg disinfection is ineffective in controlling parent-to-offspring transmission of bacterial kidney diseases (BKD).

INCUBATION WATER SHOULD BE FREE OF DISEASE AGENTS. Egg disinfection has little effect if eggs are placed in contaminated water after disinfection. If incubation water is not free of disease agents, then it should be disinfected. Access to incubators should be limited to a few persons and

access should require a boot bath at minimum. In many instances fish disease agents introduced into a hatchery originate from wild fish in the water supply. WILD FISH OR HATCHERY ESCAPEES SHOULD BE KEPT OUT OF THE HATCHERY WATER SUPPLY. Such fish should be eliminated or all incoming fish should be disinfected.

People and equipment can also transmit disease. DISINFECT ALL HATCHERY AND PERSONAL EQUIPMENT AFTER IT IS USED OR BETWEEN USES ON DIFFERENT GROUPS OF FISH. Routine disinfection procedures should be established for boots, nets, buckets, raingear, gloves, graders, spawning equipment, brooms, brushes, etc. Equipment must be clean of mud and silt for disinfection to be effective. Any dead fish, regardless of cause of death, should be disinfected and disposed of in a sanitary manner. Equipment used to pick out dead fish and the hands of the pickers should also be disinfected. Personal fishing waders should not be allowed on the hatchery; hatchery waders should not be allowed off of the hatchery. Sport fishermen can transmit disease agents from wild waters to hatchery waters. They should not be allowed on or near the hatchery.

HAULING TRUCKS AND ALL ASSOCIATED EQUIPMENT SHOULD BE DISINFECTED WHENEVER A VISITING TRUCK ARRIVES AT YOUR HATCHERY OR WHENEVER YOUR TRUCK HAS BEEN OFF OF HATCHERY GROUNDS. In either case, disinfect before the contaminated truck is brought onto your hatchery grounds.

Sanitation is far easier to preach about than it is to practice. Sanitation is a pain in the proverbial, often impractical, and sometimes impossible. However, the more you can do in the way of sanitation, the better off your disease situation will be.

INFECTIOUS HEMATOPOIETIC NECROSIS - Infectious hematopoietic necrosis (IHN) is a viral infection of Pacific Coast chinook and sockeye salmon, and steelhead and rainbow trout. It is characterized by destruction of the blood forming (hematopoietic) tissues of the anterior kidney and spleen. It affects mainly sac fry through yearlings and often affects the largest fry first. IHN is present from the Sacramento River, California, to Kodiak, Alaska. The virus can be transmitted from fish to fish (direct contact via contaminated water) and from parent to offspring via milt and eggs. Survivors of an outbreak are thought to become carriers of the virus for life and shed infective viral particles when spawning.

IHN outbreaks typically exhibit a sudden lethal onset and high mortalities. Other signs of IHN infection vary according to fish species but may include:

- hyperactivity alternating with lethargis
- sporadic whirling (may have to tap on side of container)
- darkening of body
- popeye
- dropsy
- hemorrhages at bases of fins and behind head on dorsal surface
- petechiae in muscle, mesenteries, and adipose tissue
- pale gills, liver, kidney and spleen
- white to gray fecal casts

There is no effective treatment for IHN-infected fish. Hence, prevention is paramount. According to some authors, egg disinfection breaks parent-to-offspring transmission. However, there are several reports of outbreaks

among fish hatched from disinfected eggs spawned by adult carriers. Some authors suggest that keeping fry at low densities tends to inhibit the spread of the disease once an outbreak is underway. Water reuse (or recirculation), handling stress and crowding increase severity of an IHN outbreak. If an outbreak of IHN is suspected, quarantine affected lots of fish, reduce loading of affected eggs and fry, and contact the California Department of Fish and Game.

BACTERIAL KIDNEY DISEASE - Bacterial kidney disease (BKD) of salmonids is usually a slowly progressing systemic infection, although it can progress very rapidly at 13-18°C. First signs of the disease may not appear in Pacific salmon until 30-90 days post-infection. Thus, fish are relatively well grown before losses begin unless fish are subjected to other stress. Salmon often die shortly after transfer to seawater. Cumulative mortality in BKD outbreaks is often high. The disease can be transmitted from fish to fish or from parents to offspring via eggs. Apparently, bacteria are carried in, rather than on, the surface of eggs. Therefore, egg disinfection has little effect on parent-to-offspring transmission.

Fish infected with BKD may appear normal. However, some of the commonly observed signs accompanying BKD infection include:

numerous small open ulcers in skin (buckshot appearance) - chinook salmon, rainbow and brown trout
large external welts (boils) filled with cream to pink fluid - coho salmon, brook trout
body darker in color
popeye
hemorrhages at bases of fins
kidney light in color and swollen, with corrugated or lumpy surface
posterior kidney often with soft, creamy-white "cysts" (massive colonies of bacteria)
muscle often with large cavities filled with cheesy-like fluid

BKD is one of the most difficult bacterial diseases of fish to treat. Prevention is the only valid control measure. When possible, obtain eggs from sources certified free of BKD. Erythromycin and sulfamethazine given in the feed control the disease only as long as the drugs are administered. However, when drug treatment is withdrawn, mortalities usually resume. Erythromycin phosphate has been effective in combating BKD. Adult salmon are injected with erythromycin phosphate solution at time of return and at 30-day intervals until about 30 days prior to spawning. Eggs taken from injected females have drug levels which inhibit the BKD bacterium. Some workers have reported success with a second technique involving the water hardening of freshly fertilized eggs in erythromycin phosphate solution.

BACTERIAL GILL DISEASE - Bacterial gill disease (BGD) is a cosmopolitan disorder of hatchery fish, including salmonids. It is characterized by large numbers of long, filamentous bacteria on the gills accompanied by swelling and fusing of gill lamellae and sometimes fusing of whole filaments. The disease is usually associated with poor environmental conditions (overcrowding, high ammonia levels, high organic material) which cause gill irritation. In response to this irritation, the gills secrete excess mucus

which is an excellent substrate for bacterial growth. Hence, the disease is probably an environmental disease and the bacteria are merely secondary (opportunistic) invaders. For this reason some workers refer to the disease as environmental gill disease. Signs of BGD in salmonids may include:

lethargis (fish gather at outlet)
loss of appetite (may lead to pinheads)
gills often appear swollen
gill covers may not close completely
red gill tissue may protrude from under gill covers
white to gray spots on gills
swelling or fusion of lamellae
fusion of filaments

Because BGD is mainly an environmental disease, maintaining a good environment is paramount to prevention. Do not overcrowd fish, clean ponds regularly, do not over feed and remove dead fish or weakened fish. When an outbreak of BGD occurs, increase water exchange rate and withhold feed to reduce organic matter in the water. External disinfection is suggested whenever bacterial invasion is observed on the gills. Reducing fish biomass is effective but fish with severe BGD cannot usually tolerate the stress of handling and moving (Table 1).

COLDWATER DISEASE - Coldwater disease is a serious disease of coho fry and fingerlings, although it also affects other salmon and trout. It is a necrotic skin condition occurring when water temperatures are low (usually 4-12°C). Outbreaks are most serious in sac fry, particularly at or shortly after button up. Transmission of the disease is associated with the presence of carrier fish. Transmission from parent to offspring is suspected.

In sac fry, skin covering the yolk is eroded away and yolk is spilled out. Often the first sign of an outbreak in sac fry is the mechanical plugging of screens by pieces of coagulated yolk. Losses can be catastrophic in sac fry. After button up, the most characteristic sign is the erosion of the caudal peduncle and eventual loss of the entire tail. Tail lesions begin as small, pale white to gray areas. The peduncle darkens, the fin becomes frayed and eroded, and eventually the flesh appears to be scooped out. Unless death intervenes, the whole tail may be eroded away leaving only the vertebral column attached to the living fish. Often fish die prior to tail erosion. In these cases, death is often preceeded by a darkening of the tail region posterior to the adipose fin.

Some workers suggest that rearing coho sac fry in shallow, rather than deep, troughs inhibits disease outbreaks. Crowding and high levels of organic matter in the water tend to promote outbreaks and should be avoided. Egg disinfection will inhibit parent-to-offspring transmission. Early external infections may be treated with oxytetracycline or quarternary ammonium compounds in the water. Oral administration of sulfonamides or oxytetracycline can successfully treat the disease if fish are feeding. Furanace in the water gives the best and most effective control. However, it is expensive and approved by the Food and Drug Administration for use on non-food fish only. Raising water temperature is an effective control but is rarely feasible.

Table 1. Estimation of severity of gill disorder and treatment recommendation for bacterial gill disease (based on Post, 1983).

Designation of hyperplastic severity	Distinctive characters	Recommended treatment
Grade I	Lamellae swollen but not fused	Reduce gill irritants by increasing water exchange or reducing fish biomass in water
Grade II	Some but not all lamellae fused, primarily at distal ends of filaments	Use external disinfectant; reduce gill irritants by increasing water exchange or reducing fish biomass
Grade III	Most lamellae fused but no filaments fused	One or more daily treatments of external disinfectant; reduce gill irritants by increasing water exchange; delay reducing biomass until fish can be moved safely
Grade IV	Most lamellae fused, some filaments fused	Usually two to three consecutive daily treatments of external disinfectant; reduce gill irritants by increasing water exchange; delay reducing biomass until fish can be moved safely

Note: External disinfection is suggested in all cases when bacterial invasion is observed on the gills.

FURUNCULOSIS - Furunculosis is a serious disease of salmonids and a few other fishes. The disease is named for the presence of boils (so called "furuncles") on the backs and sides of chronically infected fish. Such "furuncles" are not diagnostic as they are lacking in acute furunculosis, and they are often indistinguishable from lesions produced by some other bacterial septicemias. Furunculosis can be transmitted from fish to fish, via the water supply (short term only), via clothing or equipment, via fish-eating birds, or from parent to offspring on the surface of the eggs.

Signs of furunculosis are similar to those produced by other bacterial septicemias. In fry you may see only darkening, loss of appetite, and lethargis, followed by death. Fingerlings may exhibit hemorrhages at bases of fins, erosion of pectoral fins, hemorhagic vents and petechiae on the ventral surface and on viscera. Chronically infected adults exhibit "furuncles" filled with a yellow, blood-tinged fluid. Internally there is often a bloody fluid in the body cavity, a liquifactive necrosis of the kidney and spleen, as well as enlargement of the spleen.

Most outbreaks in hatcheries originate from imported eggs or from wild fish in the hatchery water supply. Stringent egg disinfection programs and elimination of wild carrier fish from the water supply are, therefore, effective preventive measures. Oxytetracycline and sulfamerazine incorporated into the feed can be effective treatments. Care, however, should be taken to ensure that the strain of bacteria involved is not resistant to either or both drugs. A commercial vaccine against furunculosis is available.

TRICHODINA - Trichodinids are hockey puck-shaped protozoan parasites which live on the skin and gills of fish. They possess chitinoid hooks for attachment, as well as rows of cilia (contractile hairs) around the margin of the body. When swimming, trichodinids "fly" through the water much like one would expect a flying saucer to do. Transmission is direct from fish to fish via the water. Signs of trichodinid infection include:

flashing
lethargis
body becomes dull with a thin whitish film of mucus (mucus may cover entire body in severe cases and may flake off in large pieces)

If the gills are invaded, excess mucus is produced. This mucus inhibits respiration and leads to signs of respiratory distress.

A formalin bath at 167-250 ppm for one hour is usually successful in treating trichodinids. When salmonids are sensitive to formalin, Diquat at 2-4 ppm for one hour can be used.

ICHTHYOPHTHIRIUS - Ichthyophthirius (ICH) is a large spherical protozoan with short cilia covering the entire body. Cilia give the body a rolling movement. The life cycle of ICH alternates between stages within the skin, fins or gills with stages off of the fish. Treatment is effective only on stages off of the fish.

Affected fish characteristically possess large (up to 1 mm) white "pustules" in the skin, fins and gills. They tend to congregate near incoming water, flash excessively, leap and skitter across the surface as they are irritated by penetration of the parasites.

Successful treatment of ICH requires elimination of those stages off of the fish. Repeated treatments of formalin at 167-250 ppm for one hour at daily intervals for several days are usually effective.

FISH HEALTH MANAGEMENT - The primary purpose of fish health management is to reduce the risk of exposure of fish stocks to disease. In a hatchery, this strategy is carried out in great measure by a carefully planned and executed plan of hatchery sanitation. A program of hatchery sanitation must be developed before a disease outbreak occurs. Once an outbreak is in progress, sanitation is too late.

To prevent losses of large numbers of fish, it is important to respond to a disease outbreak very quickly. A rapid, accurate diagnoses, followed by appropriate therapy, can save large numbers of fish. To respond in such a rapid fashion, all hatcheries should develop a plan of action prior to a disease outbreak. Of particular concern are answers to the following:

What to do?
When to do it?
Who should do it?
How to do it?

Post-treatment evaluation is extremely valuable. A good weapon in combatting fish diseases is experience--recorded--not just remembered. Only with experience can we stop doing those things that have caused disease problems in the past. As a sage prophet once said "To err is human, but only once!".

RECOMMENDED REFERENCES

Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. Fish hatchery management. U.S. Department of the Interior, Fish and Wildlife Service. 517 pp. (available from American Fisheries Society, 5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814).

Post, G.W. 1983. Textbook of fish health. TFH Publications, Inc., 211 West Sylvania Avenue, Neptune City, New Jersey 07753. 256 pp. (available from publisher).

Warren, J.W. 1982. Diseases of hatchery fish. U.S. Department of the Interior, Fish and Wildlife Service. 91 pp. (available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402).

Wood, J.W. 1974. Diseases of Pacific salmon. Their prevention and treatment. Washington Department of Fisheries (Hatchery Division). 82 pp. (available from Department of Fisheries, 115 General Administration Bldg., Olympia, WA 98504).

REVIEW OF CALIFORNIA PONDING PROGRAMS

Steve Sanders
California Department of Fish and Game
10725 Main Street
Potter Valley, CA 95169

A slideshow presentation was given by Steve Sanders, Fish Culturist for the Salmon Stamp projects. Slides were shown of many of the volunteer fish rearing projects in northern California. The merits of circular ponds, raceway ponds, ocean pen rearing, and washout ponds were discussed:

Circular ponds are the least expensive and easiest to build. They can be used with low water flows (50-75 gpm), and water flows and volumes can be easily controlled. Fish can be fed either by hand or by mechanical feeders. Some of the disadvantages are: (1) pond maintenance is more difficult; (2) liners are easily damaged; (3) treatment of bacterial diseases is expensive because flush treatments with Copper Sulfate can't be used. Antibiotics must be used instead (Amifur and Terrimycin).

Raceway ponds are the most desirable because of ease of feeding by hand or mechanical feeders, ease of cleaning, and use of inexpensive chemicals for flush treatments. Some of the disadvantages include high water flow requirements (1 - 3 cfs) and the initial high cost of building (e.g., excavation, cement headflumes and raceways, and plastic or concrete liners).

Ocean pen rearing. These programs show promise. Large numbers of anadromous fish can be reared in a small space. Fish are easy to feed by hand or with mechanical feeders. The disadvantages are protecting the pens from high tides and storms, lack of control of water temperature, cleaning of nets (algae), and predators (animal and human).

Washout ponds. These ponds can only be used with chinook salmon. The fish are released the first high flows of the fall. The advantages are: fish don't have to be transported to the release site and they are reared in the streams they will return to as adults. Organizations rearing fish don't have to rear fish in winter when storms and high water cause problems with intake systems. The disadvantages include lack of good control of fish and water flows in ponds, chemical treatments flow directly into streams, ponds can't be cleaned, cost of excavation can be excessive, and the size of the pond offers a very large area to feed. Water flows and temperatures can be a problem and a good site is difficult to find.

For all types of ponding, intake systems are always a major problem. Adequate systems with low maintenance are difficult and expensive to build. Intakes must be at least four times larger than the maximum flow in the ponds. This keeps cleaning to a minimum. Water should not be taken from the surface if possible because of debris (e.g., leaves, pine needles, wood, logs, etc.). Buried intake pipes are best, if possible.

Perforated pipes buried in clean, 1½-inch diameter gravel works well if flows are suitable.

Aeration is sometimes required if springs or wells are used for water supplies. Aerators can be built inexpensively. Plans are available from the California Department of Fish and Game.

No matter what type of pond is used it must be tailored to the geography, the stream flows, and be accessible to vehicles.

This year, there are four rearing ponds in the first stages of development, 18 sites rearing fish, and five trapping sites to catch adult salmon and steelhead so their eggs can be used in the rearing programs this spring. The total production of all pond rearing and hatchbox programs will be approximately 175,000 steelhead, 110,000 coho salmon and 200,000 chinook salmon. We can look forward to doubling these numbers in the near future.